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The Three-Factor Model: A Practitioner's Guide

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There is no doubt that the Capital Asset Pricing Model (CAPM) is one of the models most widely used in finance.[1] But despite its widespread use, the CAPM is far from uncontroversial. Debate on its merits has been raging on for decades, and a consensus on its usefulness is nowhere in sight.

That being said, of the many models that have challenged the supremacy of the CAPM over the years, only one has slowly but steadily emerged to become a strong contender—namely, the *three-factor model* (3FM). This model aims to assess risk more comprehensively than the CAPM, and thereby provide a more reliable estimation of an asset's required return. That required return can be used as an input in the calculation of the cost of capital, an important variable in most corporate investment decisions, and also as an input in the calculation of excess returns, a measure at the center of performance evaluation and portfolio management.

This article aims to provide practitioners with a practical introduction to the 3FM by discussing an alternative to the CAPM for estimating required or expected returns. To that end, it discusses the model's foundations, intuition, and applications to both corporate finance and portfolio management.

A Brief Review of the CAPM

The required return on any asset i (R_i) can be estimated as the sum of two variables: the risk free rate (R_f) and the asset's risk premium (RP_i). Expressed as an equation,

$$R_i = R_f + RP_i \,. \tag{1}$$

The risk-free rate is the compensation required for the expected loss of purchasing power, and the risk premium is the compensation for bearing the risk of an asset. As expression (1) shows, the risk-free rate is the same for all assets, whereas the risk premium is specific to the asset considered.

This risk premium is precisely what the CAPM provides a way to estimate. In fact, this model suggests that an asset's risk premium should be estimated as the product of the market risk premium and the asset's beta. The market risk premium is the compensation required by investors for investing in relatively risky stocks as opposed to (ultimately risk-free) government bonds. Beta is a measure of the sensitivity of the asset's returns to fluctuations in the market's returns; assets with a beta higher (lower) than 1 magnify (mitigate) the market's fluctuations. According to the CAPM, then, the risk premium of asset i can be estimated as follows:

$$RP_i = MRP \cdot \beta_i \tag{2}$$

where MRP represents the market risk premium and β_i is the beta of asset i. As noted earlier, and is also apparent from expression (2), the market risk premium is the same for all assets, whereas beta is specific to the asset considered.

Combining equations (1) and (2) we get the following:

$$R_i = R_f + MRP \cdot \beta_i \,, \tag{3}$$

which is the usual way to express the CAPM. Note that this expression yields both the required return and the expected return for a given asset. This is the case because, in the equilibrium assumed by this model, whenever these two returns are different, prices are assumed to adjust to restore the equality. For example, if investors require a 10% annual return from an asset but expect it to yield 15%, buying pressure is expected to drive the asset's price up and its expected return down. Conversely, if investors expect this asset to yield only 5%, selling pressure is expected to push the asset's price down and its expected return up. In both cases, the adjustment is expected to continue until the required and the expected return are the same.

The intuition behind expression (3) is straightforward. The CAPM suggests that investors should require compensation for the expected loss of purchasing power and for bearing risk. And it specifies that the compensation for risk should be measured by the risk premium required for investing in

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1. Over 70-80% of practitioners claim to use this model to estimate the cost of equity; see Robert Bruner, Kenneth Eades, Robert Harris, and Robert Higgins (1998), "Best Practices in Estimating the Cost of Capital: Survey and Synthesis," *Financial Practice and Education*, Spring/Summer, 13-28, and John Graham and Campbell Harvey (2001), "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics*, 60, 187-243.

relatively risky stocks instead of less risky bonds, adjusted by a factor specific to each asset that reflects how much more or less risky the asset is relative to the market.

The simplicity of this model, however, conceals a very strong statement. Recall that beta is a measure of *systematic* risk. That implies that bankruptcy risk, liquidity risk, currency risk, and as many others sources of firm-specific or "idiosyncratic" risk as you can imagine are all irrelevant when assessing the required return of an asset (though some of these factors may be reflected in beta and therefore have a systematic component). Liquidity, as the recent financial crisis reminded us, is a good example of a risk that seemed to pervade the entire financial system.

And yet, however strong this statement may be, a supporter of the CAPM would justify it in at least two ways. The first argument would be theoretical; it would claim that, unlike the vast majority of its contenders, the CAPM is solidly grounded in theory. In fact, it would argue that in a world in which investors behave optimally, beta must be the only relevant risk factor. In other words, the CAPM's strong statement is not an assumption but the result of a model of optimal behavior.

The second argument would be empirical; it would claim that a vast amount of research supports the plausibility of the CAPM. But this is a tricky argument. There is a massive amount of research testing the validity of the CAPM in different countries, over different time periods, and with different methodologies. The problem is that there is a huge amount of evidence on both sides of the fence. Those who support the CAPM and those who dismiss it can point to a vast amount of evidence that supports their position. As a result, the evidence alone does not enable to either embrace or reject the CAPM.

The Size and Value Premiums

And yet at least some empirical evidence is surprisingly consistent. Data for different countries and over different time periods show a consistent negative relationship between market capitalization and returns; that is, over the long term, small companies tend to deliver higher returns than large companies. This empirical regularity is usually known as the size premium.[2]

Similarly, data for different countries and over different time periods show a consistent positive relationship between book-to-market ratios (BtM) and returns; in the long term, companies with high BtM tend to deliver higher returns than those with low BtM. Recall that this ratio is a measure of cheapness in the sense that high and low BtM indicate cheap and expensive stocks relative to book value. And the evidence shows that, over the long run, cheap (also known as "value") stocks tend to outperform expensive (also called "growth") stocks. This empirical regularity is usually known as the value premium.[3]

But if the evidence on the size and value premiums is rather clear, the theoretical reasons for the existence of these premiums are much less convincing. In other words, no model of optimal behavior leads to a result in which stock returns depend on market cap and BtM. Some may not consider this a problem; they would claim that, as long as we can isolate the variables that explain differences in returns, we should use them to determine required or expected returns. Yet others would argue that there is no point using models that do not follow from a sound underlying theory. You can pick your side on this debate.

If you think a bit about it, though, these two risk premiums seem to make sense. Small companies are likely to be less diversified and less able to survive negative shocks than large companies. As for cheap companies, well, there must be a reason why they are cheap! When buying value stocks, investors are expecting a rebound but may get a falling knife. In short, it is not hard to come up with plausible stories to explain why small and cheap stocks are riskier than large and expensive stocks, and therefore why they should deliver higher returns.

But those are just stories. A better alternative may be to establish empirical links from size and value to credible sources of risk. The evidence on this seems to point to the fact that small companies and value companies are less profitable (they have lower earnings or cash flow relative to book value) than large companies and growth companies. In other words, small companies and value companies may be distressed because of their poor profitability, and are therefore perceived by investors as riskier.[4]

To summarize, then, the CAPM suggests that stocks with high systematic (or market) risk should outperform those with low systematic risk. In addition, the evidence quite clearly shows that small stocks outperform large stocks; that cheap (value) stocks outperform expensive (growth) stocks; and that small and value companies are less profitable than large and growth companies. Putting all this together, we conclude that stock returns are determined by a market premium, a size premium, and a value premium—and that is the main insight of the 3FM.

One last issue before we discuss this model. Although the evidence on the existence of the size and value premiums is largely undisputed, there is a heated controversy about

2. One of the earliest analysis of the relationship between size and stock returns is in Rolf Banz (1981), "The Relationship Between Return and Market Value of Common Stocks," *Journal of Financial Economics*, 9, 3-18.

3. Although value investing has a very long history, one of the earliest formal analysis of the relationship between cheapness and stock returns is in Sanjoy Basu (1983), "The Relationship Between Earnings Yield, Market Value, and Return for NYSE Common Stocks: Further Evidence," *Journal of Financial Economics*, 12, 129-156.

4. See Cliff Asness, John Liew, and Ross Stevens (1997), "Parallels Between the Cross-Sectional Predictability of Stock and Country Returns," *Journal of Portfolio Management*, Spring, 79-87.

whether or not the excess returns of small and value stocks (relative to large and growth stocks) are the result of their higher risk. Some argue that this is not the case; that is, small and value stocks are not riskier than large and growth stocks, and therefore the additional returns they provide are a free lunch courtesy of an inefficient market. Yet others argue exactly the opposite; that is, small and value stocks offer higher returns than large and growth stocks precisely because they are riskier, which is exactly what one would expect in an efficient market.

Again you can pick your side on this debate, but it's important to keep in mind that estimating required returns with the 3FM amounts to an implicit acceptance of the second point of view. This is the case because, as we will discuss shortly, this model states that the higher an asset's exposure to the size and value premiums—in other words, the higher the asset's risk as defined by the 3FM—the higher should be the asset's required return.

An Overview of the 3FM

Estimating required returns with the 3FM is just a bit more difficult than with the CAPM because we need to estimate two more risk premiums and two more betas, for which we need some additional data. Other than that, the model poses no real challenge for any practitioner that wants to implement it.

According to the 3FM, the required return on an asset follows from its exposure to the market, its size (measured by market cap), and its valuation (measured by BtM). More precisely, the required return on any asset i follows from the expression

$$R_i = R_f + MRP \cdot \beta_i + SMB \cdot \beta_i^S + HML \cdot \beta_i^V , \qquad (4)$$

where SMB (small minus big, referring to market cap) and HML (high minus low, referring to BtM) denote the size premium and the value premiums, and β_i^S and β_i^V denote the return sensitivity of asset i to changes in these premiums.

Let's think a bit about this expression. Recall that the market risk premium (MRP) seeks to capture the additional compensation required by investors for investing in relatively riskier stocks as opposed to relatively safer bonds. Recall also that it is measured by the average historical difference between the return of a widely diversified portfolio of stocks and the return of government bonds. And recall, finally, that β_i measures the sensitivity of asset i's risk premium ($RP_i = R_i - R_f$) to fluctuations in the market risk premium.

In similar fashion, the size premium (SMB) seeks to capture the additional compensation required by investors for investing in relatively riskier small companies as opposed to relatively safer large companies. The size premium is measured by the average historical difference between the returns of a portfolio of small stocks and those of a portfolio of large stocks. And the beta associated with this factor, usually called the size beta (β_i^S), measures the sensitivity of asset i's risk premium to fluctuations in the size premium.

Finally, the value premium (HML) seeks to capture the additional compensation required by investors for investing in relatively riskier value stocks as opposed to relatively safer growth stocks. The value premium is measured by the average historical difference between the returns of a portfolio of high-BtM stocks and those of a portfolio of low-BtM stocks. And the beta associated with this factor, usually called the value beta (β_i^V), measures the sensitivity of asset i's risk premium to fluctuations in the value premium.

Note that, just as we stressed earlier about the MRP, neither SMB nor HML in expression (4) have a subscript i. This means that the size and value premiums (as well as the risk-free rate and the market risk premium) are the same for all assets. Conversely, note that the size beta and the value beta (as well as the market beta) do have a subscript i, and therefore are specific to the asset considered.

Implementation of the 3FM

Like the CAPM, the 3FM is silent about several practical issues that are inevitably faced when implementing this model. What is an appropriate portfolio of small stocks—and of large stocks? What is an appropriate portfolio of value stocks—and of growth stocks? Should we estimate betas using daily, weekly, monthly, or annual data? And how long a period should we use to estimate those betas? And to estimate the risk premiums? Theory offers no clear guidance and there are only more and less widely accepted answers to these questions.

A quick comment before we get to specifics. The 3FM was proposed by Eugene Fama and Kenneth French in a series of articles published in the 1990s, which is why you may occasionally find this model referred to as the Fama-French 3FM.[5] In the "Data Library" that appears on Ken French's web page,[6] you will find plenty of information on this model, as well as the data necessary to implement it (in the "Historical Benchmark Returns" section of the page). For that reason, we will focus here on the essentials and leave interested readers to explore further details on their own.

Let's start with the risk-free rate. A widely accepted (though by no means only) choice is the yield on 10-year Treasury notes. Some people might make plausible arguments for using yields of shorter or longer maturity, and theory has little to say about this, but we will use here the 10-year yield, which has become the benchmark rate for all other maturities.

5. Their seminal article on the subject is Eugene Fama and Kenneth French (1992), "The Cross-Section of Expected Stock Returns," *Journal of Finance*, 47, 427-465.

6. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Table 1 **Risk Premiums**

This exhibit shows the market risk premium (MRP), the size premium (SMB), and the value premium (HML) between 1990 and 2009. It also shows the arithmetic (AM) and geometric (GM) average for the three risk premiums over the 1927-2009 period. All figures are annual and expressed in %. All data taken from Ken French's web page.

Year	MRP	SMB	HM	Year	MRP	SMB	HML
1990	–13.8	–14.4	–10.6	2000	–16.7	–5.7	21.4
1991	29.1	16.5	–15.1	2001	–14.8	28.4	27.2
1992	6.4	7.8	23.1	2002	–22.9	4.4	3.7
1993	8.4	7.5	17.0	2003	30.7	28.1	15.1
1994	–4.1	0.4	–0.1	2004	10.7	6.3	13.2
1995	31.0	–6.9	–3.5	2005	3.2	–2.7	3.7
1996	16.3	–1.9	0.2	2006	10.6	1.0	11.9
1997	26.1	–3.7	11.1	2007	0.8	–7.0	–21.6
1998	19.4	–23.3	–15.0	2008	–38.4	0.2	–9.1
1999	20.2	11.7	–39.4	2009	29.1	17.7	23.7
AM (1927-2009)					**8.1**	**3.8**	**4.4**
GM (1927-2009)					**5.9**	**2.9**	**3.3**

French's web page provides annual figures for MRP, SMB, and HML from 1927 on, as well as a detailed explanation on how these magnitudes are estimated, so we will not get into any details here. For our practical purposes, it is enough to highlight that the MRP in expression (4) is estimated as an average of the annual differences between the return of a diversified portfolio of stocks and the return of government bonds. Similarly, the SMB is estimated as an average of the annual differences between the return of a portfolio of small stocks and that of a portfolio of large stocks. And the HML is estimated as an average of the annual differences between the return of a portfolio of high-BtM stocks and that of a portfolio of low-BtM stocks.[7]

Table 1 shows the values of MRP, SMB, and HML over the period 1990-2009, as well as the arithmetic and geometric averages over the much longer period 1927-2009. Based on the geometric averages in the last line of the table, stocks outperformed bonds by 5.9% a year; small stocks outperformed large stocks by 2.9% a year; and value stocks outperformed growth stocks by 3.3% a year.

Finally, expression (4) states that we need three betas. Importantly, these three betas must be estimated jointly by running a time-series regression between the risk premium of stock i ($RP_i = R_i - R_f$) and the three portfolios that capture the market, size, and value premiums (MRP, SMB, and HML); that is,

$$R_{it} - R_{ft} = \alpha + \beta_1 \cdot MRP_t + \beta_2 \cdot SMB_t + \beta_3 \cdot HML_t + u_t \,, \quad (5)$$

where α, β_1, β_2, and β_3 are coefficients to be estimated; u is an error term; and t indexes time. Note that β_1 is the usual (market) beta, β_2 is the size beta (β_i^S), and β_3 is the value beta (β_i^V). As is the case with the CAPM, this regression is often estimated with monthly data over a five-year period.[8] Monthly returns for the MRP, SMB, and HML portfolios for this purpose are also available from French's web page.

Application 1 – Estimating the Cost of Equity

Let's now put everything together and use the 3FM to estimate the cost of equity for the 30 companies in the Dow; and for the sake of comparison, let's also estimate the cost of equity of the same companies with the CAPM. In both cases, we will assume that we are at the very beginning of 2010.

For the risk-free rate we will use the yield on the 10-year Treasury note, which at the beginning of 2010 was 3.9%. For MRP, SMB, and HML we will use the geometric averages for 1927-2009 on the last line of Table 1; that is, 5.9%, 2.9%, and 3.3%. Given these figures, we will then estimate the cost of equity on the 30 stocks in the Dow at the beginning of 2010 with the expression

$$R_i = 0.039 + 0.059 \cdot \beta_i + 0.029 \cdot \beta_i^S + 0.033 \cdot \beta_i^V \,. \quad (6)$$

Note that this expression is the same as (4) but with specific values for R_f, MRP, SMB, and HML. All we need now to estimate required returns with the 3FM are the beta, size beta, and value beta of the 30 companies in the Dow.

7. The theory is also silent about whether we should use an arithmetic or a geometric average. This is one of the many tricky issues that practitioners face when implementing both the CAPM and the 3FM.

8. Again theory is of little help in determining the frequency of the data (daily, weekly, monthly) and how far back we need to go when estimating these betas. Using five years of monthly data is a widely accepted (though by no means the only) alternative.

Table 2 **The 3FM, the CAPM, and the Cost of Equity**

This exhibit shows, for the 30 companies in the Dow in the first column, the market beta (β_i), size beta (β_i^S), and value beta (β_i^V) estimated from expression (5) in the second, third, and fourth columns; and the cost of equity that follows from expression (6) in the fifth column. It also shows the market beta estimated from expression (5) in the sixth column, and the cost of equity that follows from expression (6) in the seventh column, in both cases omitting the size and value factors. The last column shows the differences (Diff) between the fifth and the seventh columns. The last three rows show, across all 30 companies, the lowest (Min), highest (Max) and average (Avg) value of each magnitude. All betas estimated with monthly data over the Jan/05-Dec/09 period. The monthly return of all companies is net of the monthly risk-free rate. Data for the MRP, SMB, and HML portfolios downloaded from Ken French's web page.

Company	β_i	β_i^S	β_i^V	3FM	β_i	CAPM	Diff
3M	0.66	0.05	0.18	8.5%	0.76	8.4%	0.2%
Alcoa	2.11	0.69	–0.38	17.1%	2.10	16.3%	0.8%
American Express	1.15	0.38	1.79	17.7%	2.08	16.2%	1.5%
AT&T	0.82	–0.23	–0.23	7.3%	0.66	7.8%	–0.5%
Bank of America	1.55	–1.15	2.20	17.1%	2.30	17.5%	–0.4%
Boeing	1.21	–0.64	0.44	10.7%	1.26	11.3%	–0.7%
Caterpillar	1.67	0.00	0.25	14.6%	1.78	14.4%	0.1%
Chevron	0.96	–0.58	–0.44	6.5%	0.62	7.5%	–1.1%
Cisco Systems	1.20	0.67	–0.31	11.8%	1.22	11.1%	0.8%
Coca-Cola	0.75	–0.72	–0.01	6.2%	0.56	7.2%	–1.0%
DuPont	1.10	–0.18	0.67	12.1%	1.37	12.0%	0.1%
Exxon Mobil	0.72	–0.70	–0.30	5.2%	0.41	6.3%	–1.2%
General Electric	1.21	–0.36	0.79	12.6%	1.49	12.7%	–0.1%
Hewlett-Packard	1.03	0.48	–0.26	10.5%	1.02	9.9%	0.5%
Home Depot	0.38	0.55	0.41	9.1%	0.71	8.1%	1.0%
Intel	1.45	–0.09	–0.58	10.3%	1.16	10.7%	–0.5%
IBM	0.81	0.36	–0.18	9.1%	0.81	8.7%	0.4%
Johnson & Johnson	0.60	–0.51	0.09	6.3%	0.52	7.0%	–0.7%
JPMorgan Chase	0.45	–0.50	1.51	10.2%	1.04	10.0%	0.1%
Kraft Foods	0.46	–0.17	0.29	7.1%	0.56	7.2%	–0.1%
McDonald's	0.86	–0.58	–0.25	6.5%	0.60	7.4%	–1.0%
Merck	1.36	–0.89	–0.55	7.5%	0.88	9.1%	–1.6%
Microsoft	1.09	–0.04	–0.30	9.2%	0.94	9.4%	–0.2%
Pfizer	0.71	–0.68	0.38	7.4%	0.72	8.2%	–0.8%
Procter & Gamble	0.61	–0.27	0.04	6.9%	0.56	7.2%	–0.4%
Travelers	0.71	–0.51	0.12	7.0%	0.64	7.7%	–0.7%
United Technologies	0.87	–0.32	0.32	9.2%	0.95	9.5%	–0.3%
Verizon Communications	0.87	–0.30	–0.43	6.8%	0.60	7.4%	–0.7%
Wal-Mart	0.30	–0.41	0.09	4.8%	0.24	5.3%	–0.5%
Walt Disney	0.89	0.12	0.35	10.7%	1.08	10.3%	0.4%
Min	**0.30**	**–1.15**	**–0.58**	**4.8%**	**0.24**	**5.3%**	**–1.6%**
Max	**2.11**	**0.69**	**2.20**	**17.7%**	**2.30**	**17.5%**	**1.5%**
Avg	**0.95**	**–0.22**	**0.19**	**9.5%**	**0.99**	**9.7%**	**–0.2%**

Table 3 **The 3FM, the CAPM, and Excess Returns**

This exhibit shows, in panel A, the estimates of BH's alpha (α) and market beta (β) from expression (7); and in panel B, the estimates of BH's alpha, market beta, size beta (β^S), and value beta (β^V) from expression (5). All coefficients estimated on the basis of monthly returns over the Jan/1977-Dec/2009 period. BH's returns are net of the monthly risk-free rate. Monthly returns for the MRP, SMB, and HML portfolios downloaded from Ken French's web page.

Model	α	β	β^S	β^V	Adj- dj-R^2
Panel A: The CAPM					
Coefficient	0.012	0.712			0.201
p-value	0.000	0.000			
Panel B: The 3FM					
Coefficient	0.011	0.807	–0.246	0.316	0.235
p-value	0.001	0.000	0.028	0.001	

We will estimate these three betas using expression (5); five years of monthly returns (Jan/05-Dec/09); the returns of all companies net of the monthly risk-free rate; and the returns for the MRP, SMB, and HML portfolios downloaded from French's web page. The betas estimated this way are shown in the second, third, and fourth columns of Table 2. The cost of equity of the 30 companies in the Dow that follow from these betas and expression (6) are shown in the fifth column.

Before we discuss the estimates from the 3FM, note that the sixth and seventh columns of Table 2 show the beta and the cost of equity of the same 30 companies estimated with the CAPM. Importantly, although these costs of equity were estimated using the same risk-free rate and MRP as those used for the 3FM, the (market) betas are not the same as those estimated from the 3FM. This is the case because when estimating betas with the CAPM, MRP is the only explanatory variable, whereas when doing so with the 3FM there are three explanatory variables (MRP, SMB, and HML).

Let's start by noting that the market betas estimated with the 3FM are in most cases very similar to those estimated with the CAPM. To be sure, there are substantial differences in a few cases (American Express, Bank of America, JPMorgan Chase), but they seem to be the exception rather than the rule. As the last line of Table 2 shows, on average, the market betas estimated with the 3FM (0.95) and the CAPM (0.99) are very similar.

But also of note is that although it is nearly impossible to find negative market betas, it is far from unusual to find negative size betas and value betas, as Table 2 clearly shows. In fact, this is exactly what we would expect to find in the case of large companies and growth companies. This is so because a negative size beta indicates a company whose expected return is inversely affected by an increase in the outperformance of small stocks relative to large stocks, and a negative value beta indicates a company whose expected return is inversely affected by an increase in the outperformance of value stocks relative to growth stocks.

This is an important insight of the 3FM so let's put it in a different way to make sure the idea is clear. A positive exposure to the size premium (a positive size beta) indicates a company whose returns tend to increase when the outperformance of small stocks (relative to large stocks) increases; and because the 3FM assumes that small stocks are riskier than large stocks, the required return on the company increases. Conversely, a negative exposure to the size premium (a negative size beta) indicates a company whose returns tend to fall when the outperformance of small stocks (relative to large stocks) increases; and because the 3FM assumes that large stocks are less risky than small stocks, the required return on the company decreases. The argument for positive and negative value betas runs along similar lines.

Finally, compare company by company the required returns in the fifth column of Table 2 (estimated with the 3FM) with those in the seventh column (estimated with the CAPM). As you can see, and the last column confirms, in most cases the differences are not substantial. To be sure, there are a few cases in which the difference is considerable (American Express, Merck), but on average across all 30 companies the required return from both models is virtually identical: that is, 9.5% according to the 3FM and 9.7% according to the CAPM.

Could this explain, at least partially, the popularity of the CAPM? Note that the CAPM is widely taught in business schools, is easy to understand, and easy to implement. Most alternative models, including the 3FM, are not always taught in business schools, are more demanding in terms of data collection, more difficult to implement and their intuition is not always clear. Furthermore, the differences between the required returns calculated from these two models are often well within the differences w would find between a short-term and a long-term risk-free rate, or an arithmetic or geometric average market risk premium, when implementing the CAPM. In other words, if the differences in required returns were substantial, it would certainly pay to consider both models and choose the more appropriate; but if the differences are small, and within the range of differences found when making different choices for the inputs of the CAPM, perhaps the need for an alternative model (such as the 3FM) decreases considerably.

Application 2 – Estimating Excess Returns

As already noted, the vast majority of practitioners claim to use the CAPM to estimate the cost of equity. For that specific corporate finance purpose, the CAPM is the standard choice and the 3FM is only an increasingly popular alternative. On the other hand, in portfolio management and performance evaluation, the 3FM has become the standard tool used to estimate excess returns.

But first a caveat: The variable at the center of this section, alpha, has two slightly different interpretations. Originally, it was conceived as a measure of risk-adjusted performance relative to the market. Thus, a fund with a positive alpha indicated that, after adjusting its returns by its risk, the fund had outperformed the market, and a fund with a negative alpha indicated the opposite. Over time, alpha came to be used also as a measure of return performance relative to the chosen benchmark, not necessarily the market. Thus, a fund with a positive alpha is one that delivered a higher return than the benchmark against which its manager is evaluated, and a fund with a negative alpha indicates the opposite.

To illustrate this application of the 3FM, let's consider Berkshire Hathaway (BH), the company managed by Warren Buffett. During the 33-year period between 1977 and 2009, BH shareholders obtained an annualized return of 23.7%, substantially outpacing the 10.7% annualized return of the S&P500. Needless to say, outperforming the market by 13 percentage points over a period of more than 30 years has earned Buffett the reputation he has and surely deserves. True, BH shareholders were subject to an annualized volatility of 24.8%, considerably higher than the 15.3% of the S&P500. On the other hand, although those who invested $100 in the S&P500 at the beginning of 1977 would have found themselves with $2,864 by the end of 2009, those who invested the same $100 in BH instead would have found themselves with $111,457.

Before the introduction of the 3FM in the early 1990s, the standard way to determine whether a fund outperformed the market on a risk-adjusted basis was to calculate the fund's alpha (α). This magnitude is a measure of performance that adjusts a fund's observed returns by its exposure to market risk. To estimate alpha we run the regression

$$R_{it} - R_{ft} = \alpha + \beta_1 \cdot MRP_t + u_t \,, \tag{7}$$

where the notation is just as defined earlier in expression (5).

As stated earlier, the estimate of β_1 measures the fund's exposure to market risk; it can be higher or lower than 1, indicating that the fund amplifies or dampens the market's fluctuations. The estimate of α measures outperformance or underperformance on a risk-adjusted basis. A positive alpha indicates that the fund outperformed the market in terms of risk-adjusted returns; and a negative alpha indicates the opposite.

Panel A of Table 3 shows the estimates of BH's alpha and beta from expression (7), estimated with monthly data over the Jan/1977-Dec/2009 period.[9] The estimated beta (0.712) shows that BH actually mitigated the effects of market's fluctuations. This in turn implies that Buffett's outperformance is even larger than that indicated by the 13 percentage points in terms of returns. In fact, if we annualize the estimated alpha (0.012) we obtain 14.8%, which is a measure of Buffett's risk-adjusted outperformance. In other words, over the 1977-2009 period, Buffett outperformed the market by 13 percentage points in terms of returns, and by an even larger margin (14.8 percentage points) in terms of risk-adjusted returns.

However, as is well known, Buffett concentrates his portfolio on value stocks; that is, on companies that he believes are cheap relative to their fundamentals. Importantly, because the 3FM assumes that value stocks are riskier than growth stocks, we should penalize Buffett's performance for a positive exposure to the value premium. On the other hand, Buffett also concentrates his portfolio on large companies (at least as far as publicly traded companies is concerned), and the 3FM assumes that large companies are less risky than small companies—and on that basis, we should "reward" Buffett's performance for a negative exposure to the size premium.

To estimate the exposure of BH shareholders to the market, size, and value risk premiums, we need to run a regression just like (5). This is what panel B of Table 3 shows, using monthly data over the Jan/1977-Dec/2009 period.[10] First, note that, as expected, the size beta is negative (–0.246) and the value beta is positive (0.316), indicating that we should "reward" Buffett for a negative exposure to the size premium and "penalize" him for a positive exposure

9. The dependent variable is BH's risk premium (that is, BH's monthly returns net of the monthly risk-free rate) and the independent variable is the market risk premium (MRP) taken from Ken French's web page.

10. The dependent variable is BH's risk premium (that is, BH's monthly returns net of the monthly risk-free rate) and the independent variables are the market risk premium (MRP), the size premium (SMB) and the value premium (HML) all taken from Ken French's web page.

to the value premium. The market beta (0.807) is only a bit higher than it is in panel A, and still indicates that BH mitigated the effects of market volatility.

The estimated alpha (0.011) is very similar to that in panel A. If we annualize this number we get 14.1%, which is a measure of Buffett's risk-adjusted outperformance when risk is assessed not only with respect to the market factor but also with respect to both the size and the value factors. In other words, after "rewarding" Buffett's performance for mitigating market risk for its negative exposure to the size factor, and "penalizing" his performance for a positive exposure to the value factor, he still outperformed the market by over 14 percentage points over a 33-year period.

Note that the "penalty" for exposure to the value factor is only a bit larger than the "reward" for the negative exposure to the size factor. Note also that the market beta estimated from the 3FM is a bit higher than that estimated from the CAPM. For these reasons, the alpha estimated from the 3FM is a bit lower than that estimated from the CAPM. In other words, BH was a bit riskier, and its outperformance a bit lower, when risk is assessed with three factors rather than with just one.

This example illustrates how the 3FM is now used in portfolio management and performance evaluation. As long as practitioners believe (and they generally do believe) that small companies are riskier than large companies, and value stocks riskier than growth stocks, these sources of risk should be taken into account when calculating required returns. In fact, calculating alphas based on the 3FM has become the standard way to assess the performance of portfolio managers.

An Assessment

Ever since the CAPM was introduced in the 1960s, many competing models have been proposed to replace it. But at present, the CAPM remains the standard model used by academics and practitioners to estimate required returns. That being said, the 3FM has become an increasingly accepted alternative in both corporate finance and portfolio management applications, particularly the latter.

The CAPM makes the strong statement that the only variable that should have an impact on an asset's required return is the asset's beta. However, evidence from both the U.S. and other countries quite clearly shows that size and value do matter; that is, in the long term, small stocks tend to outperform large stocks, and value stocks tend to outperform growth stocks. Under the assumption that size and value are risk factors, the 3FM articulates the market risk premium, the size premium, and the value premium into a model that aims to assess risk in a more comprehensive way, and ultimately to provide a more reliable estimation of required returns.

Although its popularity has been steadily increasing over time, the jury is still out on whether the 3FM is a better model than the CAPM in the sense of estimating more accurate required returns. Be that as it may, practitioners should be aware of, understand, and know how to apply the 3FM. There is little doubt that this model has become an important tool in any practitioner's toolkit.

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