CHAPTER 24

Portfolio Performance Evaluation

Investments, 8th edition

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McGraw-Hill/Irwin

Introduction

- Complicated subject
- Theoretically correct measures are difficult to construct
- Different statistics or measures are appropriate for different types of investment decisions or portfolios
- Many industry and academic measures are different
- The nature of active management leads to measurement problems

Dollar- and Time-Weighted Returns

Dollar-weighted returns

- Internal rate of return considering the cash flow from or to investment
- Returns are weighted by the amount invested in each stock

Time-weighted returns

- Not weighted by investment amount
- Equal weighting

Text Example of Multiperiod Returns

Period	Action
0	Purchase 1 share at $50
1	Purchase 1 share at $53
	Stock pays a dividend of $2 per share
2	Stock pays a dividend of $2 per share
	Stock is sold at $108 per share

Dollar-Weighted Return

Period	Cash Flow
0	-50 share purchase
1	+2 dividend -53 share purchase
2	+4 dividend + 108 shares sold

Internal Rate of Return:

$$-50 = \frac{-51}{(1+r)^1} + \frac{112}{(1+r)^2}$$

$$r = 7.117\%$$

Time-Weighted Return

$$r_1 = \frac{53 - 50 + 2}{50} = 10\%$$

$$r_2 = \frac{54 - 53 + 2}{53} = 5.66\%$$

Text Example Average: $r_G = [\ (1.1)\ (1.0566)\ ]^{1/2} - 1$

$= 7.81\%$

Adjusting Returns for Risk

- Benchmark portfolio
  - Comparison with other managers of similar investment style
  - May be misleading

Figure 24.1 Universe Comparison

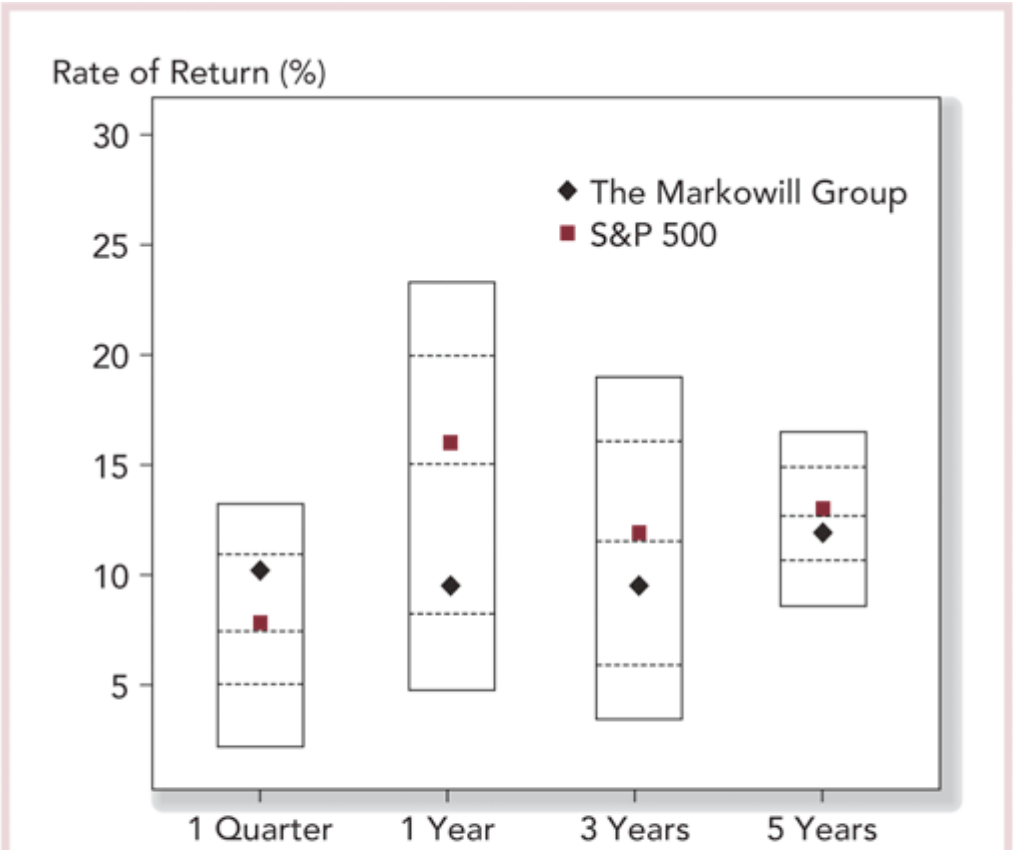

FIGURE 24.1 Universe comparison. Periods ending December 31, 2008

Risk Adjusted Performance: Sharpe

1) Sharpe Index

$$\frac{(\overline{r_P} - \overline{r_f})}{\sigma_P}$$

$\overline{r_p}$ = Average return on the portfolio

$\overline{r_f}$ = Average risk free rate

σ_p = Standard deviation of portfolio return

Risk Adjusted Performance: Treynor

2) Treynor Measure

$$\frac{(\overline{r_P} - \overline{r_f})}{\beta_P}$$

$\overline{r}_p$ = **Average return on the portfolio**

$\overline{r}_f$ = ***Average risk free rate***

β_p = **Weighted average β for portfolio**

Risk Adjusted Performance: Jensen

3) Jensen's Measure

$$\alpha_P = \overline{r}_P - \left[\overline{r}_f + \beta_P(\overline{r}_M - \overline{r}_f)\right]$$

α_p = Alpha for the portfolio

$\overline{r}_p$ = Average return on the portfolio

β_p = Weighted average Beta

$\overline{r}_f$ = Average risk free rate

$\overline{r}_m$ = Average return on market index portfolio

Information Ratio

Information Ratio = $\alpha_p / \sigma(e_p)$

Information Ratio divides the alpha of the portfolio by the nonsystematic risk

Nonsystematic risk could, in theory, be eliminated by diversification

M^2 Measure

- Developed by Modigliani and Modigliani
- Equates the volatility of the managed portfolio with the market by creating a hypothetical portfolio made up of T-bills and the managed portfolio
- If the risk is lower than the market, leverage is used and the hypothetical portfolio is compared to the market

$$M^2 = r_{P*} - r_M$$

M^2 Measure: Example

Managed Portfolio: return = 35% standard deviation = 42%

Market Portfolio: return = 28% standard deviation = 30%
T-bill return = 6%

Hypothetical Portfolio:

30/42 = .714 in P (1-.714) or .286 in T-bills

(.714) (.35) + (.286) (.06) = 26.7%

Since this return is less than the market, the managed portfolio underperformed

Figure 24.2 M^2 of Portfolio P

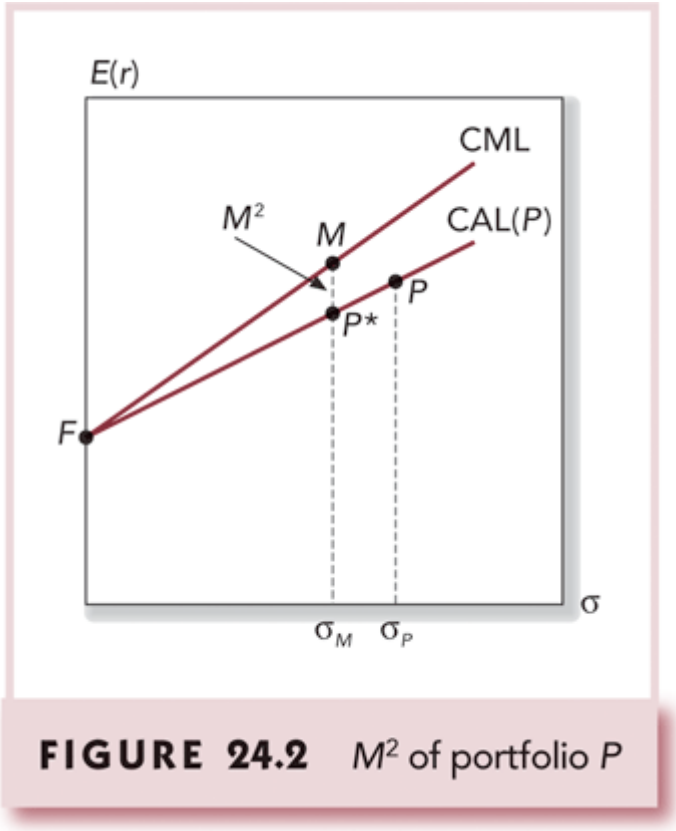

FIGURE 24.2 M^2 of portfolio P

Which Measure is Appropriate?

It depends on investment assumptions

1) If the portfolio represents the entire investment for an individual, Sharpe Index compared to the Sharpe Index for the market
2) If many alternatives are possible, use the Jensen α or the Treynor measure

   The Treynor measure is more complete because it adjusts for risk

Table 24.1 Portfolio Performance

	Portfolio *P*	Portfolio *Q*	Market
Beta	.90	1.60	1.0
Excess return $(\bar{r} - \bar{r}_f)$	11%	19%	10%
Alpha*	2%	3%	0

TABLE 24.1

Portfolio performance

*Alpha = Excess return − (Beta × Market excess return)

$$= (\bar{r} - \bar{r}_f) - \beta(\bar{r}_M - \bar{r}_f) = \bar{r} - [\bar{r}_f + \beta(\bar{r}_M - \bar{r}_f)]$$

Figure 24.3 Treynor's Measure

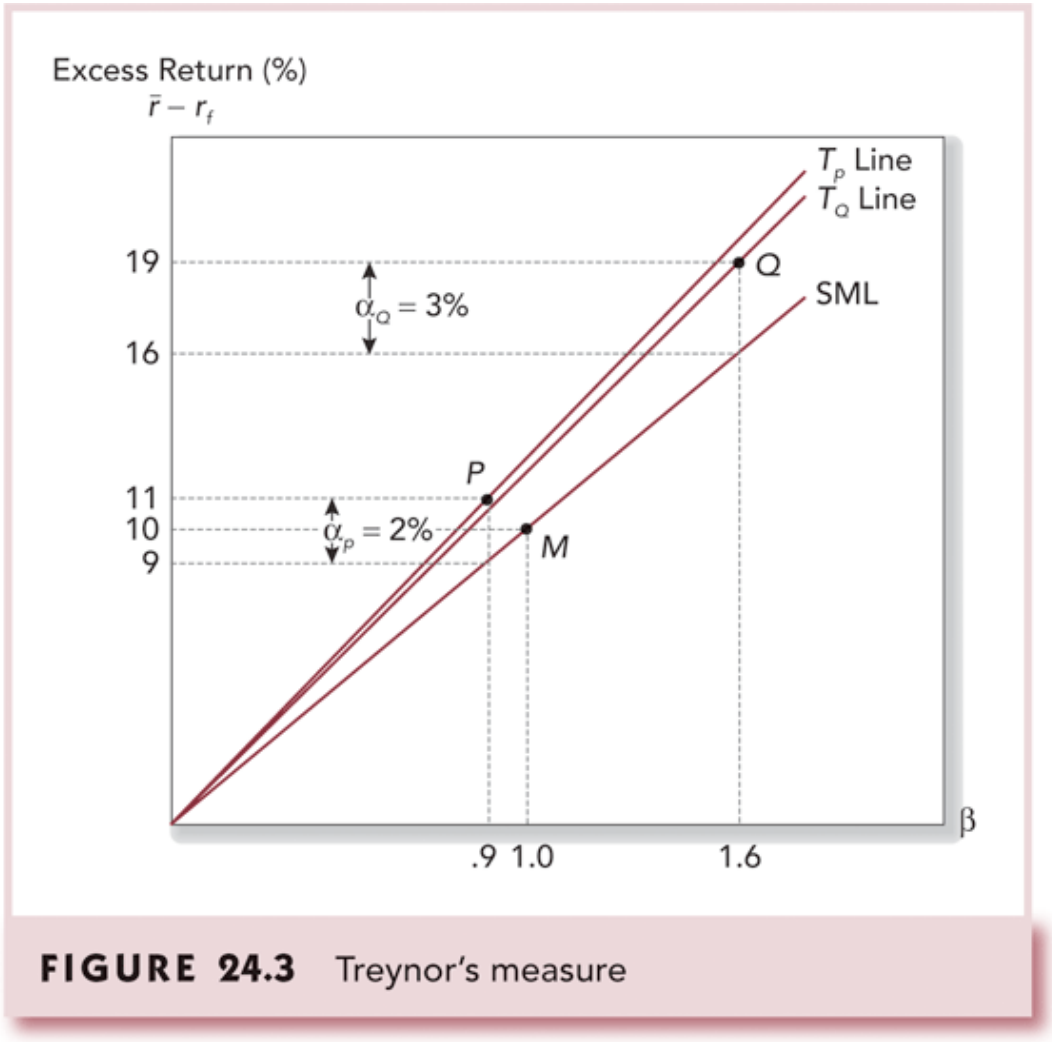

FIGURE 24.3 Treynor's measure

Table 24.2 Excess Returns for Portfolios *P* and *Q* and the Benchmark *M* over 12 Months

TABLE 24.2

Excess returns for portfolios *P* and *Q* and the benchmark *M* over 12 months

Month	Jane's Portfolio *P*	Alternative *Q*	Benchmark *M*
1	3.58%	2.81%	2.20%
2	−4.91	−1.15	−8.41
3	6.51	2.53	3.27
4	11.13	37.09	14.41
5	8.78	12.88	7.71
6	9.38	39.08	14.36
7	−3.66	−8.84	−6.15
8	5.56	0.83	2.74
9	−7.72	0.85	−15.27
10	7.76	12.09	6.49
11	−4.01	−5.68	−3.13
12	0.78	−1.77	1.41
Average	2.76	7.56	1.63
Standard deviation	6.17	14.89	8.48

Table 24.3 Performance Statistics

TABLE 24.3

Performance statistics

	Portfolio *P*	Portfolio *Q*	Portfolio *M*
Sharpe's measure	0.45	0.51	0.19
M^2	2.19	2.69	0.00
SCL regression statistics			
Alpha	1.63	5.28	0.00
Beta	0.69	1.40	1.00
Treynor	4.00	5.40	1.63
T^2	2.37	3.77	0.00
$\sigma(e)$	1.95	8.98	0.00
Information ratio	0.84	0.59	0.00
R-SQR	0.91	0.64	1.00

Performance Measurement for Hedge Funds

- When the hedge fund is optimally combined with the baseline portfolio, the improvement in the Sharpe measure will be determined by its information ratio:

$$S_P^2 = S_M^2 + \left[\frac{\alpha_H}{\alpha(e_H)}\right]^2$$

Performance Measurement with Changing Portfolio Composition

- For actively managed portfolios, it is helpful to keep track of portfolio composition and changes in portfolio mean and risk

Figure 24.4 Portfolio Returns

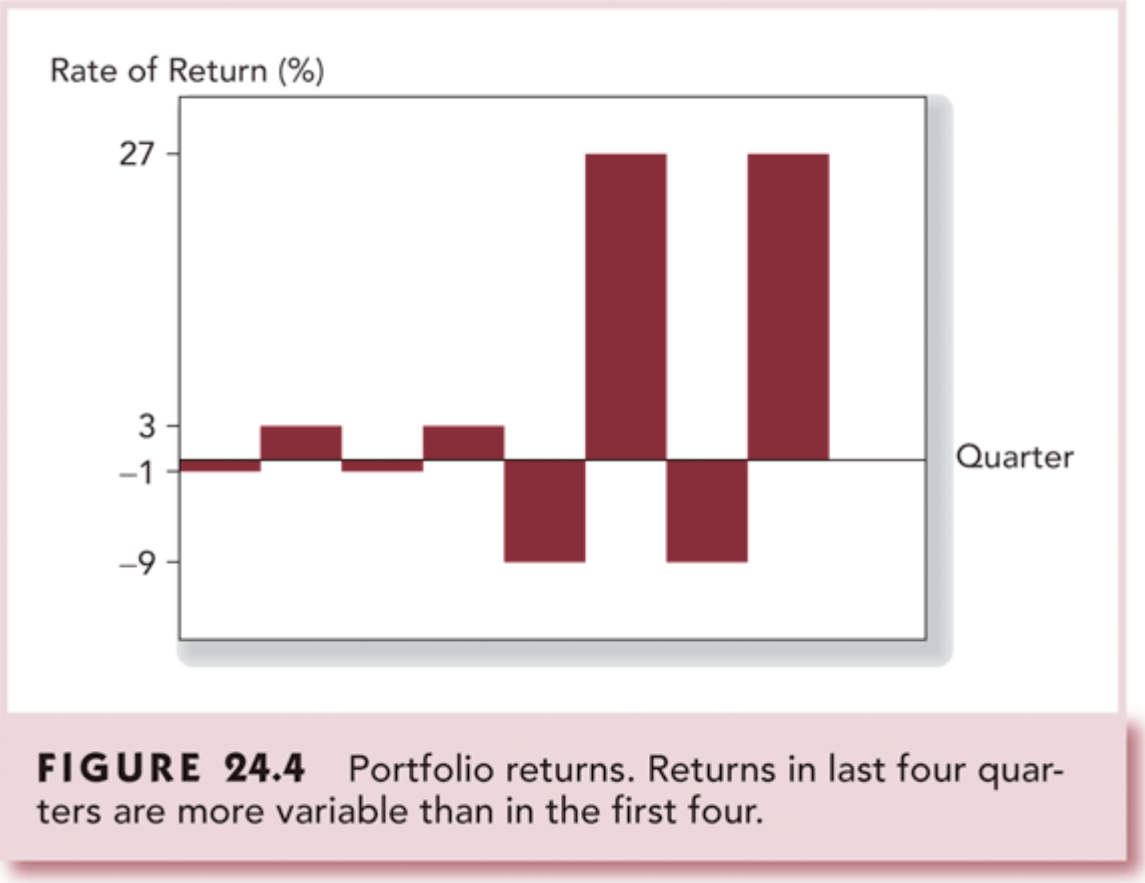

FIGURE 24.4 Portfolio returns. Returns in last four quarters are more variable than in the first four.

Market Timing

- In its pure form, market timing involves shifting funds between a market-index portfolio and a safe asset
- Treynor and Mazuy:

$$r_P - r_f = a + b(r_M - r_f) + c(r_M - r_f)^2 + e_P$$

- Henriksson and Merton:

$$r_P - r_f = a + b(r_M - r_f) + c(r_M - r_f)D + e_P$$

Figure 24.5 Characteristic Lines: Panel A: No Market Timing. Panel B: Beta Increases with Expected Market Excess. Return Panel C: Market Timing with Only Two Values of Beta.

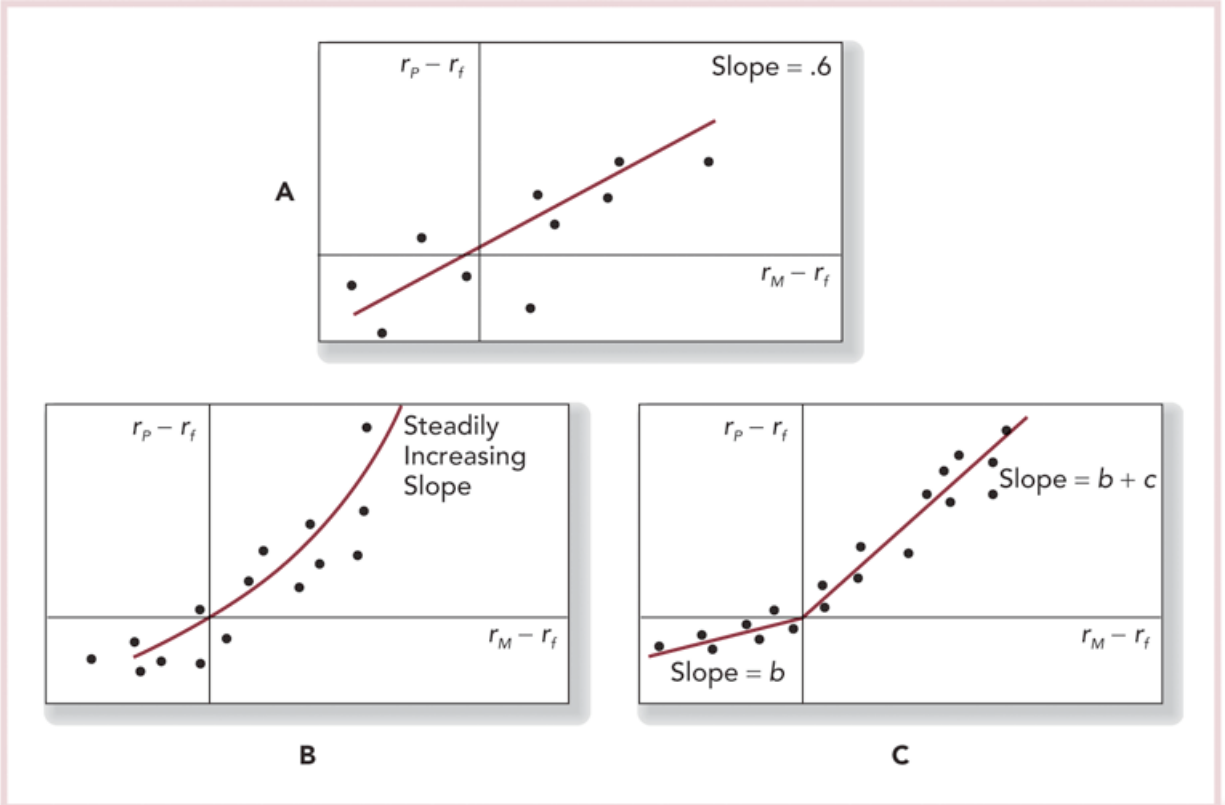

FIGURE 24.5 Characteristic lines. *Panel A:* No market timing, beta is constant. *Panel B:* Market timing, beta increases with expected market excess return. *Panel C:* Market timing with only two values of beta.

Table 24.4 Performance of Bills, Equities and (Annual) Timers – Perfect and Imperfect

Strategy	Bills	Equities	Perfect Timer	Imperfect Timer*
Terminal value	18.35	2,318.04	172,732.75	3,494.91
Arithmetic average (%)	3.75	12.15	17.04	54.81
Standard deviation (%)	3.15	20.26	13.82	15.77
Geometric average (%)	3.70	10.17	16.27	10.74
LPSD (relative to bills)	0	10.63	0	5.75
Minimum (%)	−.06**	−45.56	−.06	−25.90
Maximum (%)	14.86	54.56	54.56	54.56
Skew	1.03	−.36	.66	.53
Kurtosis	1.10	−.07	−.37	.31
One-period call value ($)	0	0	.1605	.0642
Terminal value of call ($)	0	0	225,330.92	174.19

TABLE 24.4

Performance of bills, equities, and (annual) timers—perfect and imperfect

*The imperfect timer has $P_1 = .7$ and $P_2 = .7$. $P_1 + P_2 - 1 = .4$.

**A negative rate on "bills" of –.06% was observed in 1940. The Treasury security used in the data series for this year actually was not a T-bill, but a T-bond with a short remaining maturity.

Figure 24.6 Rate of Return of a Perfect Market Timer as a Function of the Rate of Return on the Market Index

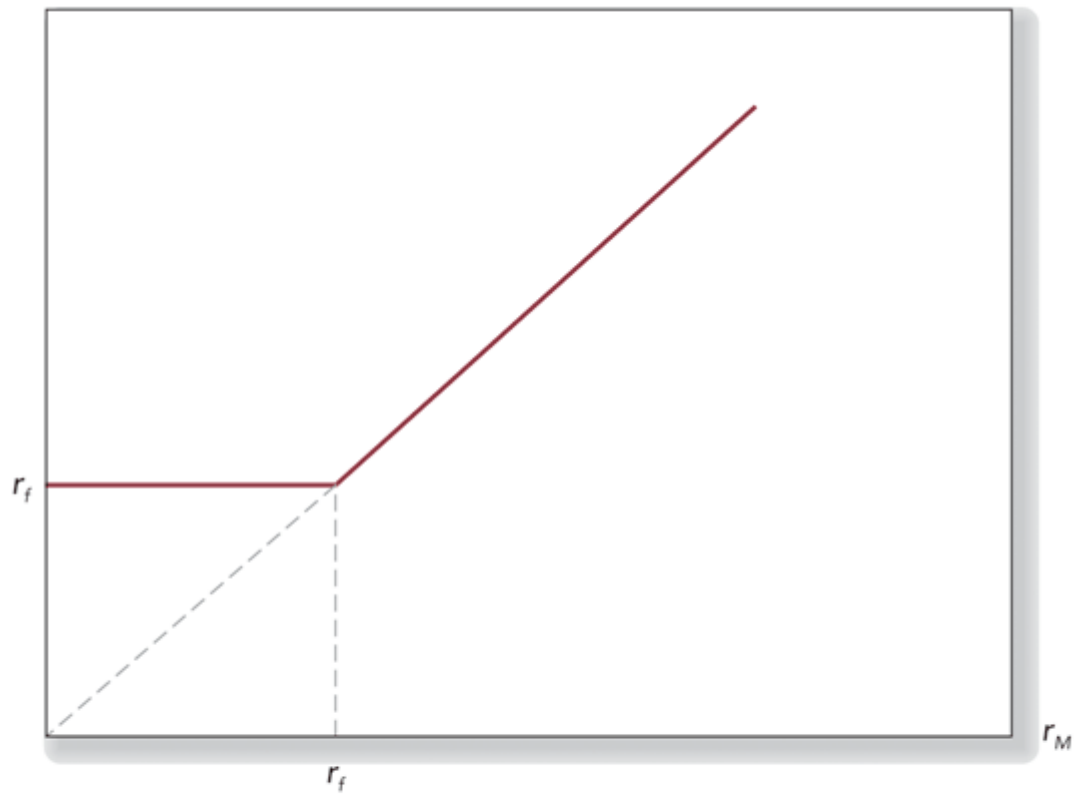

FIGURE 24.6 Rate of return of a perfect market timer as a function of the rate of return on the market index.

Figure 24.7 Scatter Diagram of Timer Performance

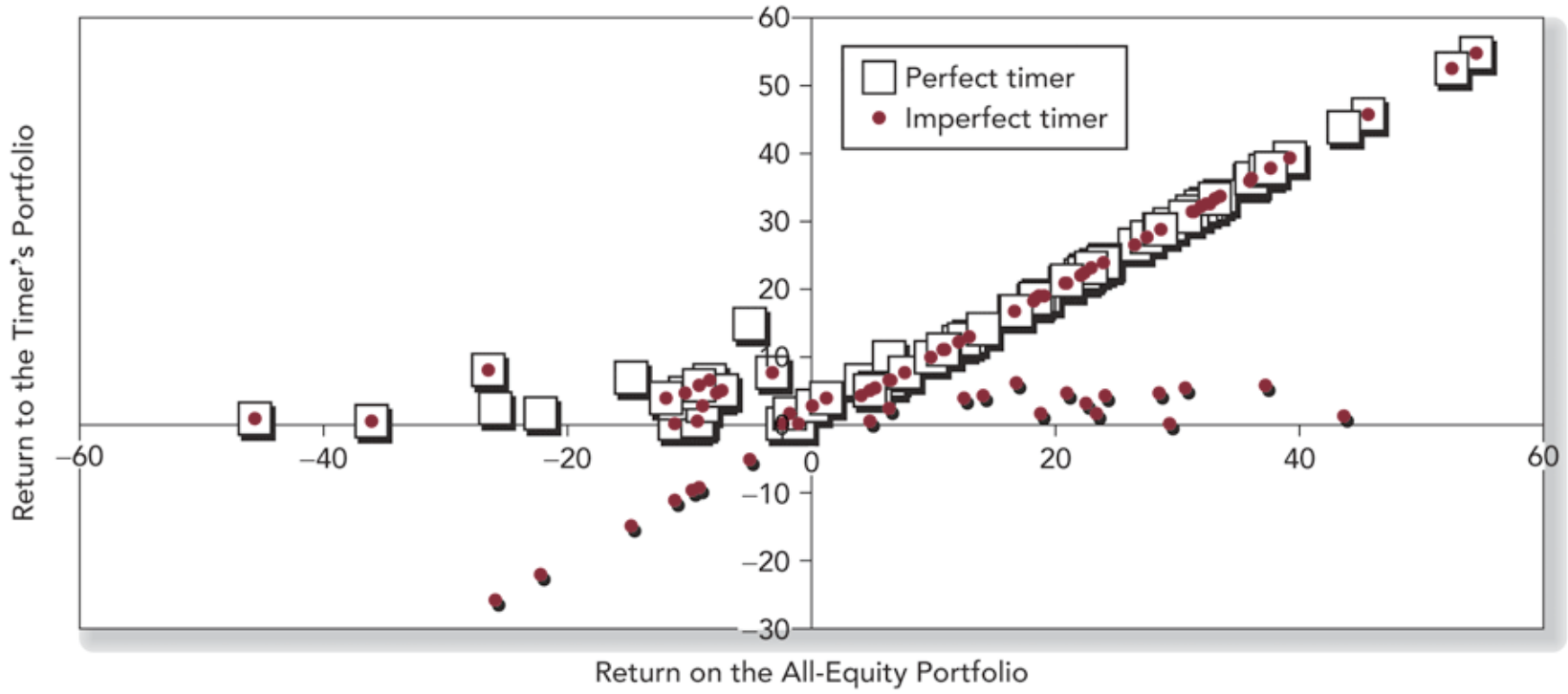

FIGURE 24.7 Scatter diagram of timer performance

Style Analysis

- Introduced by William Sharpe
- 1992 study of mutual fund performance
  - 91.5% of variation in return could be explained by the funds' allocations to bills, bonds and stocks
- Later studies show that 97% of the variation in return could be explained by the funds' allocation to a broader range of asset classes

Table 24.5 Style Analysis for Fidelity's Magellan Fund

TABLE 24.5

Style analysis for Fidelity's Magellan Fund

Style Portfolio	Regression Coefficient
T-Bill	0
Small Cap	0
Medium Cap	35
Large Cap	61
High P/E (growth)	5
Medium P/E	0
Low P/E (value)	0
Total	100
R-square	97.5

Source: Authors' calculations. Return data for Magellan obtained from **finance.yahoo.com/funds** and return data for style portfolios obtained from the Web page of Professor Kenneth French: **mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.**

Figure 24.8 Fidelity Magellan Fund Cumulative Return Difference: Fund versus Style Benchmark and Fund versus SML Benchmark

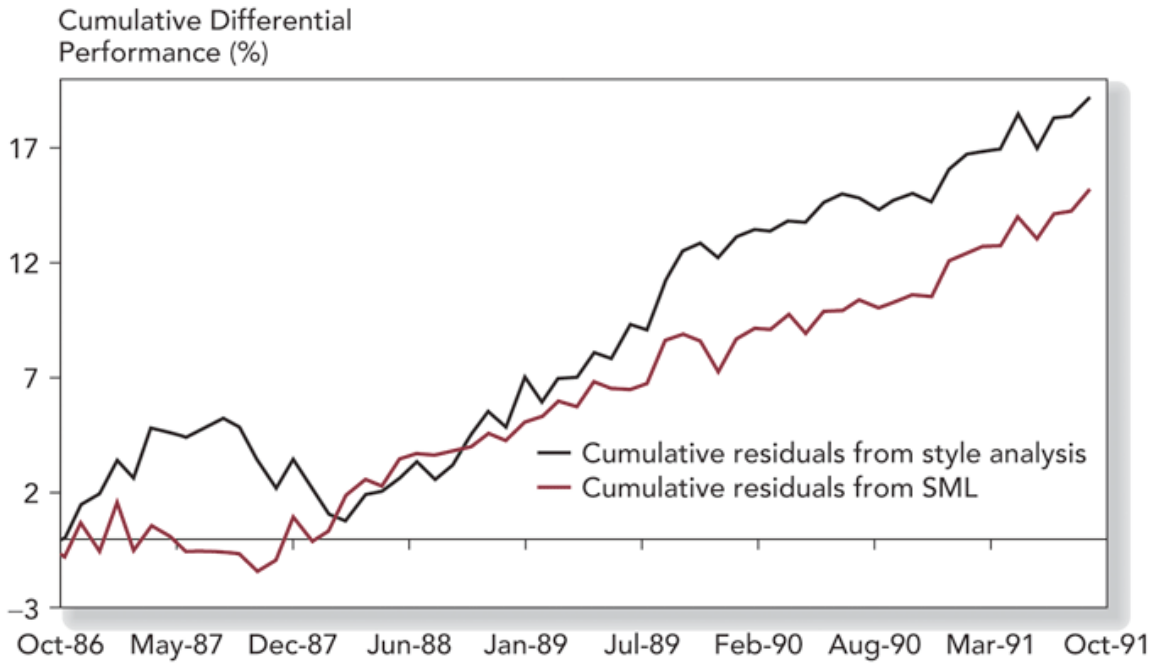

FIGURE 24.8 Fidelity Magellan Fund cumulative return difference: Fund versus style benchmark and fund versus SML benchmark

Source: Authors' calculations.

Figure 24.9 Average Tracking Error for 636 Mutual Funds, 1985-1989

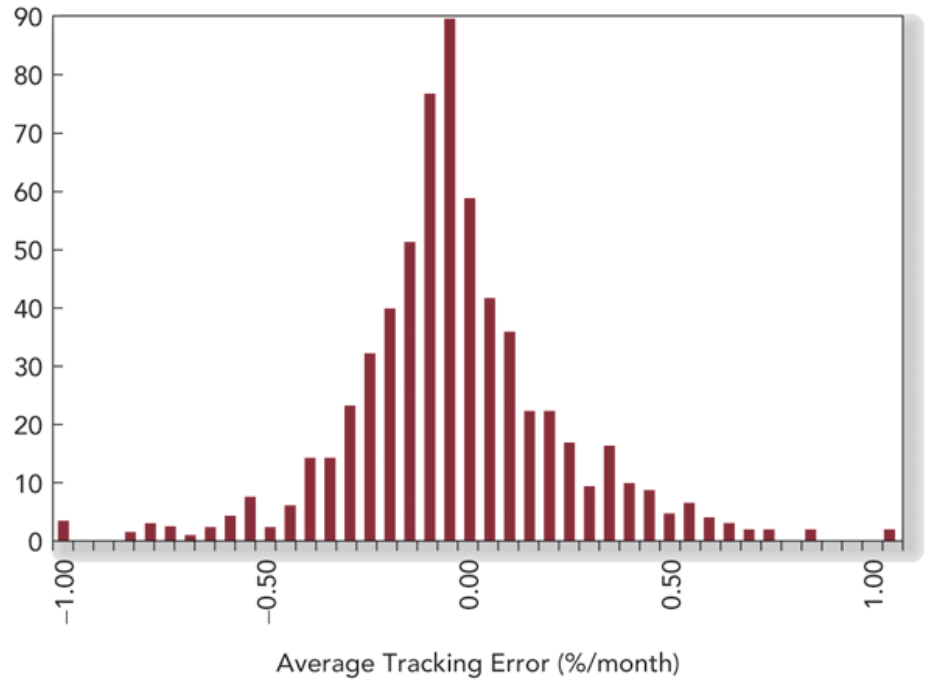

FIGURE 24.9 Average tracking error for 636 mutual funds, 1985–1989

Source: William F. Sharpe, "Asset Allocation: Management Style and Performance Evaluation," *Journal of Portfolio Management*, Winter 1992, pp. 7–19. Copyrighted material is reprinted with permission from Institutional Investor, 225 Park Avenue South, NewYork NY 10003.

Morningstar

- Morningstar computes fund returns as well as a risk measure based primarily on fund performance in its worst years
- The risk-adjusted performance is ranked across funds in a style group and stars are awarded

Evaluating Performance Evaluation

- Performance Evaluation has two problems
  - Many observations are needed for significant results
  - Shifting parameters when portfolios are actively managed makes accurate performance evaluation all the more elusive

Figure 24.10 Rankings Based on Morningstar's Category RARs and Excess Return Sharpe Ratios

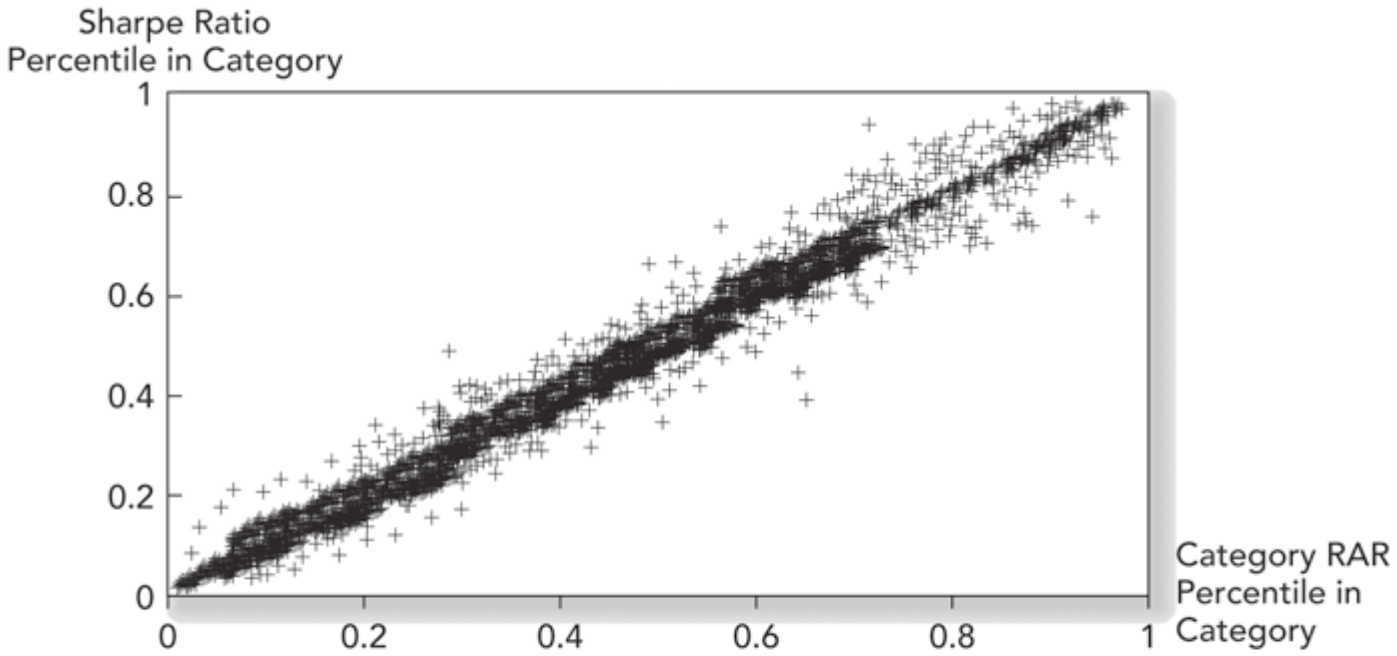

FIGURE 24.10 Rankings based on Morningstar's category RARs and excess return Sharpe ratios

Source: William F. Sharpe, "Morningstar Performance Measures," **www.wsharpe.com.** Used by permission of William F. Sharpe.

Performance Attribution

- Decomposing overall performance into components
- Components are related to specific elements of performance
- Example components
  - Broad Allocation
  - Industry
  - Security Choice
  - Up and Down Markets

Attributing Performance to Components

Set up a ‘Benchmark’ or ‘Bogey’ portfolio

- Use indexes for each component
- Use target weight structure

Attributing Performance to Components Continued

- Calculate the return on the 'Bogey' and on the managed portfolio
- Explain the difference in return based on component weights or selection
- Summarize the performance differences into appropriate categories

Formula for Attribution

$$r_B = \sum_{i=1}^{n} w_{Bi} r_{Bi} \;\&\; r_p = \sum_{i=1}^{n} w_{pi} r_{pi}$$

$$r_p - r_B = \sum_{i=1}^{n} w_{pi} r_{pi} - \sum_{i=1}^{n} w_{Bi} r_{Bi} =$$

$$\sum_{i=1}^{n} (w_{pi} r_{pi} - w_{Bi} r_{Bi})$$

Where B is the bogey portfolio and p is the managed portfolio

Figure 24.11 Performance Attribution of *i*th Asset Class

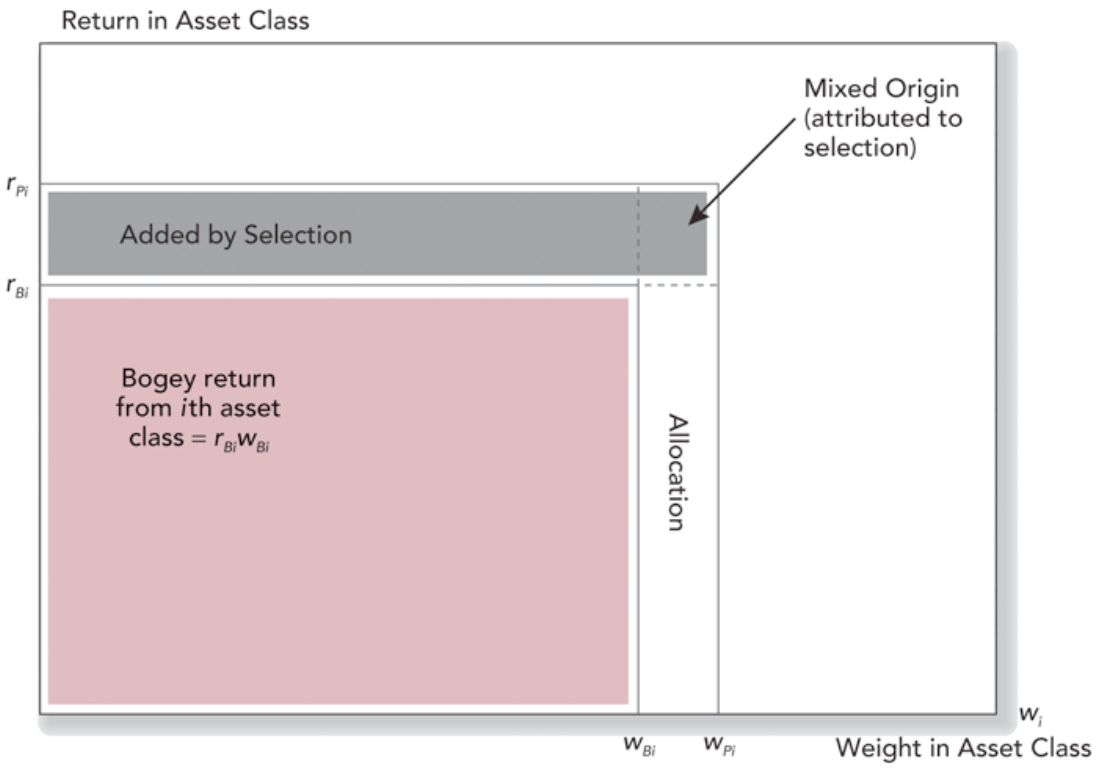

FIGURE 24.11 Performance attribution of *i*th asset class. Enclosed area indicates total rate of return.

Table 24.6 Performance of the Managed Portfolio

TABLE 24.6

Performance of the managed portfolio

Component	Bogey Performance and Excess Return: Benchmark Weight	Bogey Performance and Excess Return: Return of Index during Month (%)
Equity (S&P 500)	.60	5.81
Bonds (Lehman Brothers Index)	.30	1.45
Cash (money market)	.10	0.48
Bogey = (.60 × 5.81) + (.30 × 1.45) + (.10 × 0.48) = 3.97%		
Return of managed portfolio	5.34%	
– Return of bogey portfolio	3.97	
Excess return of managed portfolio	1.37%	

Table 24.7 Performance Attribution

TABLE 24.7

Performance attribution

A. Contribution of asset allocation to performance

Market	(1) Actual Weight in Market	(2) Benchmark Weight in Market	(3) Active or Excess Weight	(4) Market Return (%)	(5) = (3) × (4) Contribution to Performance (%)
Equity	.70	.60	.10	5.81	.5810
Fixed-income	.07	.30	−.23	1.45	−.3335
Cash	.23	.10	.13	.48	.0624
Contribution of asset allocation					.3099

B. Contribution of Selection to Total Performance

Market	(1) Portfolio Performance (%)	(2) Index Performance (%)	(3) Excess Performance (%)	(4) Portfolio Weight	(5) = (3) × (4) Contribution (%)
Equity	7.28	5.81	1.47	.70	1.03
Fixed-income	1.89	1.45	0.44	.07	0.03
Contribution of selection within markets					1.06

Table 24.8 Sector Selection within the Equity Market

Sector	(1) Beginning of Month Weights (%) Portfolio	(2) Beginning of Month Weights (%) S&P 500	(3) Active Weights (%)	(4) Sector Return (%)	(5) = (3) × (4) Sector Allocation Contribution
Basic materials	1.96	8.3	−6.34	6.9	−0.4375
Business services	7.84	4.1	3.74	7.0	0.2618
Capital goods	1.87	7.8	−5.93	4.1	−0.2431
Consumer cyclical	8.47	12.5	−4.03	8.8	0.3546
Consumer noncyclical	40.37	20.4	19.97	10.0	1.9970
Credit sensitive	24.01	21.8	2.21	5.0	0.1105
Energy	13.53	14.2	−0.67	2.6	−0.0174
Technology	1.95	10.9	−8.95	0.3	−0.0269
TOTAL					1.2898

TABLE 24.8

Sector selection within the equity market

Table 24.9 Portfolio Attribution: Summary

TABLE 24.9

Portfolio attribution: summary

			Contribution (basis points)
1. Asset allocation			31
2. Selection			
a. Equity excess return (basis points)			
i. Sector allocation	129		
ii. Security selection	18		
	147	× .70 (portfolio weight) =	102.9
b. Fixed-income excess return	44	× .07 (portfolio weight) =	3.1
Total excess return of portfolio			137.0