Can Managed Portfolio Performance Be Predicted?

Performance should be evaluated over complete stock market cycles.

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Financial periodicals and pension fund consultants devote considerable attention to measuring and ranking the investment performance of mutual fund and pension fund portfolio managers. Contrary to conventional wisdom, investors who select managers on the basis of a high current performance ranking can be lured into adverse timing by: 1) dropping managers who are about to recover from a depressed ranking, and 2) adding managers who are destined to fall from a top ranking — a practice called "hire high, fire low."

The folly of this practice is confirmed by many studies that observe that rankings of portfolio performance are quite unstable over time, and hence serve as poor predictors of future rankings. Examples are Barksdale and Green [1990], Bogle [1992], Donnelly [1992], Dunn and Theisen [1983], Grinblatt and Titman [1992, 1993], Kirby [1977], and Murphy [1980].

According to modern portfolio theory, portfolio returns are positively correlated with risk as measured by beta (systematic risk) and by sigma (standard deviation of return). Yet, portfolio performance ranked by the Treynor ratio and the Sharpe ratio frequently lacks consistency over time. For a critique of these CAPM risk-adjusted return measures, see Friend and Blume [1970], Roll [1977], and Shukla and Trzcinka [1991]. Fama and French [1992] and Chan and Lakonishok [1993] also ask whether these risk measures reasonably represent risk in accounting for the risk premium (the

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compensation for risk).

This study makes the case for evaluating portfolio performance over a complete stock market cycle and, on this basis, tests for the consistency of performance rankings over time.[1] A related purpose is to demonstrate that the measurement of portfolio performance over a market cycle is a practical alternative to the measurement of risk-adjusted portfolio returns (usually employing beta or sigma).

THE CASE FOR LONG-TERM MEASURES

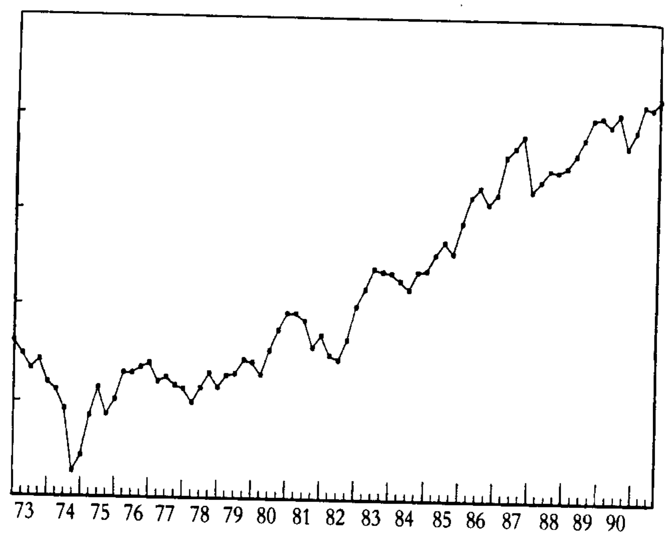
Investors in common stocks tend to be long-term investors because stocks as a class are expected to experience higher returns than fixed-income securities over long-term periods as revealed in numerous studies such as *Stocks, Bonds, Bills, and Inflation* [1994]. Yet because stocks as a class experience more variable returns over short time intervals, investors favor money market and other fixed-income assets if they seek more stable returns over time.

This means that equity investors with long-term planning horizons are more interested in achieving long-term return objectives and are less concerned with short-term volatility.[2] Indeed, such investors may advantageously exploit short-term fluctuations by employing some form of time diversification such as dollar-averaging stock market purchases and liquidations over a period of years.

The investment objectives of many, if not most, common stock portfolios of mutual funds and pension funds focus on long-term time horizons. Long-term objectives are compatible with the widely used investment decision-making process that focuses on fundamental research analysis and the intrinsic value approach, whose purpose is to achieve growth in intrinsic value and dividend income, and appreciation in undervalued stocks over the long term. Fundamental analysis places less emphasis on forecasting short-term market fluctuations than on projecting long-term trends in such factors as corporate earnings and stock values.

If portfolio performance is to be evaluated fairly, the criteria used should be consistent with the portfolio objectives chosen and with the investment decision-making process followed. This implies that the performance evaluation period should encompass what is considered to be the portfolio planning horizon period. If the planning horizon focuses on the secular trend

EXHIBIT 1
STANDARD & POOR'S 500 STOCK INDEX



of the economy and the market, rather than the overreactions of investors as reflected in bull and bear markets, an argument can be made to evaluate performance over a period representing a complete stock market cycle. And, if portfolio managers are managing their portfolios in a consistent fashion over time, it might be expected that their performance rankings would be more consistent from one full market cycle to the next.

DATA BASE

To test our hypotheses, we use a data base furnished by Callan Associates, Inc., which consists of quarterly rates of return for portfolios representing a large sample of investment management organizations, covering the period from December 1972 through September 1991. Stock market cycles are defined by the quarterly closing prices of the Standard & Poor's 500 Stock Index, a yardstick widely used for portfolio performance comparison purposes. We choose market peaks to divide market cycles from one another. From Exhibit 1, we selected the market peaks in Exhibit 2 to define the time periods for study.

All the portfolios in the Callan data base that meet the criteria described below are included in the study sample. The sample represents only diversified U.S. equity portfolios with five basic investment policies or styles: growth-oriented, value-oriented, income/yield-oriented, core (e.g., index fund tilt), and general policy (multistyle).

EXHIBIT 2
Dividing Peaks

Time Period	Date	Index Peak	Interval Between Peaks
	December 1972	118.05	
1			16 Quarters
	December 1976	107.46	
2			17 Quarters
	March 1981	136.00	
3			9 Quarters
	June 1983	168.11	
4			17 Quarters
	September 1987	321.83	
5			16 Quarters
	September 1991	387.86	

The data base is maintained on a double entry basis, and numbers are regularly reviewed for accuracy and reasonableness. Because investment managers release information only voluntarily, portfolio performance data banks are, inevitably, subject to some measure of ex post (survivor) bias. Once quarterly returns for a portfolio are entered, however, they remain in the Callan data base whether or not returns for subsequent quarters are submitted by a manager. The returns are annualized for each tax-exempt portfolio and measure the total quarterly rates of return on the entire portfolio before the deduction of management fees and expenses. The returns for each mutual fund portfolio are measured on the same basis except on a net or after-expense basis.

RANKINGS BY TOTAL RETURN

As shown in Exhibit 3, over the eighteen and three-quarter years studied, the sample of eligible portfolios increased from 128 in 1972 to 608 by 1983, reflecting the growth in the investment management industry. Even though portfolios were added to and withdrawn from the data base from time to time, each eligible portfolio needed to have quarterly rates of return over two consecutive market cycles in order to be tested for consistency of performance.

Over the total period studied, 28% of the portfolios were mutual funds; the balance represented tax-exempt pension funds. 54% of the total sample of portfolios were managed by investment advisory organizations, 13% were bank pooled equity funds, and 4% were insurance company equity accounts.

The portfolios were first assigned to quartiles according to relative rate of return in each time period designated as t. The returns for the portfolios were then measured in the *subsequent* time period, designated t + 1. As shown in Exhibit 3, the average annualized returns in time period 2 are for the 128 portfolios assigned to the indicated quartiles in the *previous* time period 1. The first quartile portfolios with a mean return of 20.9% in time period 2, for example, represent one-fourth of the portfolios that were in the highest-return quartile in time period 1; the fourth quartile return of 19.6% represents one-fourth of the portfolios that were in the lowest-return quartile in time period 1.

We repeat the whole process for time period 2. Then 437 portfolios were assigned to quartiles according to returns; the average annualized quartile returns in the subsequent time period are then shown for these portfolios in the same quartiles in time period 3. The same process is repeated in periods 3 and 4, and in periods 4 and 5.

If return rankings are positively correlated over time, the returns of the portfolios in the first quartile in time period t should have the highest returns in t + 1, while the returns of portfolios in the fourth quartile of time period t should have the lowest returns in time period t + 1. Note in Exhibit 3 that the relative performance for portfolios between the first quartile and the other quartiles is consistent for the total period studied, according to the returns in columns (6) and (7), and for a clear majority of the individual quartile cells.[3]

Investors who selected the portfolio managers in the first quartile in the previous time period would have experienced the highest return in each market cycle, an average return of 18.1% over the four market cycles, as shown in column (7), while those who selected the managers in the fourth quartile would have had an average return of only 15.8%, or 230 basis points lower per year. In addition, the average return for the managers in the first quartile exceeded the average return for the total sample in all four market cycles; and the managers in the fourth quartile underperformed the total sample over the whole period studied.

The chi-squared test of independence examines whether the portfolio quartile rankings in one market cycle are independent of their quartile rankings in the next market cycle. Accordingly, the chi-squared values in Exhibit 3 statistically support a relationship between

EXHIBIT 3

Performance in the Subsequent Time Period Based on the Quartile Rankings of Portfolio Returns in the Previous Time Period

Previous Quartile Ranking (1)		Subsequent Time Period (t + 1): 2 (2)	3 (3)	4 (4)	5 (5)	Average: 3, 4, 5 (6)	2, 3, 4, 5 (7)
	Number of Portfolios	128	437	608	514		
Total Sample	Return	18.6%	19.7%	18.7%	8.8%	15.7%	16.4%
	Sigma	15.2	19.3	15.8	18.9	18.0	17.3
	Beta	1.07	0.97	0.97	0.97	0.97	1.00
1st	Return	20.9%	23.5%	19.0%	9.1%	17.2%	18.1%
	Sigma	15.3	21.9	16.9	19.0	19.3	18.3
	Beta	1.03	1.07	1.01	0.97	1.02	1.02
2nd	Return	15.9%	20.0%	18.9%	8.8%	15.9%	15.9%
	Sigma	13.8	19.5	15.4	18.2	17.7	16.7
	Beta	0.99	0.98	0.95	0.94	0.96	0.96
3rd	Return	18.0%	18.2%	19.0%	8.7%	15.3%	16.0%
	Sigma	15.6	18.3	15.4	18.5	17.4	17.0
	Beta	1.12	0.93	0.96	0.95	0.95	0.99
4th	Return	19.6%	17.0%	17.9%	8.4%	14.4%	15.8%
	Sigma	16.2	17.5	15.2	19.9	17.5	17.2
	Beta	1.16	0.88	0.94	1.01	0.94	1.00
Return Spread between Quartiles 1 and 4		1.3%	6.5%	1.1%	0.7%	2.8%	2.3%
Chi-Squared Value		8.87	79.31***	13.77	14.95*		
Spearman Rank Correlation Coefficient		−0.02	0.37***	0.07*	0.12***		

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

periods 2 and 3 and between periods 4 and 5.

The Spearman rank correlation coefficients measure whether the individual portfolio return rankings in one market cycle have a relationship to their return rankings in the next cycle. Three out of the four time periods reveal a statistically significant positive relationship.

Exhibit 3 also shows the sigmas (the average standard deviations of quarterly returns) and the betas for the portfolios in each quartile. Although the portfolios in the first quartile tend to have modestly higher sigmas and betas, the returns are disproportionately higher. In addition, these risk measures tend to cluster together among quartiles 2, 3, and 4, appearing to provide no meaningful pattern of discrimination for performance rankings. These results suggest that the portfolio managers in the sample own stocks in similar risk classes or that their portfolios are diversified across risk classes.

RANKINGS BY RISK-ADJUSTED RETURNS

Using the procedures described, and applying modern portfolio theory, portfolios are ranked on a risk-adjusted basis in each market cycle using the Treynor ratio and the Sharpe ratio equations:

$$\text{Treynor Ratio} \quad TR = \frac{R_p - R_f}{\beta_p} \tag{1}$$

$$\text{Sharpe Ratio} \quad SR = \frac{R_p - R_f}{S_p} \tag{2}$$

where

R_p = mean quarterly portfolio return, annualized

R_f = mean quarterly Treasury bill rate, annualized

β_p = portfolio beta in time period t, based on the Standard & Poor's 500 Stock Index quarterly return

S_p = portfolio sigma, i.e., standard deviation of quarterly portfolio returns in time period t, annualized

In Exhibit 4, one-fourth of the portfolios with the highest Treynor ratios in time period t are assigned to the first quartile, with the fourth quartile made up of one-fourth of the portfolios with the lowest ratios, and so on. Following the same procedures used to construct Exhibit 3, the portfolio returns and the Treynor ratios computed in the subsequent market cycle, t + 1, are shown.

EXHIBIT 4
Performance in the Subsequent Time Period Based on the Quartile Rankings of the Treynor Ratios (TR) in the Previous Time Period

Previous Quartile Ranking (1)		Subsequent Time Period (t + 1) 2 (2)	3 (3)	4 (4)	5 (5)	Average 2, 3, 4, 5 (6)
	Number	128	437	607	514	
1st	Number	32	114	161	127	
	Return	21.0%	23.3%	19.5%	8.8%	18.2%
	TR	10.0	11.6	22.1	1.6	11.3
2nd	Number	32	111	157	134	
	Return	18.3%	20.1%	19.0%	9.0%	16.6%
	TR	7.9	8.4	12.2	1.7	7.6
3rd	Number	32	108	154	124	
	Return	16.4%	18.1%	18.7%	8.6%	15.4%
	TR	5.7	6.2	11.4	1.6	6.2
4th	Number	32	104	135	129	
	Return	18.6%	17.0%	17.7%	8.6%	15.5%
	TR	7.5	5.9	10.5	1.3	6.3
Return Spread between Q1 and Q4		2.4%	6.3%	1.8%	0.2%	2.7%
Chi-Squared Value		13.16	64.77***	27.17***	9.61	
Spearman Rank Correlation Coefficient		0.11	0.32***	0.20***	0.07	

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

For example, the portfolios ranked by the highest Treynor ratio in the first quartile in period 1 experience an average return of 21.0% and a Treynor ratio of 10.0 in period 2. The portfolios with the lowest ratios in the fourth quartile of time period 1 have an average return of only 18.6% and an average Treynor ratio of only 7.5 in period 2. This same procedure is used to form new quartile groups in time periods 3, 4, and 5.

In the vast majority of cells in the table, the returns and the ratios are consistent from one market cycle to the next.[4] Investors who chose managers assigned to the first quartile experienced a return over the four market cycles of 18.2%, as shown in column (6), while those who selected the managers in the fourth quartile earned only 15.5%, or 270 basis points less per year.

The chi-squared values and the Spearman rank correlation coefficients of the Treynor ratios are highly significant between time periods 2 and 3, and between periods 3 and 4. The Treynor ratios in time period 4 appear less effective in projecting performance, inasmuch as quartile returns tended to cluster closer together in time period 5.

Portfolios were also ranked on the basis of the Sharpe ratio. The statistical results are not presented because the portfolio rankings are quite similar to those produced by the Treynor ratio. This suggests that the sample portfolios are generally well-diversified with only modest levels of residual (non-systematic) risk. This also suggests that both beta and sigma are comparable measures of risk for this sample when beta is computed with reference to the S&P 500 Index as the benchmark portfolio.[5]

RISK MEASURES AS PREDICTORS OF RETURNS

In comparing the results of Exhibits 3 and 4, both methods seem to predict portfolio rankings about as well. Consequently, how important is it to risk-adjust portfolio returns for purposes of ranking performance, particularly for long-term investors? To answer this question, we examine more closely the relationship of portfolio returns to sigma and beta.

First, we analyze how portfolio returns in time period t are related to sigma and beta in period t using the regression equations:

$$R_{pt} = \gamma_1 + \gamma_2 \sigma_{pt} \tag{3}$$

$$R_{pt} = \gamma_1 + \gamma_2 \beta_{pt} \tag{4}$$

where

R_{pt} = mean return for portfolio p in time period t
γ_i = regression coefficients
σ_{pt} = sigma for portfolio p in time period t
β_{pt} = beta for portfolio p in time period t

In only three (two) out of five time periods, sigma (beta) is significantly and positively related to portfolio returns in the same time period, as shown in Exhibit 5. In two other periods, both sigma and beta risk measures are significant although negatively related to returns, so the portfolio security market lines and the capital market lines are negatively sloped.

This result is less surprising in time period 1 when the market return is quite low (1.6%) and the excess market return is negative (–5.2%); but it is less expected in time period 4 when market returns are high. Therefore, sigma (beta) provides statistically significant positive risk/return measures in only three (two) out of five stock market cycles.

Next, we analyze how well unadjusted past returns in combination with a risk measure predict portfolio returns. For this test, the portfolios in each return quartile, as previously shown in Exhibit 3, are subdivided into four subgroups on the basis of their portfolio sigma in period t. In Exhibit 6, subgroup mean returns are shown for period t + 1 in each of the four time periods. Subgroup S4 in each quartile is one-fourth of the portfolios in that return quartile that had

EXHIBIT 5
Regression Coefficients of Portfolio Returns Regressed Separately on Sigma and Beta

In Time Period t	σ_{pt}	β_{pt}
1	–0.26***	–7.91***
2	1.42***	14.08***
3	0.37***	5.07***
4	–0.20***	–2.90***
5	0.08**	0.42

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

EXHIBIT 6
Return in the Subsequent Time Period t + 1 Based on Quartile Rankings of Portfolio Returns and Subgroup Sigma Rankings in the Previous Time Period t

Quartile Return Ranking in t (1)	Subgroup Sigma Ranking in t (2)	Portfolio Returns in Subsequent Time Period (t + 1) 2 (3)	3 (4)	4 (5)	5 (6)	Average 3, 4, 5 (7)
1st	S4	36.0	27.6	17.0	9.6	18.1
	S3	17.0	24.3	19.3	9.3	17.6
	S2	15.6	20.3	19.8	8.6	16.2
	S1	15.0	21.8	19.9	8.9	16.9
2nd	S4	23.6	19.3	16.2	8.7	14.7
	S3	15.4	19.0	19.0	8.8	15.6
	S2	12.4	21.3	19.7	8.6	16.5
	S1	12.1	20.4	20.8	9.2	16.8
3rd	S4	24.8	18.0	16.3	10.2	14.8
	S3	16.6	18.5	19.6	8.2	15.4
	S2	14.0	17.9	19.4	8.5	15.3
	S1	16.4	18.6	20.3	7.8	15.6
4th	S4	25.5	16.2	17.0	7.6	13.6
	S3	18.4	16.7	18.3	8.7	14.6
	S2	18.3	18.3	18.6	8.4	15.1
	S1	15.2	17.2	18.7	9.0	15.0
Average Number of Portfolios in Each Subgroup		8	26-29	35-40	30-38	

S4 Highest sigma.
S3 Second-highest sigma.
S2 Second-lowest sigma.
S1 Lowest sigma.

the highest sigmas, while subgroup S1 consists of one-fourth of the portfolios that had the lowest sigmas.

While the relationship between return and sigma appears to be strongly positive in time period 2, the relationship is negative or irregular about two-thirds of the time in the other time periods and quartiles. The returns in time periods 3, 4, and 5 are averaged in column (7); subgroups in time period 2 are dropped because of smallness of the sample size. With the exception of the first quartile, the average sigmas in all of the other twelve subgroups are negatively related to portfolio returns.[6]

When subgroups are formed on the basis of beta instead of sigma, the results are identical. Consequently, ranking portfolios on the basis of beta, sigma, or a risk-adjusted return (Sharpe ratio or Treynor ratio) seems to provide little or no additional predictive information beyond that provided by the ranking of unadjusted returns in the preceding stock market cycle.

Finally, we analyze how well portfolio returns in one market cycle are predicted by portfolio returns, sigma, and beta in the previous market cycle, using the regression model:

$$R_{pt+1} = \gamma_1 + \gamma_2 R_{pt} + \gamma_3 \sigma_{pt} \text{ (or } \gamma_3 \beta_{pt}) \quad (5)$$

where

R_{pt+1} = mean unadjusted return for portfolio p in time period t + 1
γ_i = regression coefficients
R_{pt} = mean unadjusted return for portfolio p in time period t
σ_{pt} = sigma for portfolio p in time period t

β_{pt} = beta for portfolio p in time period t

As shown in column (5) of Exhibit 7, portfolio returns in period t are positively and significantly related to returns in period t + 1 in three out of four market cycles. When return is combined with either beta in column (6) or sigma in column (7), the return is always quite significant.

Beta and sigma in period t are positively significant with portfolio returns in period t + 1 in only two market cycles. In one period, time period 4, the relationship is negative; this implies that investors who selected stocks with high betas and sigmas, as reported in time period 3, were rewarded with *lower* returns. Portfolio returns in period 4 are also negatively related to portfolio betas and sigmas in the same time period as previously confirmed by Exhibit 5. These negative relationships prevailed despite the fact that this market cycle began at an S&P Index peak of 168.11 and ended at a peak of 321.83, a secular increase of 91%.

The results in Exhibit 7 suggest that portfolio returns measured over a full market cycle serve as a more reliable indicator of future returns than either portfolio betas or sigmas. Moreover, the results reveal that predictions of portfolio returns are positively related to previous period returns. The best prediction of returns in all four market cycles comes from a multiple regression model that uses prior portfolio returns and prior sigma. This model has the highest coefficient of determination and a significant coefficient (at the 0.01 level) for prior portfolio returns.

CONCLUSIONS

Our predictions of performance rankings and returns of portfolios are very rewarding when the measurement period encompasses full stock market cycles. This finding differs from those of other studies. The

EXHIBIT 7
Test of a Regression Portfolio Performance Model

R_p in Time Period t + 1 (1)	F-Statistic (2)	Adjusted R^2 (3)	Regression Coefficients γ_1 (4)	γ_2 (R_{pt}) (5)	γ_3 (β_{pt}) (6)	γ_4 (σ_{pt}) (7)	n (8)
2	0.39	0.00	18.52***	0.07			127
	31.64***	0.19	2.86		15.67***		127
	78.74***	0.38	−2.21			0.79***	127
	19.55***	0.23	0.55	0.26**	17.72***		127
	48.28***	0.43	−4.55*	0.30***		0.87***	127
3	67.34***	0.13	13.81***	0.37***			436
	14.97***	0.03	14.88***		5.04***		436
	44.22***	0.09	10.97***			0.64***	436
	33.61***	0.13	13.98***	0.37***	−0.26		436
	35.11***	0.14	12.05***	0.30***		0.21	436
4	3.36*	0.00	17.83***	0.04*			607
	51.56***	0.08	23.10***		−4.62***		607
	57.28***	0.08	23.21***			−0.24***	607
	31.00***	0.09	21.90***	0.07***	−4.95***		607
	37.16***	0.11	21.87***	0.09***		−0.27***	607
5	12.82***	0.02	6.51***	0.12***			513
	0.06	0.00	8.60***		0.16		513
	0.33	0.00	8.40***			0.02	513
	7.19***	0.02	5.53***	0.13***	0.78		513
	7.77***	0.03	5.16***	0.13***		0.07	513

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

correlations of portfolio performance rankings from one market cycle to the next are generally positive and meaningful. The portfolios in the first quartile outperform, on average, the portfolios in the other three quartile groups over the total period, and outperform the fourth quartile group in each of the four market cycles.

Because of dispersions of portfolio returns within a quartile group, the chance of experiencing the quartile mean return is obviously enhanced if an investor uses more than one portfolio manager in the group. This is easily accomplished by investors who use multiple managers.

Measuring and ranking the returns of portfolios over stock market cycles is very useful in predicting rankings and returns over the next market cycle; this is generally more useful than employing portfolio betas and sigmas for prediction purposes. Predictions of portfolio returns are highly significant in all the market cycles when past returns are used in conjunction with portfolio sigmas, however.

This is not to imply that predictions of portfolio returns and rankings should be made solely on the basis of the variables used in this study. These objectively derived variables should, of course, be used in conjunction with other factors that are known to influence portfolio performance (such as consistency of investment style and continuity of management personnel). The variables we use may serve as the initial filters in predicting portfolio performance.

ENDNOTES

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[1]Hendricks, Patel, and Zeckhauser [1993] analyze the short-term performance of no-load, growth-oriented mutual funds and find evidence of consistency of performance.

[2]Holton [1992] demonstrates that an investor's planning horizon should determine how risk is defined and measured. The volatility of annualized stock market returns diminishes as the investment horizon increases because of serial correlation over longer-term time horizons. This suggests that portfolio performance should be evaluated within the context of the planning horizon rather than over short intervals.

[3]The only real exception is in time period 2. The highest returns in time period 2 were in the first and fourth quartiles, and the lowest return was in the second quartile. Why are these relationships so weak in time period 2? Some characteristics of the portfolio rankings assigned in time period 1 may have destabilized the performance rankings. The secular trend in time period 1 was relatively flat; the return for the S&P Index was only 1.6%; and the return for the universe of portfolios only 1.0%. The market was also very volatile in that the universe of portfolios had a sigma of 26.2. Because of the very different market environments in time periods 1 and 2, the relative rankings appeared less predictable in the following market cycle.

[4]As noted in endnote 3, a meaningful exception to these positive relationships is again found in period 2. The performance of portfolios in quartiles 2, 3, and 4 in time period 2 is out of alignment with their performance in time period 1. A lack of consistency of performance may be due to the fact that the market environment in period 1 was quite different from that in period 2. The return on the S&P Index was only 1.6%, and the Treasury bill rate was 6.8%, resulting in a negative excess return of 5.2% and a negatively sloped security market line.

[5]Callan Associates found that portfolio rankings generally remained the same when the Treynor ratio employed a beta derived from broader value-weighted indexes, such as the Wilshire 5000 or the Russell 3000, possibly because the correlations between these index returns usually exceeded 0.93.

[6]This suggests that there is no consistent relationship between quarterly standard deviations of returns and portfolio returns when returns are measured over a full market cycle. Consequently, sigma may be of limited value in measuring portfolio risk when the planning horizon is long term.

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