The coefficients b_i, s_i, and h_i are the betas (also called *loadings* in this context) of the stock on the three factors. If these are the only risk factors, excess returns on all assets should be fully explained by risk premiums due to these factor loadings. In other words, if these factors fully explain asset returns, the intercept of the equation should be zero.

In a survey of asset pricing tests, Goyal[18] applies Equation 13.7 to the returns of 25 portfolios of all U.S. stocks sorted by size and B/M ratio. Figure 13.1 shows the average actual return of each portfolio over the period 1946–2010 against returns predicted by the CAPM (Panel A) and by the FF three-factor model (Panel B). In this test, the FF model provides a clear improvement over the CAPM.

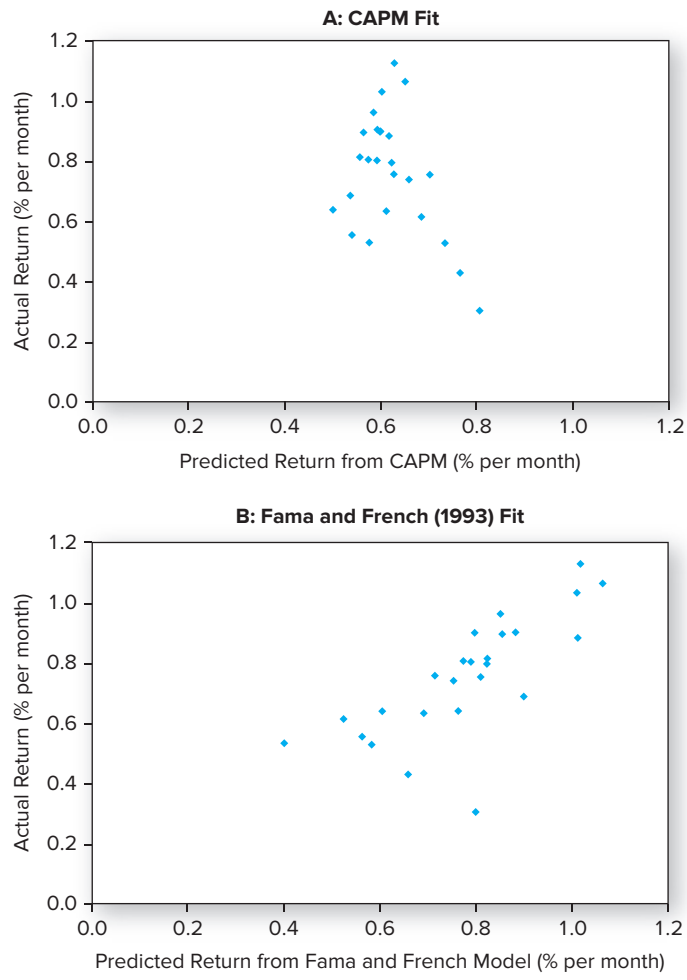

Figure 13.1 CAPM versus the Fama and French model. The figure plots the average actual returns versus returns predicted by CAPM and the FF model for 25 size and book-to-market double-sorted portfolios.

Source: Amit Goyal, "Empirical Cross Sectional Asset Pricing: A Survey," *Financial Markets and Portfolio Management* 26 (2012), pp. 3–38.

Size and B/M as Risk Factors

Liew and Vassalou[19] show that returns on style portfolios (HML or SMB) seem to predict GDP growth, and thus may in fact capture some aspects of business cycle risk. Each bar in Figure 13.2 is the average difference in the return on the HML or SMB portfolio in years before good GDP growth versus in years with poor GDP growth. Positive values mean the portfolio does better in years prior to good macroeconomic performance. The predominance of positive values leads them to conclude that the returns on the HML and SMB portfolios are positively related to future growth in the macroeconomy, and so may be proxies for business cycle risk. Thus, at least part of the size and value premiums may reflect rational rewards for greater risk exposure.

Petkova and Zhang[20] also try to tie the average return premium on value (high B/M) portfolios to risk premiums. Their approach uses a conditional CAPM. In the conventional CAPM, we treat both the market risk premium and firm betas as given parameters.

[18]Amit Goyal, "Empirical Cross Sectional Asset Pricing: A Survey," *Financial Markets and Portfolio Management* 26 (2012), pp. 3–38.

[19]J. Liew and M. Vassalou, "Can Book-to-Market, Size and Momentum Be Risk Factors That Predict Economic Growth?" *Journal of Financial Economics* 57 (2000), pp. 221–45.

[20]Ralitsa Petkova and Lu Zhang, "Is Value Riskier than Growth?" *Journal of Financial Economics* 78 (2005), pp. 187–202.

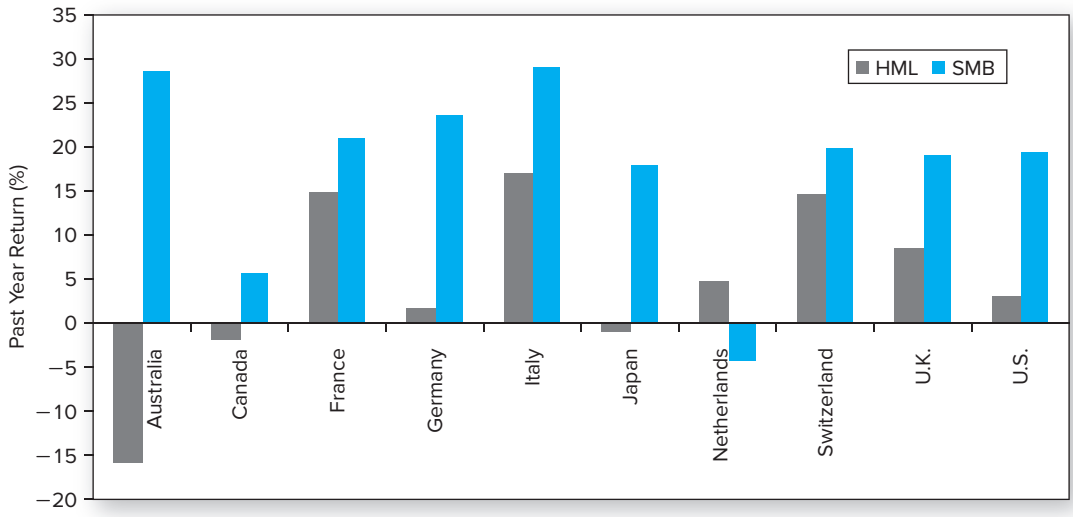

Figure 13.2 Difference in return to factor portfolios in year prior to above-average versus below-average GDP growth. Both SMB and HML portfolio returns tend to be higher in years preceding better GDP growth.

Source: J. Liew and M. Vassalou, "Can Book-to-Market, Size and Momentum Be Risk Factors That Predict Economic Growth?" *Journal of Financial Economics* 57 (2000), pp. 221–45.

In contrast, as we noted earlier in the chapter, the conditional CAPM allows both of these terms to vary over time, and possibly to co-vary. If a stock's beta is higher when the market risk premium is high, this positive association leads to a "synergy" in its risk premium, which is the product of its incremental beta and market risk premium.

What might lead to such an association between beta and the market risk premium? Zhang[21] focuses on irreversible investments. He notes that firms classified as value firms (with high book-to-market ratios) on average will have greater amounts of tangible capital. Investment irreversibility puts such firms more at risk for economic downturns because in a severe recession, they will suffer from excess capacity from assets already in place. In contrast, growth firms are better able to deal with a downturn by deferring investment plans. The greater exposure of high book-to-market firms to recessions will result in higher down-market betas. Moreover, some evidence suggests that the market risk premium also is higher in down markets, when investors are feeling more economic pressure and anxiety. The combination of these two factors might impart a positive correlation between the beta of high B/M firms and the market risk premium.

To quantify these notions, Petkova and Zhang attempt to fit both beta and the market risk premium to a set of "state variables," that is, variables that summarize the state of the economy. These are:

DIV = Market dividend yield
DEFLT = Default spread on corporate bonds (Baa – Aaa rates)
TERM = Term structure spread (10-year –1-year Treasury rates)
TB = 1-month T-bill rate

[21]Lu Zhang, "The Value Premium," *Journal of Finance* 60 (2005), pp. 67–103.

They estimate a first-pass regression, but first substitute these state variables for beta as follows:

$$R_{\text{HML}} = \alpha + \beta R_{Mt} + e_i$$
$$= \alpha + [\underbrace{b_0 + b_1 \text{DIV}_t + b_2 \text{DEFLT}_t + b_3 \text{TERM}_t + b_4 \text{TB}_t}_{= \beta_t \leftarrow \text{a } \textit{time-varying} \text{ beta}}] R_{Mt} + e_i$$

The strategy is to estimate parameters b_0 through b_4 and then fit beta using the values of the four state variables at each date. In this way, they can estimate beta in each period.

Similarly, one can directly estimate the determinants of a time-varying market risk premium, using the same set of state variables:

$$r_{Mt} - r_{ft} = c_0 + c_1 \text{DIV}_t + c_2 \text{DEFLT}_t + c_3 \text{TERM}_t + c_4 \text{TB}_t + e_t$$

The fitted value from this regression is the estimate of the market risk premium.

Finally, Petkova and Zhang examine the relationship between beta and the market risk premium. They define the state of economy by the size of the premium. A peak is defined as the periods with the 10% lowest risk premiums; a trough has the 10% highest risk premiums. The results, presented in Figure 13.3, support the notion of a countercyclical value beta: The beta of the HML portfolio is negative in good economies, meaning that the beta of value stocks (high book-to-market) is less than that of growth stocks (low B/M), but the reverse is true in recessions. While the covariance between the HML beta and the market risk premium is not sufficient to explain by itself the average return premium on value portfolios, it does suggest that at least part of the explanation may be a rational risk premium.

Behavioral Explanations

On the other side of the debate, several authors make the case that the value premium is a manifestation of market irrationality. The essence of the argument is that analysts tend to extrapolate recent performance too far out into the future, and thus tend to overestimate

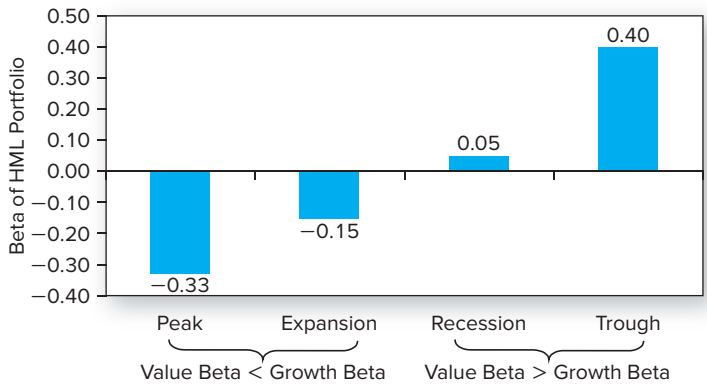

Figure 13.3 HML beta in different economic states. The beta of the HML portfolio is higher when the market risk premium is higher.

Source: Ralitsa Petkova and Lu Zhang, "Is Value Riskier than Growth?" *Journal of Financial Economics* 78 (2005), pp. 187–202.