THE SIZE EFFECT ON STOCK RETURNS: IT IS SIMPLY A RISK EFFECT NOT ADEQUATELY REFLECTED BY THE USUAL MEASURES?

by

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I. Introduction and Summary

No adequate answer has yet been found for the apparent long-run negative effect of corporate size on stock returns, even after the usual measures of stock risk (both covariance and variance of returns) are held constant.[1] The size anomaly has not been explained by introducing additional measures of risk, such as co-skewness or the multiple factors associated with arbitrage pricing theory, differences in taxation of divided yield (less important for the small companies) and capital gains (more significant for the smaller firms), and differences in transaction costs.[2] The most satisfactory "explanation" so far of the very substantial size effect found in most studies has been in terms of two factors: first, a sizable upward bias in the usual rebalancing estimates of returns on relatively inactive small stocks (at least for daily returns) and second, the well-known and perplexing January effect in which it has been found that returns in that month (and particularly the first few days) are enormously higher in small than in large firms.[3]

Theoretically, the only satisfactory explanation of the size effect would seem to be in the inadequacy of the market rate of return as a measure of the required after-tax return to investors net of transactions cost or the inadequacy of the usual measure of risk on an appropriate ex ante proxy for risk. While it is difficult to obtain a more adequate measure of required after-tax returns to investors than has been investigated in the literature, an ex ante measure of risk which is readily available does seem to hold some promise for improving on the usual measures of risk to explain differences in stock returns, especially for the smaller firm.[4] Such ex ante measures are provided by the Standard and Poor's Quality Rankings for Stocks and will be examined in this paper to determine whether they can be used to explain all or a large part of the variation in return of stock among different size groups which cannot be explained by the more objective measures of risk commonly used.

To summarize the results of this analysis, over the period 1962-86 ordinary least square (OLS) and generalized least square regressions (GLS), and tests based on counts of the number of positive and negative regression coefficients for all 7 sub-periods in the overall period of 25 years covered indicate that quality rankings do a significantly better job than beta coefficients or variance measures in explaining monthly returns on stocks and do almost as good a job as firm size. When quality ranking (their numerical equivalents) and (the log) of firm size are both introduced in the regressions attempting to explain returns by OLS (GLS), the quality rank is very much more important and for 6(4) of the seven over-lapping 25 year periods analyzed, the size effect either has the wrong sign or is statistically insignificant.

An examination of the residuals in the OLS (GLS) regression of returns on quality rankings indicates that they do not have any systematic relation to firm size for the 6(4) sub-periods in the overall period covered. In contrast, when the residuals in the OLS and GLS regressions of returns on firm size are related to quality rankings, the latter explain a statistically significant portion of the variation in returns not explained by firm size.

These results are consistent with the hypothesis that the size effect mainly reflects a risk effect and that a significant part of the latter is not caught by the usual beta and variance measures. Apparently size does play an important role in the ex ante quality rankings assigned by security analysts, but the superiority of the quality rankings over the beta and variance measures of risk in explaining returns and in subsuming the size effect is not entirely attributable to the greater weight placed on size in subjective quality ratings than in the objective historical measures of risk. When quality ranking is used as the appropriate risk measure, the anomalous size effect largely disappears. The size effect as measured by monthly returns seems largely attributable to the difference in January returns between large and small firms, and this difference in turn can be explained almost completely by the subjective quality measure of risk. What is not clear is why quality ranking plays such a crucial role in differentiating between the average January stock returns on small vs. large firms.

II. Quality Rankings

The Standard and Poor's (S&P) Rankings for common stock before 1975 were primarily based on the stability and growth of both earnings and dividends, with quantitative weights assigned to the number of annual earnings increases and number and percentage movement of declines over the past eight years and with similar provision for dividend increases and decreases over the past 20 years weighted by frequency of occurrence. In addition, these mathematically determined measures were modified for certain industries (oil and regulated public utilities) and on the basis of special circumstances for certain companies. Apart from companies in reorganization and finance-oriented firms, traded stocks were classified into seven quality rankings (ranging from A+ in the highest to C in the lowest or marginal group) and into a NR group indicating that no ranking was possible because of "insufficient data, non-recurring factors, or some other reasons."[5]

For the years 1976-77, the S&P quality rankings were based not only in the criteria mentioned above but also set minimum size limits (in terms of corporate sales volume) for the three highest rankings, except that the highest rankings were still bestowed on stocks with outstanding records of earnings and dividend stability. The inclusion of size criteria in the quality classification process was justified on the grounds that "corporate size imparts a recognized advantage from an investment standpoint." From 1978 through 1986, minimum size limits were extended to the entire range of quality rankings, again with the provision of exceptions for stocks with a record of outstanding stability.

The inclusion of size as a specific determinant of quality rankings subsequent to 1975 does not seem to have been a consequence of the extensive academic literature on the size effect on stock returns. Moreover, the omission of size as an explicit determinant of quality rankings prior to that period will permit us in a subsequent analysis to test directly the extent to which the explicit inclusion of size in quality rankings changes the usefulness of quality rankings as a measure of risk. Obviously, these data also permit us to test the extent to which size has implicitly always been used by security analysts as an element in their appraisal of risk.

Table 1 shows the relationship for a large sample of traded (NYSE) stocks between the S&P quality rankings and the average monthly rate of returns, the usual quantitative measures of risk (beta and variance), and the market value of the stock. To carry out the numerical analysis, quality ratings ranging from A+ to C are assigned the numbers from 1 to 7 in the subsequent analysis, with 1 designating the highest quality stock and 7 the lowest. Not surprisingly, there is a strong positive relationship between quality rankings (the numerical number) and the usual betas and variance measures of risk and a strong positive relationship between all measures of risk and average return.

Of particular interest in Table 1 is the results for the NR group which quality or high risk. Actually, the table suggests that the NR stocks are as a whole closer to the average for all ranked stocks in mean return, variance and beta measures of risk, and size.

Table 2 shows the correlation coefficients between quality ranking and each of the two historical measures of risk, and the log of firm size, over three different five year periods 1966-71, 1976-81, and 1981-86. These years are selected to represent, respectively, a period before any explicit mention was made of firm size as a criterion for quality ranking, a period where size criteria were used for inclusion in the highest quality rankings, and finally the most recent five year period when size criteria were used for all quality categories.

It is notable that the quality ranking is more closely related to the variance of returns than to the beta coefficient, reflecting that analysts stress on variability rather than covariability. More interesting is the high inverse correlation between quality ranking and firm size even before size was introduced explicitly into the ranking process. Not surprisingly, the correlation increased somewhat after the explicit inclusion of size on a ranking criterion. The beta coefficient and even more so the variance measure of risk was also significantly correlated with size (again inversely), but not nearly so highly as the quality ranking. This instance strongly suggests that firm size plays a major risk in a security analysts appraisal of stock risk.

III. Data and Methodologies.

The empirical tests are based on the asset pricing model which allows the expected return $E(R_i)$ (R_i denotes realized average returns in the subsequent analysis) of a common stock to be a function of RISK (We employ three different risk measures β (beta), V (variance of return), I (quality rating)) and an additional size factor MV which is the market value of equity. A simple linear relationship is assumed:

$$(1) \qquad E(R_i) = a + b\ RISK_i + c\ MV_i + e_i, \qquad i = 1, \ldots, N$$

i denotes the i^{th} firm in the subsequent analysis.

If MV has no impact on $E(R_i)$, then c=0, (1) reduces to the Sharpe-Lintner version of CAPM if RISK=β. Since expectations are not observable, the parameter in (1) must be estimated from historical data. A number of methods are available for this purpose which involves the use of pooled cross-sectional and time series regresssions to estimate coefficients. They differ primarily in: (a) the assumption concerning residual variance of the stock returns (homoscedastic or heteroscedastic in the cross-sectional regressions), and (b) the treatment of the errors-in-variables problem introduced by the use of different estimated risk measures.

We adopt the suggestions by Banz (1981) to use the grouping techniques to group individual securities into portfolios on the basis of market value and security beta, and reestimating the relevant RISK measures of the portfolios in a subsequent period, and finally performing either an ordinary least square (OLS) regressions (Fama and MacBeth (1973)) which assumes homoscedastic errors, and a generalized least square (GLS) regressions (Black and Scholes (1974)) which allows for heteroscedastic errors, on portfolio in each month. Grouping reduces the errors-in-variable problem, but is not very efficient because it does not make use of all information. The errors-in-variables problem should not be a factor as long as the portfolios contains a reasonable number of securities.[6]

The sample includes all common stocks quoted on monthly CRSP return file at least 5 years from 1962-1986 and with quality rating in S&P stock guide.[7]

The value weighted market index is used as market portfolio, β and V are estimated by the 5 years monthly return data. Quality rating ranging from A+ to C (A+, A, A-, B+, B, B-, C) are assigned the number from 1 to 7 linearly. Such arbitrary assignments of numbers not only introduce a non-trivial error-in-variables problem as those of β and V, but also bring in the problem of the adequacy of such a linear functional form. The portfolio selection procedure used in this study is identical to the one described in Banz (1981) and Black and Scholes (1974) which may reduce the errors-in-variables problem to a certain extent,[8] but the adequacy of such a linear assignment of numbers is always an open question. It is desirable to try a number of different functional forms, but this suggested trial is not carried out in this paper. The securities are assigned to one of 25 portfolios containing similar numbers of securities: on basis of market value we make 5 groups, then the securities in each of those 5 are in turn to assign to 5 portfolios on the basis of beta. This grouping technique is intended to allow for enough variation of MV and β, but against that of V and I. Five years data are used to estimate the security beta and variance; the next 5 years data are used for the reestimation of portfolio beta, variance and return. Stock price and number of shares outstanding (so is quality rating) at the end of the first 5 years periods are used to calculate MV (and I). The portfolios are updated every year.

A constrained optimization procedure, described in Fama (1976, Ch.9), is used to generate minimum variance portfolios with mean coefficients. We follow the constrained optimization procedure stated in Banz (1981) by running a cross sectional regression of the form:

$$R_{it} = a_t + b_t RISK_i + c_t MV_i \qquad (2)$$

in each month t by either OLS and GLS. Involving the usual stationarity arguments, the final estimates of the resulting 120 month (regressions) as well as those of 180 months (regressions) are reported in Table 3 (OLS) and Table 4 (GLS).[9]

IV. Econometric Analysis

We can see from Table 3 and 4, the coefficients of β, V, I and LMV (log of MV) all possess the theoretical properties: the higher risk in terms of β, V and I, the higher the return, the larger the firm's size LMV, the lower the return (small firm effect). The t-statistics of MV or (MV-AMV)/AMV (AMV is the average market value, see Banz (1981)) is much less significant than LMV, thus only those of LMV are reported.[10] To focus on the role of different risk measures in resolving size effect, the tests of the expected return on a zero-beta portfolio and the expected market risk premium are ignored. Regression results in Tables 3 and 4 indicate that, for all of sub-periods in the overall period covered, quality ranking I do a marginally significant job than β and V in explaining returns on stocks and do a marginally less significant job than LMV. When β, V and LMV are incorporated into regression with I respectively, the quality ranking I is very much more important than β, V and LMV for all 7 sub-periods in terms of t-statistics. It should be notable that when I and LMV are both introduced in the regressions attempting to explain returns by OLS and GLS, for 6 (and 4) of the 7 subperiods analyzed by OLS (and GLS), the size effect either has the wrong sign or is statistically insignificant.[11] If V and/or β are incorporated into the regression with I and LMV combined, the subsumed size effect cannot be further improved, it may be suggested that I consist in large part of the effect of β and V.

The previous subsumed size effect may be attributed to the statistical artifact of the extremely high correlation between I and LMV. The correlation between I and LMV is around -.75 to -.90 (see Table 2) which introduce serious multicollinearity problem to increase standard errors and to bias results downward in Tables 3 and 4 once I and LMV are combined. To avoid the serious multicollinearity problem and to examine the size effect by an alternative method, a residual test is introduced as follows (hereafter residual test):

We run the following regressions first:

(3) $$R_i = f(\beta_i) + e_{1i}$$

(4) $$R_i = f(V_i) + e_{2i}$$

(5) $$R_i = f(I_i) + e_{3i}$$

If the risk measure in (3), (4) and (5) are properly specified, then once we run residual e_{ki}, k=1,2,3 in (3), (4) and (5) on LMV as follows, the insignificant impact of LMV on e_{ki} should be obtained:

(6) $$e_{ki} = a_i + b_i LMV_i, \quad k = 1, 2, 3$$

In the left panel of Table 5 (and 6), the residuals in the OLS (and GLS) regression of returns on quality rankings indicate that they do not have any systematical relation to firm size for the 6 (and 4) subperiods in the overall period covered, while the size effect is very (negatively) significant over the 7 sub-periods for the cases of β and V. I may consist in large part of the effect of β and V, therefore, once β and/or V are incorporated with I respectively, the results in Table 5 and 6 can not be improved. We further examine the reverse case to run the following regression first (hereafter reverse residual test):

(7)

(7) is intended to investigate the part of return that can not be explained by LMV (embodied in the residual terms), how much can it be explained by β, V and I? It is quite evident that all three risk measures β, V and I explain a statistically significant portion of the variation in returns not explained by firm size as reported in the right panel of Table 5 (OLS) and 6 (GLS).

From the above evidence, it is evident that both risk measures β and V can only explain part of returns with the remaining part be explained by size factor (so-called size effect), while it is much less so for the case of I. In contrast, even though LMV may explain returns to a certain extent, all risk measures β, V and I can still explain the remaining portion of returns significantly. It seems to suggest that I may reduce size effect substantially, while the reverse is not quite true.

In the above discussions, we only report the Fama-MacBeth aggregate statistics. Readers may be interested to know the properties of individual regressions in the case of Tables 3 and 5 (OLS).[12] To present a summary results, only the number of significant coefficients and signs of coefficients are reported in upper panel of Table 7 which corresponds to those in Tables 3 and 4. In terms of significant number of coefficients, I is 116 while β and V are 86 and 106 respectively. But the number of significant coefficients of LMV is 122 which is higher than that of I. To determine the relative importance of variables, the number of significant coefficients with (I, β), (I, V) and (I, LMV) combined also suggests the dominant role of I over β, V and LMV, which are consistent with those reported in Tables 3 and 4.

When I and LMV are both introduced in the regressions attempting to explain returns, the size effect is much less important for the equal number of positive and negative significant coefficient of LMV. This result is also similar to those reported in Tables 3 and 4.

The number of significant coefficients of the residual tests is presented in the lower panel of Table 7. In the case of β, V and I, the number of negatively significant coefficient are is 133, 58 and 0. It is clearly consistent with the results in Tables 5 and 6. In contrast, in the case of a reverse residual test, the number of significant positive coefficient is 0, 83, 81 for the cases of I, β and V, respectively. Of particular interest is the 0 significant positive coefficient of I. One plausible reason may be attributed to the high correlation between I and LMV. Once the explanatory portion explained by LMV is removed, there is not much left for I to explain.

In the same table, we also report the number of coefficients without the counts of 1972 and 1973. In 1972 and 1973, in general, the return is negatively related to risk measures, while it is positively related to size factor (same evidence is found by Brown, Kleidon and Marsh (1983), Ariel (1987)). Once we drop the counts of these 2 years, the number of significant coefficients match the theoretical properties of the underlined variables better.

The omission of size as an explicit determinant of quality rankings prior to 1975 permits us to test directly the extent to which the explicit inclusion of size in quality rankings changes the usefulness of quality rankings as a measure of risk. From Table 3 to Table 6, subperiod 1 covers the periods in which quality rankings omit size as an explicit determinant, while subperiod 6 covers those in which quality rankings include size as a determinant. A close look at results reported in periods 1 and 6, a similar conclusion is still obtained, it may be adequate to conclude that the superiority of the quality rankings over beta and variance measures of risk in explaining returns and in subsuming size effect is not entirely attributable to the greater weight placed on size in quality rankings than in the objective historical measures of risk.

We compare our individual regression results with those of Fama-MacBeth (1973) (See Fama (1976)), the number of signs (positive and negative) of β is similar. Once we aggregate coefficients, a similar mean of β as in Fama and MacBeth is obtained, but with a much less variation: the more significant aggregate results are thus obtained.

V. The January Effect Revisited

Size effect largely occurred in January as documented by Keim (1983) and Blume and Stambaugh (1983). To investigate the January size effect, we follow the same portfolio selection procedures as in Section II. On basis of MV we make 5 size groups, then the securities in each of those 5 size groups are in turn to assign to 5 beta groups on the basis of beta. Five years data are used to estimate the security beta and variance; the next five years data are used for the reestimation of portfolio beta, variance, 5-years monthly return (R), 5-years January return (R_1) and 5-years non-January return (R_{2-12}). The portfolios are updated every year. The cross sectional regressions (2) are then performed in each year, 15 regressions are obtained. The resulting risk (β, V and I) adjusted returns are averaged across 5 beta groups in each of the 5 size groups. The final estimates of the risk adjusted returns in each size group are averaged across these 15 regressions. The t-statistics are computed by using the mean and standard errors of the risk adjusted returns in each size group across these 15 regressions. The final estimates in each size group and the t-statistics of the risk adjusted returns of smallest minus that of largest size group are reported in Table 8.

Columns 1-3 report the risk adjusted average return R in different size groups. The monotonic descending trends of risk adjusted R for β and V are reported, no monotonic trend is found for I. The t-statistics of risk adjusted R is group 1 is significantly higher than that in group 5 for β and V, but an insignificant result is found for I.

Columns 4-6 report the risk adjusted January return R_1 in different size groups. The monotonic descending trends of risk adjusted R_1 for β and V not only exist, but in a stronger manner than those in columns 1 and 2. The same as in column 3, no monotonic trend is found for I. The t-statistics of risk adjusted R_1 in group 1 is significantly higher than that in group 5 for β and V, but insignificant for I.

Columns 7-9 report the risk adjusted non-January return R_{2-12} in different size groups. No trend has been found for all these three risk measures. The t-statistics of risk adjusted R_{2-12} in group 1 is insignificantly lower than that in group 5 for all three risk measures.

It is notable that Blume and Stambaugh (1983) apply the buy and hold strategy instead of the portfolio rebalancing strategy to reduce the possible upward bias of size effect inherited in daily returns. As a result of the different technique, as reported by Blume and Stambaugh, the size effect was reduced to a certain extent and only occurred in January. In our study, the size effect only occurs in January even the portfolio rebalancing strategy is adopted (similar results are obtained for buy and hold strategy), it may be suggestive that the possible upward bias of the size effect inherited in daily returns may not exist in monthly returns.

Footnotes

[1]See, for example, Banz [1983], Lakonishok and Shapiro [1982].

[2]See the summary by Schwert [1983].

[3]Blume and Stambaugh [1983].

[4]See Blume and Friend [1974].

[5]Quality ranking D appears since 1977, but only with few entries. In our selected sample, no firm possesses D ranking.

[6]Litzenberger and Ramaswamy (1979) have suggested an alternative method which avoid grouping. They allow for heteroscedastic errors in the cross-sectional regressions and use the estimates of the standard errors of the security betas as estimates of the measurement errors. This method leads to unbiased maximum likelihood estimators for the coefficients as long as the error in the standard error of beta is small and the standard assumptions of the simple errors-in-variables model are met. Thus, it is very important that the diagonal model is the correct specification of the return generating process, since the residual variance assumes a critical position in this procedure. If the diagonal model is an incomplete specification of the return generating process, the estimate of the standard error of beta is likely to have an upward bias, since the residual variance estimate is too large. The error is the residual variance estimate appears to be related the second factor. Therefore, the resulting coefficient estimates are biased.

[7]One may question the length of periods we cover in this paper. It is of course desirable to have a longer time horizon. In fact, the quality ratings were only started from 50's but with a much smaller number of entries relative to our current samples and has to be entered by hand. A much smaller and less reliable samples from the earlier periods plus the substantial input of

[8]A number of non-grouping regressions (β is adjusted for its order bias) are also run despite the serious errors-in-variables problem. A much less satisfactory result of the quality rating is obtained.

[9]The means of the resulting 60 months (regressions) are not reported for its volatile results.

[10]A possible reason for the less significant MV or (MV-AMV)/AMV relative to LMV can be attributed to the heteroscedastic problem, inherited in the unscaled MV or (MV-AMV)/AMV, which bias the regression results downward.

[11]In our analysis, the apparent negative impact of LMV on stock returns is obtained, but not reported, even when β and/or V are held constant.

[12]Similar results are obtained for GLS.

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TABLE 1: Selected Characteristics of S&P Quality Ratings, 1968-1986

	NR	1(A+)	2(A)	3(A-)	4(B+)	5(B)	6(B-)	7(
Number of Firms	251	50	125	137	230	115	41	
R	.01231	.00895	.01046	.01111	.01269	.01353	.01493	.014
V	.01071	.00561	.00625	.00737	.01002	.01515	.02038	.025
β	1.09716	.8944	.9379	.9829	1.1264	1.2958	1.4365	1.43
MV	507	4104	1142	594	359	147	96	[illegible]

*Data source of quality ratings: S&P Stock Guide 1968/1 - 1982/1.

**NR means no ranking, quality ratings ranging from A+ to C are assigned the numbers from 1 to 7. R denotes average monthly returns, V is the variance of return, β is the equity beta, MV denotes the market value of equity in millions of dollars and LMV used in subsequent tables denotes the log of market value.

***R etc. are computed using 5 years of monthly data from 1968/1 - 1972/1 (denoted as 1972/1). We mo the window from 1968/1 - 1972/1 to 1968/2 - 1972/2 to get another series of R etc. Similar processes are carried out until the last window is reached (i.e. 1982/12 - 1986/12): thus 180 R's etc. are obtained. Th above figures are the simple averages of these 180 observations.

TABLE 2: Correlation between Different Measures of Risk and Firm Size for Three Different Periods 1966-86

(I)

	β	V	I	LMV
β	1.0	0.921*	0.682*	-.180
V		1.0	0.855*	-.470*
I			1.0	-.781*
LMV				

* β - Portfolio beta computed from monthly data from 1966/1 through 1971/1.
V - Portfolio variance computed from monthly data from 1966/1 through 1971/1.
I - S&P Quality Ranking as of 1966/1.
LMV - Log of market value of equity as of 1966/1.
* - Significant at .05 level.

(II)

	β	V	I	LMV
β	1.0	0.858*	0.522*	-.321
V		1.0	0.831*	-.661*
I			1.0	-.941*
LMV				

* β - Portfolio beta computed from monthly data from 1976/1 through 1981/1.
V - Portfolio variance computed from monthly data from 1976/1 through 1981/1.
I - S&P Quality Ranking as of 1976/1.
LMV - Log of market value of equity as of 1976/1.
* - Significant at .05 level

(III)

	β	V	I	LMV
β	1.0	0.843*	0.529*	-.176
V		1.0	0.822*	-.545*
I			1.0	-.893*
LMV				1.0

* β - Portfolio beta computed from monthly data from 1981/1 through 1986/1.
V - Portfolio variance computed from monthly data from 1981/1 through 1986/1.
I - S&P Quality Ranking as of 1981/1.
LMV - Log of market value of equity as of 1981/1.
* - Significant at .05 level.

TABLE 3: Coefficients and t-Statistics of Expected Returns on the Following Regressions by Ordinary Least Square

	$a_1+b_1\beta_i$	$a_2+b_2V_i$	$a_3+b_3I_i$	$a_4+b_4LMV_i$	$a_5+b_5I_i+c_5\beta_i$		$a_6+b_6I_i+c_6V_i$		$a_7+b_7I+c_7LMV_i$	
	b_1	b_2	b_3	b_4	b_5	c_5	b_6	c_6	b_7	c_7
31	0.00417 (6.55)	0.39332 (6.41)	0.00265 (8.03)	-0.00144 (-8.98)	0.00254 (9.19)	0.00075 (2.07)	0.00198 (8.78)	0.13794 (3.18)	0.00310 (6.67)	0.00019 (1.47)
32	0.00579 (10.27)	0.53764 (10.27)	0.00336 (11.77)	-0.00178 (-12.48)	0.00300 (12.32)	0.00168 (4.67)	0.00213 (9.92)	0.25848 (6.49)	0.00419 (10.20)	0.00050 (3.95)
33	0.00673 (14.43)	0.64122 (15.54)	0.00395 (17.76)	-0.00210 (-19.03)	0.00352 (18.48)	0.00189 (5.44)	0.00251 (13.12)	0.30641 (8.74)	0.00480 (13.81)	0.00053 (4.25)
34	0.00645 (13.00)	0.64947 (16.11)	0.00413 (20.40)	-0.00229 (-25.10)	0.00395 (25.16)	0.00100 (2.32)	0.00292 (16.98)	0.26551 (6.92)	0.00450 (11.91)	0.00016 (2.01)
35	0.00599 (10.80)	0.64289 (15.60)	0.00422 (22.13)	-0.00239 (-31.22)	0.00423 (34.19)	0.00021 (0.42)	0.00331 (22.11)	0.20495 (4.59)	0.00412 (9.83)	-.00016 (-0.93)
36	0.00572 (9.61)	0.63833 (15.09)	0.00424 (22.69)	-0.00241 (-32.81)	0.00424 (34.67)	0.00007 (0.14)	0.00341 (21.66)	0.17189 (3.43)	0.00409 (9.54)	-.00020 (-1.08)
36	0.00317 (6.30)	0.36487 (8.40)	0.00264 (11.69)	-0.00157 (-14.29)	0.00282 (14.89)	-0.00057 (-1.49)	0.00235 (13.84)	0.04959 (1.30)	0.00231 (6.38)	-.00032 (-2.40)

definition of symbols, see footnotes in Table 1. The t-Statistics are reported in the bracket.

denote the Fama-MacBeth aggregate coefficients and t-Statistics for 120 months.

lenotes the Fama-MacBeth aggregate coefficients and t-Statistics for 180 months.

TABLE 4: Coefficients and t-Statistics of Expected Returns on the Following Regressions by Generalized Least Square

	$a_1+b_1\beta_i$	$a_2+b_2V_i$	$a_3+b_3I_i$	$a_4+b_4LMV_i$	$a_5+b_5I+c_5\beta_i$		$a_6+b_6I_i+c_6V_i$		$a_7+b_7I_i+c_7LMV_i$	
	b_1	b_2	b_3	b_4	b_5	c_5	b_6	c_6	b_7	c_7
1972-1981	0.00351 (6.06)	0.47215 (6.81)	0.00247 (8.52)	-0.00117 (-8.77)	0.00242 (8.99)	0.00045 (1.36)	0.00203 (9.59)	0.13279 (3.01)	.00291 (7.64)	.00022 (2.38)
1973-1982	0.00494 (9.63)	0.62820 (10.68)	0.00304 (12.09)	-0.00143 (-12.07)	0.00289 (12.18)	0.00117 (3.51)	0.00221 (11.13)	0.25219 (6.33)	0.00365 (11.03)	0.00034 (3.77)
1974-1983	0.00572 (13.16)	0.74821 (16.25)	0.00357 (18.19)	-0.00170 (-18.13)	0.00340 (18.19)	0.00124 (3.75)	0.00258 (14.76)	0.30222 (8.71)	.00409 (14.53)	0.00029 (3.09)
1975-1984	0.00518 (10.35)	0.76092 (17.08)	0.00375 (21.41)	-0.00184 (-23.63)	0.00372 (23.97)	-0.00129 (-0.98)	0.00293 (19.14)	0.26165 (6.80)	0.00374 (11.81)	-0.00005 (-0.41)
1976-1985	0.00449 (7.71)	0.75887 (16.89)	0.00387 (24.38)	-0.00195 (-31.83)	0.00395 (31.80)	-0.00220 (-1.66)	0.00325 (24.82)	0.19246 (4.17)	0.00332 (9.28)	-0.00038 (-2.94)
1977-1986	0.00421 (6.73)	0.74941 (16.23)	0.00385 (24.13)	-0.00194 (-31.26)	0.00393 (31.04)	-0.00231 (-1.73)	0.00329 (24.28)	0.15841 (3.08)	0.00329 (9.07)	-0.00038 (-2.90)
1972-1986	0.00214 (4.35)	0.43389 (8.92)	0.00245 (12.44)	-0.00125 (-13.71)	0.00258 (14.16)	-0.00208 (-2.32)	0.00231 (15.01)	0.03043 (0.78)	0.00203 (6.90)	-0.00029 (-2.87)

*Footnotes: see Table 3.

TABLE 5: Coefficients and t-Statistics of Residuals on the Following Regressions by Ordinary Least Square

	$e_{ki}=a_k+b_k LMV_i$, e_{ki}, k=1,2,3, is residual defined from			$e_i=a_1+b_1 I_i$	$e_i=a_2+b_2 \beta_i$	$e_i=a_2+b_3 V_i$
				e is residual defined from		
	$R_i=f(\beta_i)+e_{1i}$	$R_i=f(V_i)+e_{2i}$	$R_i=f(I_i)+e_{3i}$	$R_i=f(LMV_i)+e_i$		
	b_1	b_2	b_3	b_1	b_2	b_3
1. 1972-1981	-0.00110 (-9.28)	-0.00048 (-7.79)	-0.00002 (-0.78)	0.00030 (3.05)	0.00228 (4.76)	0.12297 (3.63)
2. 1973-1982	-0.00131 (-12.35)	-0.00053 (-9.98)	0.00006 (2.47)	0.00057 (7.41)	0.00356 (8.33)	0.21567 (7.74)
3. 1974-1983	-0.00157 (-19.25)	-0.00064 (-13.84)	0.00008 (3.68)	0.00074 (13.89)	0.00423 (11.77)	0.27148 (12.87)
4. 1975-1984	-0.00179 (-27.98)	-0.00080 (-19.04)	0.00001 (0.22)	0.00068 (11.42)	0.00374 (9.08)	0.25763 (11.54)
5. 1976-1985	-0.00193 (-43.94)	-0.00091 (-24.92)	-0.00004 (-1.32)	0.00062 (9.51)	0.00320 (6.76)	0.23363 (9.28)
6. 1977-1986	-0.00196 (-46.77)	-0.00095 (-22.15)	-0.00005 (-1.54)	0.00061 (9.00)	0.00302 (5.98)	0.22001 (7.95)
7. 1972-1986	-0.00130 (-15.64)	-0.00066 (-13.08)	-0.00009 (-3.64)	0.00024 (3.31)	0.00133 (3.29)	0.09157 (3.58)

*Footnotes: see Table 3.

TABLE 6: Coefficients and t-Statistics of Residuals on the Following Regressions by Generalized Least Square

	$e_{ki}=a_k+b_k LMV_i$, e_{ki}, k=1,2,3, is residual defined from			$e_i=a_1+b_1 I_i$	$e_i=a_2+b_2\beta_i$	$e_i=a_2+b_3 V_i$
	$R_i=f(\beta_i)+e_{1i}$	$R_i=f(V_i)+e_{2i}$	$R_i=f(I_i)+e_{3i}$	e is residual defined from $R_i=f(LMV_i)+e_i$		
	b_1	b_2	b_3	b_1	b_2	b_3
1. 1972-1981	-0.00107 (-8.96)	-0.00046 (-8.64)	0.00001 (0.49)	0.00024 (3.69)	0.00212 (4.53)	0.13383 (3.90)
2. 1973-1982	-0.00128 (-12.03)	-0.00051 (-10.15)	0.00004 (2.56)	0.00841 (8.11)	0.00329 (7.82)	0.22686 (8.11)
3. 1974-1983	-0.00153 (-17.99)	-0.00062 (-13.92)	0.00004 (2.64)	0.00052 (15.78)	0.00384 (10.43)	0.28224 (13.42)
4. 1975-1984	-0.00171 (-25.58)	-0.00076 (-20.31)	-0.00002 (-1.26)	0.00045 (11.82)	0.00315 (7.06)	0.26382 (11.51)
5. 1976-1985	-0.00185 (-40.13)	-0.00087 (-30.76)	-0.00007 (-3.88)	0.00089 (8.95)	0.00234 (4.40)	0.22820 (8.37)
6. 1977-1986	-0.00184 (-39.12)	-0.00088 (-28.52)	-0.00007 (-3.62)	0.00039 (8.85)	0.00214 (3.77)	0.21336 (7.21)
7. 1972-1986	-0.00120 (-14.65)	-0.00060 (-14.52)	-0.00006 (-3.59)	0.00018 (3.76)	0.00077 (1.81)	0.08803 (3.33)

*Footnotes: see Table 3.

TABLE 7: Comparison of the Number of Significant Coefficients and Signs of Coefficients (Ordinary Least Squares)

	$R_i=a_1+b_1\beta_i$	$R_i=a_2+b_2V_i$	$R_i=a_3+b_3I_i$	$R_i=a_4+b_4LMV_i$	$R_i=a_5+b_5I_i+c_5\beta_i$		$R_i=a_6+b_6I_i+c_6V_i$		$R_i=a_7+b_7I_i+c_7LMV_i$	
ients	b_1	b_2	b_3	b_4	b_5	c_5	b_6	c_6	b_7	c_7
Pos. ient	117(117)	135(135)	151(151)	29(4)	149(149)	87(85)	148(144)	93(93)	102(102)	86(84)
Sig. e ient	86(86)	106(106)	116(116)	15(0)	132(132)	53(53)	103(103)	56(56)	79(79)	33(33)
Neg. ient	63(39)	45(21)	29(5)	151(151)	31(7)	93(71)	32(12)	87(65)	78(54)	94(72)
Sig. e ient	38(15)	24(2)	25(1)	122(122)	17(1)	57(47)	4(1)41(23)	33(11)	48(35)	

$e_{ki}=a'_k+b'_kLMV_{ki}$, k=1,2,3, where e is residual defined from				$e_i=a'_1+b'_1I_i$	$e_i=a'_2+b'_2\beta_i$	$e_i=a'_3+b'_3V_i$
	$R_{1i}=f(\beta_i)+e_{1i}$	$R_{2i}=f(V_i)+e_{2i}$	$R_{3i}=f(I_i)+e_{3i}$	e_i is residual defined from $R_i=f(LMV_i)+e_i$		
ient	b'_1	b'_2	b'_3	b'_1	b'_2	b'_3
Pos. ient	32(9)	31(16)	86(84)	113(113)	101(100)	12(111)
Sig. e ient	13(0)	1(0)	0(0)	0(0)	83(83)	81(81)
Neg. ient	148(147)	149(140)	94(72)	67(43)	79(56)	68(45)
Sig. e ient	133(133)	58(58)	0(0)	20(0)	50(28)	30(8)

he number in brackets denotes those without the counts of 1972 and 1973 coefficients.

TABLE 7: Comparison of the Number of Significant Coefficients and Signs of Coefficients (Ordinary Least Squares)

$R_i=a_2+b_2V_i$	$R_i=a_3+b_3I_i$	$R_i=a_4+b_4LMV_i$	$R_i=a_5+b_5I_i+c_5\beta_i$		$R_i=a_6+b_6I_i+c_6V_i$		$R_i=a_7+b_7I_i+c_7LMV_i$	
b_2	b_3	b_4	b_5	c_5	b_6	c_6	b_7	c_7
135(135)	151(151)	29(4)	149(149)	87(85)	148(144)	93(9[illegible])	102(102)	86(84)
106(106)	116(116)	15(0)	132(132)	53(53)	103(103)	56(56)	79(79)	33(33)
45(21)	29(5)	151(151)	31(7)	93(71)	32(12)	87(65)	78(54)	94(72)
24(2)	25(1)	122(122)	17(1)	57(47)	4(1)41(23)	33(1[illegible])	48(35)	

,2,3, where e is residual defined from			$e_i=a'_1+b'_1I_i$	$e_i=a'_2+b'_2\beta_i$	$e_i=a'_3+b'_3V_i$
			e_i is residual defined from $R_i=f(LMV_i)+e_i$		
$+e_{1i}$	$R_{2i}=f(V_i)+e_{2i}$ b'_2	$R_{3i}=f(I_i)+e_{3i}$ b'_3	b'_1	b'_2	b'_3
)	31(16)	86(84)	113(113)	101(100)	12(111)
)	1(0)	0(0)	0(0)	83(83)	81(81)
)	149(140)	94(72)	67(43)	79(56)	68(45)
)	58(58)	0(0)	20(0)	50(28)	30(8)

enotes those without the counts of 1972 and 1973 coefficients.

TABLE 7: Comparison of the Number of Significant Coefficients and Signs of Coefficients (Ordinary Least Squares)

Coefficients	$R_i=a_1+b_1\beta_i$	$R_i=a_2+b_2V_i$	$R_i=a_3+b_3I_i$	$R_i=a_4+b_4LMV_i$	$R_i=a_5+b_5I_i+c_5\beta_i$		$R_i=a_6+b_6I_i+c$	
	b_1	b_2	b_3	b_4	b_5	c_5	b_6	c_6
No. of Pos. Coefficient	117(117)	135(135)	151(151)	29(4)	149(149)	87(85)	148(144)	93
No. of Sig. Positive coefficient	86(86)	106(106)	116(116)	15(0)	132(132)	53(53)	103(103)	56
No. of Neg. Coefficient	63(39)	45(21)	29(5)	151(151)	31(7)	93(71)	32(12)	87
No. of Sig. Negative Coefficient	38(15)	24(2)	25(1)	122(122)	17(1)	57(47)	4(1)41(23)	33

Coefficient	$e_{ki}=a'_k+b'_kLMV_{ki}$, $k=1,2,3$, where e is residual defined from			$e_i=a'_1+b'_1I_i$	$e_i=a'_2$
	$R_{1i}=f(\beta_i)+e_{1i}$	$R_{2i}=f(V_i)+e_{2i}$	$R_{3i}=f(I_i)+e_{3i}$		e_i is residua $R_i=f(L$
	b'_1	b'_2	b'_3	b'_1	b
No. of Pos. Coefficient	32(9)	31(16)	86(84)	113(113)	101
No. of Sig. Positive Coefficient	13(0)	1(0)	0(0)	0(0)	83
No. of Neg. Coefficient	148(147)	149(140)	94(72)	67(43)	79
No. of Sig. Negative Coefficient	133(133)	58(58)	0(0)	20(0)	50

*The number in brackets denotes those without the counts of 1972 and 1973 coefficients.

TABLE 8: Risk Adjusted Returns in Different Size Categories

Size Category From Small to Large	$e_i=R_i-a_1-b_1\beta_i$	$e_i=R_i-a_2-b_2V_i$	$e_i=R_i-a_3-b_3I_i$	$e_i=R_{1i}-a_4-b_4\beta_i$	$e_i=R_{1i}-a_5-b_5V_i$	$e_i=R_{1i}-a_6-b_6I_i$	$e_i=R_{2-12i}-a_7b_7\beta_i$	$e_i=R_{2-12i}$
1	0.00253	0.00085	-.00018	0.04036	0.02004	0.00795	-.00092	-.00
2	0.00097	0.00070	0.00025	0.01180	0.00775	0.00007	-.00002	0.00
3	-.00012	0.00028	0.00015	-.00671	-.00312	-.00535	0.00048	0.00
4	-.00069	-.00005	0.00000	-.01729	-.00926	-.00541	0.00082	0.00
5	-.00269	-.00177	-.00023	-.02816	-.01542	0.00273	-.00037	-.00
t-statistics of 1-5	3.93	3.66	0.106	13.1	12.1	1.636	-.393	-.

R_1 - Returns of January

R_{2-12} - Returns from February to December

R - Returns from January to December

TABLE 8: Risk Adjusted Returns in Different Size Categories

b_2V_i	$e_i=R_i-a_3-b_3I_i$	$e_i=R_{1i}-a_4-b_4\beta_i$	$e_i=R_{1i}-a_5-b_5V_i$	$e_i=R_{1i}-a_6-b_6I_i$	$e_i=R_{2-12i}-a_7b_7\beta_i$	$e_i=R_{2-12i}-a_{[illegible]}-b_8V_i$	$e_i=R_{2-12i}-a_9-b_9I_i$
5	-.00018	0.04036	0.02004	0.00795	-.00092	-.0009[illegible]	-.00091
0	0.00025	0.01180	0.00775	0.00007	-.00002	0.0000[illegible]	0.00027
8	0.00015	-.00671	-.00312	-.00535	0.00048	0.00058	0.00065
5	0.00000	-.01729	-.00926	-.00541	0.00082	0.00079	0.00049
7	-.00023	-.02816	-.01542	0.00273	-.00037	-.00053	-.00050
6	0.106	13.1	12.1	1.636	-.393	-.453	-.848

ry to December

y to December