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REDUCING THE SHORT TERM VARIABILITY OF SMALL PORTFOLIO BETAS

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Abstract

Management of portfolio risk is difficult if beta is nonstationary, due to an inability to predict the level of beta in subsequent periods. Since large, well diversified portfolios have stationary betas, this study focuses on the variability of small portfolio betas. Common stocks are combined into small portfolios based on their individual beta variability. The variability of the resultant portfolio betas is then compared to randomly generated portfolios. Results indicate it is possible to significantly reduce the variability of the portfolio beta by systematically combining stocks according to their individual beta variability.

INTRODUCTION

Beta is commonly used as a measure of portfolio risk. However, management of portfolio risk becomes very difficult if beta is nonstationary, since it indicates an inability to predict the level of beta in subsequent periods. Chen and Martin [4] and Tole [15] show as the size of the portfolio is increased, the portfolio beta becomes more stationary. Since large, well diversified portfolios have stationary betas, this study focuses on reducing beta nonstationarity for small portfolios.

Using traditional methodology, a portfolio beta is stationary if it remains at the same level in two successive long term periods. However, as Tole [15] states,

> "The value of beta in future time periods must not fluctuate in the short run beyond some limit acceptable to investors. If beta fluctuated too much, the investor's portfolio may temporarily fall outside an acceptable risk class."

Short term beta variability, therefore, adds an element of uncertainty to daily management of portfolio risk. To illustrate, assume two portfolios each with a beta of 1.10 estimated using monthly data over a five year period. If over the successive five year period their betas are again estimated at 1.10, traditional studies would classify both as having stationary betas. Assume further that, using short term measures, the beta of the first portfolio remained constant at 1.10 while the other beta fluctuated between 0.75 and 1.35. The second portfolio exhibited far greater short term beta variability. Therefore, short term variability is a portfolio beta characteristic not directly captured by traditional stationarity measures.

In this study the short term variability of individual stock betas is measured using beta standard deviation. Based upon their individual variability, stocks are combined into small portfolios ranging in size from 5 to 35 securities and the variability of the portfolio betas is measured. Results indicate it is possible to significantly reduce the variability of the portfolio beta by systematically combining stocks according to their beta standard deviation.

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LITERATURE REVIEW

Many studies examine the problem of beta nonstationarity and indicate the serious potential for nonstationarity in betas of small and/or specialized portfolios. Rosenberg [14] states the use of long term beta estimates does not measure current portfolio risk. According to Rosenberg, the value of the estimated beta over any 60-month period is actually the average of the changing beta for that period and not the true, fixed beta.

Tole [15] uses random generation to form portfolios ranging in size from 1 to 500 stocks. As a measure of stationarity Tole uses the percentage change in the standard deviation of portfolio beta over adjacent five year time periods. He computed standard deviation using twenty three-month betas in each period. He concludes at least 250 securities are required to achieve an acceptable level of stationarity in the short term variability of portfolio betas.

Forming portfolios by the level of beta, Hawawini, Michel and Corhay [6], Blume [1] and Levy [9] examine beta stationarity by focusing on the difference in the value of beta in two successive time periods. Using rank order correlation, they also find stationarity increases with portfolio size.

Others, including King [7], Campanella [2], Livingston [10], Farrell [5], Klemkosky and Martin [8], Martin and Keown [11], and Chen and Martin [4] demonstrate beta nonstationarity is related across groups of firms. Shared industry and economic factors can make the returns of these firms covary with each other as well as with the overall market. The implication is betas of portfolios specializing in certain industries will not be stable.

METHODOLOGY

A random sample of 500 common stocks was collected from the Center for Research in Security Price (CRSP) NYSE/ASE daily returns tape. To be included in the sample the stock could not have any missing observations during the study period.

Using the overlapping methodology of Officer [13] and Merton [12] for computing standard deviation, a series of thirty betas was generated for each stock in the sample. Using the first thirty trading days of 1980, the initial beta value was computed by regressing daily returns against the CRSP Equal Weighted Index. The second beta in the series was computed by adding the next 10 trading days while simultaneously deleting the earliest 10 days. The process continued until a series of 30 betas was generated for each of the 500 stocks.

For measuring individual stock beta variability, the standard deviation of each thirty beta sequence was computed. However, as an absolute measure of variability, standard deviation can be interpreted differently for different levels of beta. Therefore, the standardized beta standard deviation, or coefficient of variation, was computed for each stock by dividing the beta standard deviation by the mean beta.

Formation Of Portfolios

All 500 stocks were ranked by ascending standardized beta standard deviation, CV. The five stocks with the lowest beta CV were placed in portfolio 1. The next 5 were placed in portfolio two, and the process continued until the five highest beta CV stocks formed portfolio 100. Portfolio sizes of 10, 15, 20, 25, 30, and 35 stocks each were also assembled using the same ranking methodology.

To separate the base and test periods, the test period began 30 trading days after the end of the base period. The overlapping procedure described above was used to generate 30 betas, this time, for each formed portfolio. Thus, the base period was used to estimate the variability of the individual stock betas and to form portfolios. The test period was used to measure the variability of the portfolio betas.

Random portfolios were used as a control group to determine if forming portfolios using individual stock beta variability significantly affects the variability of the portfolio beta. From the sample of 500, stocks were randomly selected to form portfolios in each size category of 5 to 35 stocks. An overlapping series of thirty betas was calculated for each random portfolio over the test period. Using the series the standard deviation of each portfolio beta was calculated. For each size category, the standard deviations of the thirty random portfolios were averaged providing an unbiased estimate of beta variability for randomly generated portfolios of the given size.

Tests Of Beta Variability

A Runs test was performed to determine the relationship between the variability of individual stock betas and the variability of the resulting portfolio beta. In the base period, stocks were formed into portfolios according to standardized beta standard deviation, CV. For each formed portfolio of size n, where n = 5, 10, 15, 20, 25, 30, 35, the portfolio containing stocks with the lowest CVs was given a ranking of one. The portfolio with the next lowest CV stocks was ranked two, and so on, until all the portfolios in each size category were ranked.

Over the test period, the standard deviation of each portfolio beta is compared to the average of the beta standard deviations for the thirty random portfolios of the same size. For example, the 100 formed portfolios containing five stocks each are now ranked 1 to 100. If the beta standard deviation of the formed portfolio is higher than that for the average random portfolio containing five stocks, it is labeled "H". If lower, it is labeled "L". The pattern of H's and L's over the ranking of the 100 five stock portfolios is then tested for randomness. If a relationship exists between individual stock and portfolio beta variability, there will be statistically significant runs of H's and/or L's. The procedure is applied to all the portfolio size categories.

A second test uses Spearman correlations to determine the nature and strength of the relationship between individual stock and portfolio beta variability. The portfolios in each size category are again ranked, this time by portfolio beta standard deviation over the test period. The portfolio with the lowest beta standard deviation is ranked one, the second lowest is ranked two, etc. A significant positive correlation between this test period ranking and the base period ranking by individual stock beta CV would indicate a direct relationship.

To insure the test results are robust, all procedures are repeated starting with the first trading day of 1988 using a second randomly generated sample of 500 stocks. This date represents the latest combined base and test periods for which data are available on the 1990 CRSP NYSE/ASE daily returns tape.

RESULTS

Summaries of the data and test results are presented in Tables 1 and 2 for the 1980 and 1988 time periods. Since the total number of stocks remains constant at 500, the number of formed portfolios varies from 100 to 14 depending on portfolio size. Each of the 7 portfolio size categories is summarized by dividing them into quartiles. Portfolios that contain stocks with the lowest beta CVs comprise the first quartile. It progresses so the last quartile is portfolios that contain stocks with betas having the highest CVs.

TABLE 1

Portfolios With Lower Beta Variability Than Randomly Generated Portfolios Of The Same Size
Test Period - 1980 Tests (Z Values In Parentheses)

	Portfolio Size[1]						
Quartile	**5**	**10**	**15**	**20**	**25**	**30**	**35**
1	25/25	13/13	7/8	4/6	3/5	3/4	3/4
2	24/25	11/12	5/8	4/6	1/5	2/4	2/3
3	21/25	8/12	2/8	2/6	0/5	1/4	0/3
4	11/25	4/13	0/9	0/7	0/5	0/4	0/4
Runs Test	(2.33) ***	(2.33) ***	(2.47) ***	(1.88) *	(0.55)	(0.13)	(1.87) *
Spearman Rank	p = 0.66 (6.49) ***	0.77 (5.33) ***	0.72 (4.07) ***	0.75 (3.61) ***	0.43 (1.83) *	0.54 (2.10) **	0.64 (2.31) ***

1 The first number is the number of portfolios in the quartile with lower variability. The second is the total portfolios in the quartile.
* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

Several interesting observations can be made about the results of the 1980 tests (Table 1). For the portfolios comprised of 5 stocks each, all 25 in the first quartile achieved lower beta variability than the average of 30 randomly formed 5 stock portfolios. The same unanimous result occurred when the portfolio size increased to 10 stocks. Looking across all first quartiles in Table 1, there are a total of 65 portfolios of varying size. Of all first quartile portfolios, 89% had lower beta variability than the average of 30 randomly formed portfolios of the same size.

The above result indicates combining low beta variability stocks produces low beta variability portfolios. If a direct relationships exists, combining stocks with high beta variability will increase portfolio beta variability. This appears to happen, and in a logical pattern from the first to fourth quartiles. Across the fourth quartiles, 77% of the portfolios had higher beta variability than the average random portfolio. In fact, for portfolios of 15 or more stocks, 100% had higher beta variability.

These observations indicate a positive relationship between the variability of individual stock betas and the variability of resulting portfolios. To determine the statistical significance of the relationship, two different nonparametric tests are conducted. The results of the Runs test show, especially for portfolios of 5 to 20 stocks, a significant departure from randomness in the pattern of portfolio beta variability. The statistically significant relationship indicates variability of portfolio betas is a positive function of the variability of the betas of individual stocks in the portfolio.

Spearman rank correlations provide further evidence of the statistical significance of the results. Both correlations and significance levels are high, particularly for portfolio sizes up to 20 stocks. Possibly due to reduced sample sizes, both the Spearman rank and the Runs tests show deterioration in statistical significance as portfolio size increases.

The results of the 1988 tests are summarized and presented in Table 2 and are stronger than the 1980 results. Without exception, first quartile portfolios had lower beta variability than comparable random portfolios. Ninety-seven percent of second quartile portfolios had lower beta variability as compared to 59% for the third quartile. By the fourth quartile only 19% had lower beta variability than random portfolios.

The Spearman rank and Runs tests confirm the significant positive relationship between variability of individual common stock betas and the variability of the portfolio beta.

TABLE 2

Portfolios With Lower Beta Variability Than Randomly Generated Portfolios Of The Same Size
Test Period - 1988 Tests (Z Values In Parentheses)

	Portfolio Size[1]						
Quartile	**5**	**10**	**15**	**20**	**25**	**30**	**35**
1	25/25	13/13	8/8	6/6	5/5	4/4	4/4
2	24/25	11/12	8/8	6/6	5/5	4/4	3/3
3	11/25	4/12	7/8	5/6	3/5	4/4	3/3
4	5/25	3/13	2/9	0/7	0/5	1/4	2/4
Runs Test	(4.59) ***	(3.10) ***	(3.43) ***	(4.48) ***	(2.98) ***	(1.79) *	(1.02)
Spearman Rank	p = 0.81 (8.10) ***	0.86 (6.03) ***	0.89 (5.03) ***	0.92 (4.51) ***	0.78 (3.42) ***	0.86 (3.31) ***	0.85 (3.05) ***

1 The first number is the number of portfolios in the quartile with lower variability. The second is the total portfolios in the quartile.
* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

CONCLUSION

This study focuses on the effect of individual stock beta variability on the variability of the portfolio beta. The coefficient of variation was used to measure standardized individual stock beta variability and form portfolios of different sizes. The variability of the portfolio betas was compared to that of betas of randomly generated portfolios.

The most important implication of the results applies to managers of small portfolios. Results indicate it is possible to significantly reduce the variability of the portfolio beta by systematically combining stocks according to their beta standard deviation.

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