While this portfolio is still risky (due to the residual risk, e_P), the systematic risk has been eliminated, and if P is reasonably well-diversified, the remaining nonsystematic risk will be small. Thus the objective is achieved: the manager can take advantage of the 4% alpha without inadvertently taking on market exposure. The process of separating the search for alpha from the choice of market exposure is called *alpha transport.*

This "long-short strategy" is characteristic of the activity of many *hedge funds.* Hedge fund managers identify an underpriced security and then try to attain a "pure play" on the perceived underpricing. They hedge out all extraneous risk, focusing the bet only on the perceived "alpha" (see the box on p. 272). Tracking funds are the vehicle used to hedge the exposures to which they do *not* want exposure. Hedge fund managers use index regressions such as those discussed here, as well as more-sophisticated variations, to create the tracking portfolios at the heart of their hedging strategies.

SUMMARY

1. A single-factor model of the economy classifies sources of uncertainty as systematic (macroeconomic) factors or firm-specific (microeconomic) factors. The index model assumes that the macro factor can be represented by a broad index of stock returns.
2. The single-index model drastically reduces the necessary inputs in the Markowitz portfolio selection procedure. It also aids in specialization of labor in security analysis.
3. According to the index model specification, the systematic risk of a portfolio or asset equals $\beta^2\sigma_M^2$ and the covariance between two assets equals $\beta_i\beta_j\sigma_M^2$.
4. The index model is estimated by applying regression analysis to excess rates of return. The slope of the regression curve is the beta of an asset, whereas the intercept is the asset's alpha during the sample period. The regression line is also called the *security characteristic line.*
5. Optimal active portfolios constructed from the index model include analyzed securities in proportion to their information ratios. The full risky portfolio is a mixture of the active portfolio and the passive market index portfolio. The index portfolio is used to enhance the diversification of the overall risky position.
6. Practitioners routinely estimate the index model using total rather than excess rates of return. This makes their estimate of alpha equal to $\alpha + r_f(1 - \beta)$.
7. Betas show a tendency to evolve toward 1 over time. Beta forecasting rules attempt to predict this drift. Moreover, other financial variables can be used to help forecast betas.

Related Web sites for this chapter are available at www.mhhe.com/bkm

KEY TERMS

single-factor model
single-index model
regression equation
residuals
security characteristic line
scatter diagram
information ratio
tracking portfolio

PROBLEM SETS

Quiz

1. What are the advantages of the index model compared to the Markowitz procedure for obtaining an efficiently diversified portfolio? What are its disadvantages?
2. What is the basic trade-off when departing from pure indexing in favor of an actively managed portfolio?
3. How does the magnitude of firm-specific risk affect the extent to which an active investor will be willing to depart from an indexed portfolio?
4. Why do we call alpha a "nonmarket" return premium? Why are high-alpha stocks desirable investments for active portfolio managers? With all other parameters held fixed, what would happen to a portfolio's Sharpe ratio as the alpha of its component securities increased?

Problems

5. A portfolio management organization analyzes 60 stocks and constructs a mean-variance efficient portfolio using only these 60 securities.
   a. How many estimates of expected returns, variances, and covariances are needed to optimize this portfolio?
   b. If one could safely assume that stock market returns closely resemble a single-index structure, how many estimates would be needed?

6. The following are estimates for two stocks.

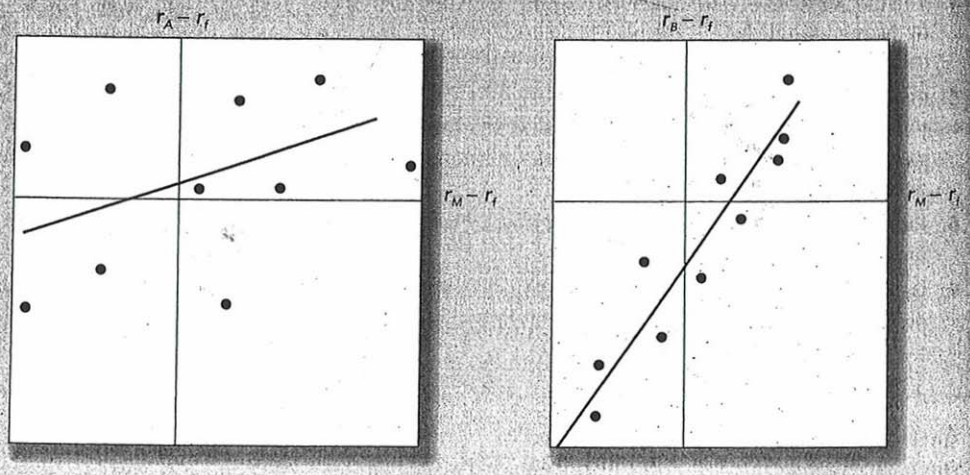
Stock	Expected Return	Beta	Firm-Specific Standard Deviation
A	13%	0.8	30%
B	18	1.2	40

The market index has a standard deviations of 22% and the risk-free rate is 8%.
   a. What are the standard deviations of stocks *A* and *B*?
   b. Suppose that we were to construct a portfolio with proportions:

Stock *A*:	.30
Stock *B*:	.45
T-bills:	.25

Compute the expected return, standard deviation, beta, and nonsystematic standard deviation of the portfolio.

7. Consider the following two regression lines for stocks *A* and *B* in the following figure.



   a. Which stock has higher firm-specific risk?
   b. Which stock has greater systematic (market) risk?
   c. Which stock has higher R^2?
   d. Which stock has higher alpha?
   e. Which stock has higher correlation with the market?

8. Consider the two (excess return) index model regression results for *A* and *B*:
   $R_A = 1\% + 1.2R_M$
   R-square = .576
   Residual standard deviation = 10.3%
   $R_B = -2\% + .8R_M$
   R-square = .436
   Residual standard deviation = 9.1%

a. Which stock has more firm-specific risk?
b. Which has greater market risk?
c. For which stock does market movement explain a greater fraction of return variability?
d. If r_f were constant at 6% and the regression had been run using total rather than excess returns, what would have been the regression intercept for stock A?

Use the following data for Problems 9 through 14. Suppose that the index model for stocks A and B is estimated from excess returns with the following results:

$$R_A = 3\% + .7R_M + e_A$$
$$R_B = -2\% + 1.2R_M + e_B$$
$$\sigma_M = 20\%;\ R\text{-square}_A = .20;\ R\text{-square}_B = .12$$

9. What is the standard deviation of each stock?
10. Break down the variance of each stock to the systematic and firm-specific components.
11. What are the covariance and correlation coefficient between the two stocks?
12. What is the covariance between each stock and the market index?
13. For portfolio P with investment proportions of .60 in A and .40 in B, rework Problems 9, 10, and 12.
14. Rework Problem 13 for portfolio Q with investment proportions of .50 in P, .30 in the market index, and .20 in T-bills.
15. A stock recently has been estimated to have a beta of 1.24:
    a. What will Merrill Lynch compute as the "adjusted beta" of this stock?
    b. Suppose that you estimate the following regression describing the evolution of beta over time:
    $$\beta_t = .3 + .7\beta_{t-1}$$
    What would be your predicted beta for next year?
16. Based on current dividend yields and expected growth rates, the expected rates of return on stocks A and B are 11% and 14%, respectively. The beta of stock A is .8, while that of stock B is 1.5. The T-bill rate is currently 6%, while the expected rate of return on the S&P 500 index is 12%. The standard deviation of stock A is 10% annually, while that of stock B is 11%. If you currently hold a passive index portfolio, would you choose to add either of these stocks to your holdings?
17. A portfolio manager summarizes the input from the macro and micro forecasters in the following table:

Micro Forecasts

Asset	Expected Return (%)	Beta	Residual Standard Deviation (%)
Stock *A*	20	1.3	58
Stock *B*	18	1.8	71
Stock *C*	17	0.7	60
Stock *D*	12	1.0	55

Macro Forecasts

Asset	Expected Return (%)	Standard Deviation (%)
T-bills	8	0
Passive equity portfolio	16	23

a. Calculate expected excess returns, alpha values, and residual variances for these stocks.
b. Construct the optimal risky portfolio.
c. What is Sharpe's measure for the optimal portfolio and how much of it is contributed by the active portfolio?
d. What should be the exact makeup of the complete portfolio for an investor with a coefficient of risk aversion of 2.8?

18. Recalculate Problem 17 for a portfolio manager who is not allowed to short sell securities.
    a. What is the cost of the restriction in terms of Sharpe's measure?
    b. What is the utility loss to the investor ($A = 2.8$) given his new complete portfolio?
19. Suppose that based on the analyst's past record, you estimate that the relationship between forecast and actual alpha is:

$$\text{Actual abnormal return} = .3 \times \text{Forecast of alpha}$$

    Use the alphas from Problem 17. How much is expected performance affected by recognizing the imprecision of alpha forecasts?

Challenge Problem

20. Suppose that the alpha forecasts in row 44 of Spreadsheet 8.1 are doubled. All the other data remain the same. Recalculate the optimal risky portfolio. Before you do any calculations, however, use the Summary of Optimization Procedure to estimate a back-of-the-envelope calculation of the information ratio and Sharpe ratio of the newly optimized portfolio. Then recalculate the entire spreadsheet example and verify your back-of-the-envelope calculation.

CFA® PROBLEMS

1. When the annualized monthly percentage rates of return for a stock market index were regressed against the returns for ABC and XYZ stocks over a 5-year period ending in 2008, using an ordinary least squares regression, the following results were obtained:

Statistic	ABC	XYZ
Alpha	–3.20%	7.3%
Beta	0.60	0.97
R^2	0.35	0.17
Residual standard deviation	13.02%	21.45%

   Explain what these regression results tell the analyst about risk–return relationships for each stock over the sample period. Comment on their implications for future risk–return relationships, assuming both stocks were included in a diversified common stock portfolio, especially in view of the following additional data obtained from two brokerage houses, which are based on 2 years of weekly data ending in December 2008.

Brokerage House	Beta of ABC	Beta of XYZ
A	.62	1.45
B	.71	1.25

2. Assume the correlation coefficient between Baker Fund and the S&P 500 Stock Index is .70. What percentage of Baker Fund's total risk is specific (i.e., nonsystematic)?
3. The correlation between the Charlottesville International Fund and the EAFE Market Index is 1.0. The expected return on the EAFE Index is 11%, the expected return on Charlottesville International Fund is 9%, and the risk-free return in EAFE countries is 3%. Based on this analysis, what is the implied beta of Charlottesville International?
4. The concept of *beta* is most closely associated with:
    a. Correlation coefficients.
    b. Mean-variance analysis.
    c. Nonsystematic risk.
    d. Systematic risk.
5. Beta and standard deviation differ as risk measures in that beta measures:
    a. Only unsystematic risk, while standard deviation measures total risk.
    b. Only systematic risk, while standard deviation measures total risk.

c. Both systematic and unsystematic risk, while standard deviation measures only unsystematic risk.
d. Both systematic and unsystematic risk, while standard deviation measures only systematic risk.

Go to **www.mhhe.com/edumarketinsight** and click on the *Company* link. Enter the ticker symbol for the stock of your choice and click on the *Go* button. In the *Excel Analytics* section go to the *Market Data* section and get the *Monthly Adjusted Prices* data for the past 4 years. The page will also show monthly returns for your stock and for the S&P 500. Copy the data into an *Excel* worksheet and then do a regression to generate the characteristic line for the stock. (Use the menus for *Tools, Data Analysis, Regression,* input the X range and the Y range, select *New Worksheet Ply* under *Output Options,* and click on *OK.*) Based on the regression results, what is the beta coefficient for your stock?

STANDARD &POOR'S

Next use *Excel* to plot an X-Y Scatter graph of the stock's returns versus the S&P 500's returns. Once the graph is constructed, select one of the data points and right click on it. Choose the *Add Trendline* option and select the *Linear* type. On the *Options* tab, select *Display Equation on Chart.* How does the equation compare with your regression results?

Go back to the main page for your stock's information and select *S&P Stock Reports* from the menu. Choose *Stock Report* from the submenu and when the stock report opens, find the beta coefficient for the firm. How does this beta compare to your results? What are possible reasons for any differences?

E-Investments

Beta Estimates

Go to **http://finance.yahoo.com** and click on *Stocks* link under the *Investing* tab. Look for the *Stock Screener* link under *Research Tools.* The *Java Yahoo! Finance Screener* lets you create your own screens. In the *Click to Add Criteria* box, find *Trading and Volume* on the menu and choose *Beta.* In the *Conditions* box, choose < = and in the *Values* box, enter *1.* Hit the *Enter* key and then request the top 200 matches in the *Return Top_Matches* box. Click on the *Run Screen* button.

Select the *View Table* tab and sort the results to show the lowest betas at the top of the list by clicking on the *Beta* column header. Which firms have the lowest betas? In which industries do they operate?

Select the *View Histogram* tab and when the histogram appears, look at the bottom of the screen to see the *Show Histogram for* box. Use the menu that comes up when you click on the down arrow to select *beta.* What pattern(s), if any, do you see in the distributions of betas for firms that have betas less than 1?

SOLUTIONS TO CONCEPT CHECKS

1. *a.* Total market capitalization is 3,000 + 1,940 + 1,360 = 6,300. Therefore, the mean excess return of the index portfolio is

$$\frac{3,000}{6,300} \times 10 + \frac{1,940}{6,300} \times 2 + \frac{1,360}{6,300} \times 17 = 9.05\% = .0905$$