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INVESTMENT PERFORMANCE OF COMMON STOCKS IN RELATION TO THEIR PRICE-EARNINGS RATIOS: A TEST OF THE EFFICIENT MARKET HYPOTHESIS

S. Basu*

I. Introduction

In an efficient capital market, security prices fully reflect available information in a rapid and unbiased fashion and thus provide unbiased estimates of the underlying values. While there is substantial empirical evidence supporting the efficient market hypothesis,[1] many still question its validity. One such group believes that price-earnings (P/E) ratios are indicators of the future investment performance of a security. Proponents of this price-ratio hypothesis claim that low P/E securities will tend to outperform high P/E stocks.[2] In short, prices of securities are biased, and the P/E ratio is an indicator of this bias.[3] A finding that returns on stocks with low P/E ratios tends to be larger than warranted by the underlying risks, even after adjusting for any additional search and transactions costs, and differential taxes, would be inconsistent with the efficient market hypothesis.[4]

The purpose of this paper is to determine empirically whether the investment performance of common stocks is related to their P/E ratios. In Section II data, sample, and estimation procedures are outlined. Empirical results are discussed in Section III, and conclusions and implications are given in Section IV.

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1. See Fama [8] for an extensive discussion of the efficient market hypothesis and a synthesis of much of the empirical evidence on this issue.

2. See Williamson [28; p. 162].

3. Smidt [27] argues that one potential source of market inefficiency is inappropriate market responses to information. Inappropriate responses to information implicit in P/E ratios are believed to be caused by exaggerated investor expectations regarding growth in earnings and dividends; i.e., exaggerated optimism leads, on average, to high P/E securities and exaggerated pessimism leads, on average, to stocks with low P/E ratios. For an elaboration on this point see [19; p. 28], [20], [21] and [28; p. 161–162]. A contrary position is discussed in [22].

4. In general, results of previous empirical research by Breen [5], Breen & Savage [6], McWilliams [18], Miller & Widmann [19] and Nicholson [20] seem to support the price-ratio hypothesis. While this may suggest a violation of the semi-strong form of the efficient market hypothesis, all of these studies have one or more of the following limitations: (i) retroactive selection bias, (ii) no adjustment for risk, marginal information processing and transactions costs, and differential tax effects pertaining to capital gains and dividends, and (iii) earnings information is assumed to be available on or before the reporting date.

II. Data and Methodology

The following general research design was employed to examine the relationship between P/E ratios and investment performance of equity securities. For any given period under consideration, two or more portfolios consisting of securities with similar P/E ratios are formed. The risk-return relationships of these portfolios are compared and their performance is then evaluated in terms of pre-specified measures. Finally, as a test of the efficient market hypothesis, the returns of the low P/E portfolio are compared to those of a portfolio composed of randomly selected securities with the same overall level of risk. The data base and methodological details are now discussed.

Data Base & Sample Selection Criteria

The primary data for this study is drawn from a merged magnetic tape at Cornell University that includes the COMPUSTAT file of NYSE Industrial firms, the Investment Return file from the CRSP tape and a delisted file containing selected accounting data and investment returns for securities delisted from the NYSE.[5] With the inclusion of the delisted file (375–400 firms), the data base represents over 1400 industrial firms, which actually traded on the NYSE between September 1956–August 1971.

For any given year under consideration, three criteria were used in selecting sample firms:[6] (i) the fiscal year-end of the firm is December 31 (fiscal years being considered are 1956–1969); (ii) the firm actually traded on the NYSE as of the beginning of the portfolio holding period and is included in the merged tape described above; and (iii) the relevant investment return and financial statement data are not missing. A total of 753 firms satisfied the above requirements for at least one year, with about 500, on average, qualifying for inclusion in each of the 14 years.

Method of Analysis

Beginning with 1956, the P/E ratio of every sample security was computed. The numerator of the ratio was defined as the market value of common stock (market price times number of shares outstanding) as of December 31 and the denominator as reported annual earnings (before extraordinary items) available for common

5. To the extent data for the delisted file was not available from the COMPUSTAT-CRSP tapes, it was collected by this author. The principal sources for financial statement data were *Moody's Industrial Manual* (1956–71) and corporate annual reports. For the investment return segment, data was collected from: (i) *Bank and Quotation Record & National Association of Security Dealers, Monthly Stock Summary* (1956–71), (ii) *Moody's Dividend Record* (1956–71), (iii) *Capital Changes Reporter* (1972), and (iv) *Directory of Obsolete Securities* (1972). The following assumptions were made in computing the monthly returns on firms that were acquired or liquidated: (i) all proceeds received on a merger were reinvested in the security of the acquiring firm, and (ii) all liquidating dividends were reinvested in Fisher's Arithmetic Investment Performance (Return) Index (see Fisher [12]).

6. The fiscal year requirement was imposed since P/E portfolios are formed by ranking P/E ratios as of the fiscal year-end, and it isn't clear that these ratios computed at different points in time are comparable. Further, for reasons indicated in Section III, all firms having less than 60 months of investment return data preceding the start of the portfolio holding period in any given year were excluded.

stockholders. These ratios were ranked and five[7] portfolios were formed.[8] Although the P/E ratio was computed as of December 31, it is unlikely that investors would have access to the firm's financial statements, and exact earnings figures at that time, even though Ball & Brown [1] among others indicates that the market reacts as though it possesses such information. Since over 90% of firms release their financial reports within three months of the fiscal year-end (see [1]), the P/E portfolios were assumed to be purchased on the following April 1. The monthly returns on each of these portfolios were then computed for the next twelve months assuming an equal initial investment in each of their respective securities and then a buy-and-hold policy.[9]

The above procedure was repeated annually on each April 1 giving 14 years (April 1957–March 1971) of return data for each of the P/E portfolios. Each of these portfolios may be viewed as a mutual fund with a policy of acquiring securities in a given P/E class on April 1, holding them for a year, and then reinvesting the proceeds from disposition in the same class on the following April 1.[10]

If capital markets are dominated by risk-averse investors and portfolio (security) returns incorporate a risk premium, then the appropriate measures of portfolio (security) performance are those that take into consideration both risk and return. Three such evaluative measures have been developed by Jensen, Sharpe and Treynor, and are employed here.[11] While these measures were originally based upon the Sharpe-Lintner version of the capital asset pricing model (see [26], [17], and [9] for example), recent empirical and theoretical developments in the area (see [2], [3], [11]) suggest an alternate specification might be more appropriate. Accordingly, performance measures underlying both specifications of the asset pricing equation are estimated:

$$r_{pt} - r_{ft} = \hat{\delta}_{pf} + \hat{\beta}_{pf}[r_{mt} - r_{ft}] \tag{1}$$

$$r_{pt} - r_{zt} = \hat{\delta}_{pz} + \hat{\beta}_{pz}[r_{mt} - r_{zt}] \tag{2}$$

where r_{pt} = continuously compounded return on P/E portfolio p in month t;

7. Although the construction of five portfolios is arbitrary, that number represents a balance between obtaining as large a spread in P/E's as possible and a reasonable number of securities (about 100) in each portfolio.

8. Actually, the reciprocal of the P/E ratio was employed in ranking the securities. Consequently, firms with negative earnings (losses) were included in the highest P/E portfolio (see [18]). Since it is somewhat questionable whether such firms should be included in the highest P/E group, a sixth portfolio was constructed by excluding these firms from the highest P/E portfolio.

9. See [16] for computational details. The entire analysis was repeated assuming monthly reallocation with substantially identical results.

10. A survey of the industry distributions (20 SIC groups) of the five P/E portfolios reveals that although firms in high-technology industries, such as chemicals and electronics, are disproportionately concentrated in the high P/E classes, the various portfolios consist of securities drawn from the entire spectrum of industries. The results of a chi-square test, however, reject the hypothesis that the proportion of firms in the 20 industry groups is the same in all P/E portfolios.

11. See Friend & Blume [13] for an excellent discussion comparing these three measures.

computed as the natural logarithm of one plus the realized monthly return (wealth relative).

r_{mt} = continuously compounded return on "market portfolio" in month t; measured by the natural logarithm of the link relative of Fisher's "Arithmetic Investment Performance (Return) Index" (see [12]).

r_{ft} = continuously compounded "risk-free" return in month t; measured by the natural logarithm of one plus the monthly return on 30-day U.S. treasury bills.

r_{zt} = continuously compounded return on "zero-beta" portfolio; measured by the natural logarithm of one plus the ex post estimate, $\hat{\gamma}_{0t}$.[12]

$\hat{\delta}_{pf}, \hat{\delta}_{pz}$ = estimated intercepts (differential return − Jensen's measure).

$\hat{\beta}_{pf}, \hat{\beta}_{pz}$ = estimated slopes (systematic risk).

III. Empirical Results

Relative Performance of the P/E Portfolios

Equations (1) and (2) were estimated by ordinary least squares (OLS) using 168 months of return data (April 1957–March 1971). Table 1 shows the scores of the three performance measures and selected summary statistics for the (i) five P/E portfolios (A = highest P/E, B, C, D and E = lowest P/E); (ii) highest P/E portfolio (A) excluding firms with negative earnings, A^*; (iii) sample, S and (iv) Fisher's Index, F.

The following observations on the results in Table 1 seem pertinent.[13] First, consider the median price-earnings ratio and inter-quartile range for each of the P/E portfolios over the 14-year period ending March 31, 1971. The differences in P/E ratios for the various portfolios are, of course, significant. Since these statistics are based on 1957–71 pooled data, the inter-quartile ranges reflect the dispersion of P/E ratios over the 14-year period.

Second, the two low P/E portfolios, D and E, earned on average 13.5% and 16.3% per annum respectively over the 14-year period; whereas the two high P/E portfolios, A (or A^*) and B, earned 9.3–9.5% per year. In fact, Table 1 indicates that the average annual rates of return decline (to some extent monotonically) as one moves from the low P/E to high P/E portfolios.[14] However, contrary to capital market theory, the higher returns on the low P/E portfolios were not associated with higher levels of systematic risk; the systematic risks of portfolios D and E are lower than those for portfolios A, A^* and B. Accordingly, Jensen's

12. Ex post estimates of $r_{zt}, \hat{\gamma}_{0t}$, for the period 1935–1968 (June) were generously provided by Professors Fama and MacBeth (see [11]). Using their methodology, estimates for the period July 1968–71 were computed. As in the case of r_{ft} and r_{mt}, $\hat{\gamma}_{0t}$ is assumed to be exogenously determined.

13. It should be noted that the results in Table 1 are based on continuous compounding and that although monthly return data were employed in estimating equations (1) and (2), $\bar{r}_p$, $\bar{r}'_p$, $\hat{\delta}_p$ and $\sigma(\tilde{r}'_p)$ in that table have been stated on an annual basis by multiplying their mean monthly values by 12. This is always possible under continuous compounding due to the additive property of logarithms, i.e. if $\bar{r}^*_p$ and $\bar{r}_p$ are the continuously compounded mean monthly and annual returns respectively, then it can be easily shown that $\bar{r}_p = 12\bar{r}^*_p$.

Furthermore, the entire analysis was repeated assuming monthly compounding with substantially similar results.

14. A year-by-year comparison reveals that this pattern is not discernible for certain periods, e.g. for the years ended March 31, 1958 and 1970.

TABLE 1

PERFORMANCE MEASURES & RELATED SUMMARY STATISTICS
(April 1957–March 1971)

Performance Measure/ Summary Statistic	CAPM defined with	P/E Portfolios[1]						Market Portfolios[1]	
		A	*A**	*B*	*C*	*D*	*E*	*S*	*F*
Median P/E ratio and inter-quartile range[2]	—	35.8 (41.8)	30.5 (21.0)	19.1 (6.7)	15.0 (3.2)	12.8 (2.6)	9.8 (2.9)	15.1 (9.6)	
Average annual rate of return ($\bar{r}_p$)[3]	—	0.0934	0.0955	0.0928	0.1165	0.1355	0.1630	0.1211	0.1174
Average annual excess return ($\bar{r}'_p$)[4]	r_f	0.0565	0.0585	0.0558	0.0796	0.0985	0.1260	0.0841	0.0804
	r_z	0.0194	0.0214	0.0187	0.0425	0.0613	0.0889	0.0470	0.0433
Systematic risk ($\hat{\beta}_p$)	r_f	1.1121	1.0579	1.0387	0.9678	0.9401	0.9866	1.0085	1.0000
	r_z	1.1463	1.0919	1.0224	0.9485	0.9575	1.0413	1.0225	1.0000
Jensen's differential return ($\hat{\delta}_p$) and t-value in parenthesis	r_f	−0.0330 (−2.62)	−0.0265 (−2.01)	−0.0277 (−2.85)	0.0017 (0.18)	0.0228 (2.73)	0.0467 (3.98)	0.0030 (0.62)	
	r_z	−0.0303 (−2.59)	−0.0258 (−2.04)	−0.0256 (−2.63)	0.0014 (0.15)	0.0198 (2.34)	0.0438 (3.80)	0.0027 (0.57)	
Treynor's reward-to-volatility measure:[5] $\bar{r}'_p/\hat{\beta}_p$	r_f	0.0508	0.0553	0.0537	0.0822	0.1047	0.1237	0.0834	0.0804
	r_z	0.0169	0.0196	0.0183	0.0448	0.0640	0.0854	0.0460	0.0433
Sharpe's reward-to-variability measure:[6] $\bar{r}'_p/\sigma(\tilde{r}'_p)$	r_f	0.0903	0.0978	0.0967	0.1475	0.1886	0.2264	0.1526	0.1481
	r_z	0.0287	0.0331	0.0312	0.0762	0.1095	0.1444	0.0797	0.0755
Coefficient of correlation: $\rho(\tilde{r}'_p, \tilde{r}'_m)$	r_f	0.9662	0.9594	0.9767	0.9742	0.9788	0.9630	0.9936	
	r_z	0.9748	0.9676	0.9780	0.9767	0.9809	0.9705	0.9946	
Coefficient of serial correlation: $\rho(\tilde{e}_{t+1}, \tilde{e}_t)$	r_f	0.0455	0.0845	0.0285	−0.1234	0.0065	0.1623	0.1050	
	r_z	0.0048	0.0681	0.0163	−0.1447	0.0408	0.1485	0.0763	
F-Statistics for Test on Homogeneity of Asset-Pricing Relationships (Chow-test)[7]	r_f	2.3988	2.2527	0.4497	1.2249	1.1988	0.2892	0.0496	
	r_z	0.8918	0.2490	0.9767	0.3575	0.6987	0.4761	0.2826	

1. A = highest P/E quintile, E = lowest P/E quintile, A^* = highest P/E quintile excluding firms with negative earnings, S = sample and F = Fisher Index.

2. Based on 1957–71 pooled data; inter-quartile range is shown in parenthesis.

3. $\bar{r}_p = (\Sigma_{t=1}^{168} r_{pt})/14$, where r_{pt} is the continuously compounded return of portfolio p in month t (April 1957–March 1971).

4. $\bar{r}'_p = (\Sigma_{t=1}^{168} r'_{pt})/14$, where r'_{pt} is the continuously compounded excess return (r_{pt} minus r_{ft} or r_{zt}) of portfolio p in month t (April 1957–March 1971).

5. Mean excess return on portfolio p, $\bar{r}'_p$, divided by its systematic risk, $\hat{\beta}_p$.

6. Mean excess return on portfolio p, $\bar{r}'_p$, divided by its standard deviation, $\sigma(\tilde{r}'_p)$.

7. None of the computed figures are significant at the 0.05 level: $Pr(F(2,120) \geqslant 3.07) = 0.01$; $Pr(F(2,\infty) \geqslant 3.0) = 0.05$ and degrees of freedom in denominator = 164.

measure (differential return) indicates that, if we ignore differential tax effects regarding dividends and capital gains, the low P/E portfolios, E and D, earned about $4\frac{1}{2}\%$ and 2% per annum respectively *more* than that implied by their levels of risk, while the high P/E portfolios earned $2\frac{1}{2}$–3% per annum *less* than that implied by their levels of risk. Furthermore, assuming normality,[15] these differential returns are statistically significant at the 0.05 level or higher.[16] Since the relative systematic risks of the P/E portfolios are not substantially different, relative performance as indicated by Treynor's measure (reward-to-volatility) is consistent with that indicated by $\hat{\delta}_p$. As would be expected, all of the P/E portfolios are well diversified[17]—the correlation coefficients for the return of the various portfolios and the market (Fisher Index) are all greater than 0.95. Consequently, the Sharpe measure (reward-to-variability) also shows that the performance of the low P/E portfolios is superior to that of their high ratio counterparts.

Third, with the exception of portfolios E and C, the serial correlation in the regression residuals is fairly small for both versions of the asset pricing model. The residuals from the regressions for portfolios E and C were tested for positive and negative first order serial correlation respectively. Results of the Von Neumann test (see [15]) indicate that (i) the null hypothesis of zero positive first order autocorrelation could be rejected at the 0.05 level for portfolio E, and (ii) for portfolio C, the null hypothesis (zero negative first order autocorrelation) could be rejected for the "zero-beta" version at the 0.05 level. Consequently, while the estimated differential returns and systematic risks for portfolios E and C are unbiased, the conventional methods for determining statistical significance, strictly speaking, are not applicable.[18]

A fundamental assumption underlying the results in Table 1 is stationarity of the regression relationships—differential return (intercept) and systematic risk (slope)—over the entire 14-year period. To determine the validity of this assumption, the 14 years were divided into two non-overlapping sub-periods of seven years each (April 1957–March 1964 and April 1964–March 1971). Equations (1) and (2) were then estimated by OLS for each of the various P/E portfolios and the sample in each of these two sub-periods. The homogeneity of the estimated regression coefficients in the two time-periods was tested statistically,[19] and the results of this

15. The reader should use some caution in accepting the significance levels since the normality assumption can be questioned. For example, see Fama [10].

16. The results in Table 1 assume that the P/E portfolios are formed and traded annually. To investigate the impact of frequency of trading, the analysis was repeated for intervals of up to five years. For the bi-annual trading situation, the differential returns are largely similar to those shown in Table 1. For longer periods, in particular the five-year case (i.e., trading occurs in April 1962 and April 1967), the differential returns for all of the P/E portfolios, as might be expected, are not statistically different from zero.

17. Recall that, on average, each of the P/E portfolios (except A^*) is composed of about 100 securities. Portfolio A^*, which includes the securities in A other than those with negative earnings, has on average about 80 securities in each of the annual trading periods.

18. Scheffe [24] shows that by using the (estimated) autocorrelation coefficient and the asymptotic property of the t-distribution, one can estimate the effect of serial correlation on confidence intervals. Computations, however, show that after adjusting for serial correlation in portfolio E's residuals, the nominal significance levels are not altered significantly.

19. The statistical test employed is often referred to as the "Chow test." See Johnston [15].

test appear in the last panel in Table 1. It will be noted that none of the F-statistics are significant at the 0.05 level. This finding, of couse, is consistent with the hypothesis that systematic risk, differential returns, and related measures of performance for each of the seven portfolios were not different in the two time-periods.

Differential Tax Effects

The results in Table 1 ignore the effect of the differential treatment given to the taxation of dividends and capital gains. Empirical evidence on whether capital asset prices incorporate this differential tax effect is conflicting. Brennan [7] concluded that differential tax effects are important in the determination of security yields. Black & Scholes [4], on the other hand, question Brennan's analysis. On the basis of their empirical results, they argue that there are virtually no differential returns earned by investors who buy high dividend-yielding securities or low dividend-yielding ones. However, to verify the sensitivity of the results in Table 1 to these tax effects, the following approach was employed. Assuming the tax rate on capital gains and dividends to be 0.25 and 0.50 respectively, the monthly returns, net of tax, for each of the P/E portfolios, the sample, the risk-free asset[20] and the market portfolio (Fisher Index) were computed. Equation (1) was then re-estimated by OLS employing the 168 months of after-tax return data. Selected summary statistics from these regressions appear in Table 2.

TABLE 2

PERFORMANCE MEASURES, NET OF TAX, AND RELATED SUMMARY STATISTICS
(CAPM: $r_m - r_f$; April 1957–March 1971)

Portfolio	Performance Measure/Statistic[1,2] $\bar{r}_p$	$\hat{\beta}_p$	$\hat{\delta}_p$	$t(\hat{\delta}_p)$	$\bar{r}'_p/\hat{\beta}_p$	$\bar{r}'_p/\sigma(\tilde{r}'_p)$	$\rho(\tilde{r}'_p,\tilde{r}'_m)$	$\rho(\tilde{e}_t,\tilde{e}_{t+1})$	Chow Test:[3] F-Statistic
A	0.0699	1.1161	−0.0198	−2.10	0.0460	0.1094	0.9667	0.0404	2.4093
*A**	0.0703	1.0611	−0.0158	−1.61	0.0488	0.1153	0.9603	0.0827	2.1886
B	0.0647	1.0428	−0.0203	−2.86	0.0443	0.1064	0.9779	0.0360	0.4766
C	0.0810	0.9711	0.0006	0.09	0.0644	0.1543	0.9753	−0.1271	1.1642
D	0.0941	0.9451	0.0153	2.43	0.0800	0.1924	0.9788	0.0104	1.1574
E	0.1145	0.9913	0.0328	3.73	0.0969	0.2293	0.9632	0.1541	0.3168
S	0.0852	1.0126	0.0022	0.63	0.0659	0.1611	0.9941	0.1172	0.0289
F	0.0822	1.0000	—	—	0.0637	0.1566	—	—	—

1. Continuously compounded annual rates, net of 25% and 50% tax on capital gains and dividends respectively.

2. $\bar{r}_p$ = average annual return; $\bar{r}'_p$ = average annual excess return; $\hat{\beta}_p$ = estimated systematic risk; $\hat{\delta}_p$ = estimated differential return; $t(\hat{\delta}_p)$ = t-value for $\hat{\delta}_p$; $\bar{r}'_p/\hat{\beta}_p$ = reward-to-volatility ratio; $\bar{r}'_p/\sigma(\tilde{r}'_p)$ = reward-to-variability ratio; $\rho(\tilde{r}'_p,\tilde{r}'_m)$ = correlation coefficient for $\tilde{r}'_p$ and $\tilde{r}'_m$; $\rho(\tilde{e}_t,\tilde{e}_{t+1})$ = serial correlation coefficient.

3. Test on homogeneity of asset pricing relationships; none of the values are significant at the 0.05 level.

20. The returns on the risk-free asset (30-day treasury bills) were treated as ordinary income for tax purposes. No attempt was made to estimate equation (2) on an after-tax basis due to the inherent difficulty in specifying the return on the zero-beta portfolio, $\bar{r}_z$, on an after-tax basis.

Although the adjustment for tax effects result in $\hat{\delta}_p$ being closer to zero,[21] the general relationships discussed in connection with the before-tax case also seem to hold here. Therefore, assuming the tax rate estimates are reasonably realistic, differential tax rates on dividends and capital gains cannot entirely explain the relative before-tax performance of the various portfolios.

The Effect of Risk on Performance Measures

The propriety of the one-parameter performance measures employed in this paper is conditional upon the validity of the asset pricing models underlying equations (1) and (2). To the extent these models do not reflect the equilibrium risk-return relationships in capital markets, the related evaluative measures also do not appropriately measure the performance of the various P/E portfolios. Previous empirical work by Friend & Blume [13], and Black, Jensen & Scholes [3] among others, indicate that, contrary to theory, the differential returns, δ's are on average non-zero and are inversely related to the level of systematic risk;[22] low risk (low β) portfolios, on average, earn significantly more than that predicted by the model ($\delta > 0$) and, on average, high risk portfolios earn significantly less than that predicted by the model ($\delta < 0$).

A review of the data presented in Table 1 shows that those results seem to display this property. If this is the case, conclusions regarding the relative performance of the P/E portfolios would have to be qualified. The following test was conducted to determine the bias, if any, caused by β. For each of the P/E portfolios (A, A^*, B, C, D and E) and the sample, (S), five sub-portfolios were constructed so as to maximize the dispersion of their systematic risks.[23] Equations (1) and (2) were then estimated by OLS for each of these sub-portfolios using 14 years of monthly data. Table 3 includes selected summary statistics for these regressions.

Consistent with the results of Friend & Blume and Black, Jensen & Scholes, Table 3 shows that the $\hat{\delta}$ of a portfolio does seem to depend on its $\hat{\beta}$; the higher the $\hat{\beta}$ the lower the $\hat{\delta}$. This observation holds for each of the P/E classes and the sample. When $\hat{\beta}$ is held constant, $\hat{\delta}$ seems to depend on its P/E class. To see this more clearly, a scatter diagram of $\hat{\delta}$ and $\hat{\beta}$ for the P/E classes and the sample

21. Note that $\hat{\delta}_p$ for A^* is not significantly different from zero at the 0.05 level or higher.

22. Friend & Blume [13] also show empirically that, in addition to the Jensen measure, the Treynor and Sharpe measures are also related to β and state that the three one-parameter measures based on capital market theory "seem to yield seriously biased estimates of performance, with the magnitude of the bias related to portfolio risk" (p. 574). Since the bias seems to be shared by the three measures, only Jensen's differential return is investigated in this sub-section.

23. The methodology employed in the construction of these sub-portfolios is similar to that described in Black, Jensen & Scholes [3]. Consider the formation of sub-portfolios for P/E class E. Starting with April 1957 β for each of the securities included in portfolio E was estimated by regressing that security's excess return ($r_{jt} - r_{ft}$ or $r_{jt} - r_{zt}$ as the case may be) on the excess return on the market using 60 months of *historical* data. Continuously compounded data was employed for this purpose. These securities were then ranked on estimated β from maximum to minimum, and 5 groups (sub-portfolios) were formed. The monthly returns on each of these 5 sub-portfolios were computed for the next 12 months assuming an equal-initial investment and then a buy-and-hold policy. This procedure was repeated annually on each April 1 giving 14 years of return data for each of the 5 sub-portfolios for P/E class E. The sub-portfolios for the other P/E classes and the sample were computed in an analogous fashion.

TABLE 3

MEAN EXCESS & DIFFERENTIAL RETURNS BY P/E AND SYSTEMATIC RISK CLASSES[1]
(April 1957–March 1971)

Portfolio		Capital Asset Pricing Model/Summary Statistic[2]									
P/E	β	$r_m - r_f$					$r_m - r_z$				
Class	Class	$\hat{\beta}_p$	$\bar{r}'_p$	$\hat{\delta}_p$	$t(\hat{\delta}_p)$	$\hat{\rho}$	$\hat{\beta}_p$	$\bar{r}'_p$	$\hat{\delta}_p$	$t(\hat{\delta}_p)$	$\hat{\rho}$
	1	0.724	0.059	0.001	0.06	0.84	0.753	0.021	−0.012	−0.54	0.85
	2	0.936	0.089	0.014	0.72	0.90	0.971	0.013	−0.029	−1.44	0.91
A	3	1.121	0.058	−0.032	−1.50	0.91	1.132	0.023	−0.026	−1.28	0.93
	4	1.282	0.041	−0.063	−2.50	0.91	1.370	0.020	−0.039	−1.67	0.93
	5	1.554	0.019	−0.106	−3.76	0.92	1.552	0.002	−0.065	−2.34	0.93
	1	0.683	0.064	0.009	0.42	0.81	0.723	0.021	−0.010	−0.46	0.82
	2	0.938	0.074	−0.001	−0.06	0.88	0.912	0.020	−0.020	−0.97	0.89
*A**	3	1.017	0.063	−0.018	−0.76	0.87	1.073	0.027	−0.020	−0.94	0.92
	4	1.222	0.042	−0.056	−2.39	0.91	1.261	0.006	−0.049	−2.02	0.92
	5	1.498	0.034	−0.087	−2.93	0.91	1.547	0.016	−0.051	−1.84	0.93
	1	0.753	0.044	−0.016	−0.95	0.88	0.691	0.017	−0.013	−0.79	0.88
	2	0.903	0.073	0.001	0.04	0.91	0.897	0.009	−0.030	−1.81	0.93
B	3	1.039	0.037	−0.046	−2.84	0.94	1.015	0.018	−0.026	−1.68	0.95
	4	1.196	0.065	−0.031	−1.54	0.93	1.160	0.037	−0.013	−0.64	0.93
	5	1.337	0.043	−0.064	−2.96	0.93	1.373	−0.002	−0.061	−3.12	0.95
	1	0.658	0.102	0.049	2.79	0.85	0.588	0.070	0.044	2.94	0.87
	2	0.840	0.095	0.027	1.62	0.90	0.811	0.045	0.009	0.65	0.93
C	3	0.952	0.070	−0.007	−0.45	0.93	0.922	0.032	−0.008	−0.56	0.94
	4	1.039	0.058	−0.025	−1.44	0.93	1.108	0.049	0.001	0.04	0.94
	5	1.381	0.061	−0.051	−2.35	0.94	1.347	0.005	−0.054	−2.58	0.94
	1	0.649	0.127	0.075	5.02	0.88	0.706	0.094	0.063	4.16	0.90
	2	0.898	0.116	0.044	2.66	0.92	0.838	0.074	0.038	2.38	0.92
D	3	0.961	0.095	0.017	1.22	0.94	0.945	0.051	0.010	0.62	0.94
	4	1.022	0.097	0.014	0.85	0.93	1.065	0.047	0.000	0.03	0.95
	5	1.203	0.047	−0.050	−2.59	0.94	1.264	0.030	−0.025	−1.48	0.96
	1	0.742	0.130	0.070	3.60	0.85	0.784	0.108	0.074	3.57	0.86
	2	0.911	0.125	0.052	3.00	0.91	0.917	0.084	0.044	2.34	0.91
E	3	0.913	0.122	0.049	2.82	0.91	1.038	0.075	0.030	1.76	0.94
	4	1.101	0.106	0.018	0.88	0.92	1.171	0.078	0.027	1.33	0.93
	5	1.281	0.134	0.031	1.31	0.92	1.310	0.085	0.028	1.31	0.94
	1	0.701	0.093	0.037	3.46	0.94	0.677	0.053	0.023	2.55	0.96
Sample	2	0.886	0.095	0.024	2.89	0.98	0.891	0.051	0.012	1.39	0.98
(*S*)	3	0.969	0.091	0.013	1.57	0.98	1.002	0.052	0.009	1.07	0.98
	4	1.134	0.070	−0.021	−2.21	0.98	1.147	0.040	−0.101	−1.18	0.99
	5	1.383	0.064	−0.047	−3.16	0.97	1.422	0.032	−0.030	−2.67	0.98

1. Continuously compounded annual rates; details are described in footnote 13.

2. $\hat{\beta}_p$ = estimated systematic risk; $\bar{r}'_p$ = mean excess return; $\hat{\delta}_p$ = estimated differential return; $t(\hat{\delta}_p)$ = t-value for $\hat{\delta}_p$ and $\hat{\rho}$ = coefficient of correlation between $\tilde{r}'_p$ and the excess return on the market $\tilde{r}'_m$.

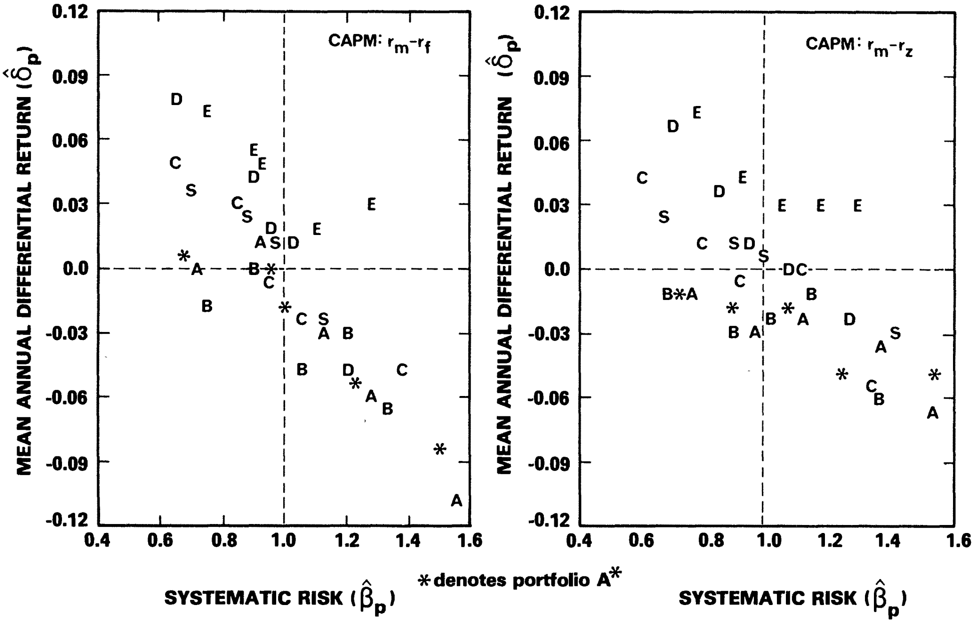

FIGURE 1. Scatter Diagram of Mean Annual Differential Return vs. Systematic Risk by P/E Classes (April 1957–March 1971)

appears in Figure 1. It will be observed that $\hat{\delta}$ for the low P/E classes is larger than that for the high P/E's. This is generally true for most levels of $\hat{\beta}$.

These results are consistent with one of the following two propositions. First, it seems that the asset pricing models do not completely characterize the equilibrium risk-return relationships during the period studied and that, perhaps, these models are mis-specified because of the omission of other relevant factors.[24] However, this line of reasoning, when combined with our results, suggests that P/E ratios seem to be a proxy for some omitted risk variable. On the other hand, if the asset pricing models are assumed to be valid, the results included in Table 3 and Figure 1 confirm the earlier remarks on the relative performance of the P/E portfolios. Nevertheless, the bias caused by β is sufficiently severe that it would be inappropriate to rely exclusively on CAPM performance measures.

Comparisons with Randomly Selected Portfolios of Equivalent Risk

Pettit & Westerfield [23] argue that empirical studies employing asset pricing models should present performance measures for portfolios composed of randomly selected securities of the same overall level of risk. Their approach attempts to neutralize the bias described above by holding the level of β constant in performance comparisons and allows a direct comparison to be made between the realized return on a P/E portfolio with that on the related random portfolio of equivalent risk. In order to make these comparisons, the following procedures were employed.

For *each* of the six P/E portfolios (A, A^*, B, C, D & E) ten portfolios consisting

24. See Friend & Blume [13] for an elaboration.

of randomly selected securities with β's comparable to the P/E portfolio were formed.[25] Equations (1) and (2) were then estimated by OLS for each of these 60 random portfolios using 168 months of before-tax return data.[26] From the ten random portfolios associated with each P/E portfolio, the one whose estimated systematic risk, $\hat{\beta}$, was closest to that of the P/E portfolio was selected for analysis.[27]

Panel *A* in Table 4 shows on a before- and after-tax basis for the Sharpe-Lintner version of CAPM:[28] (i) the estimated systematic risk, $\hat{\beta}_R$, for six random portfolios (*RA*, *RA**, *RB*, *RC*, *RD* & *RE*) related to the six P/E portfolios (*A*, *A**, *B*, *C*, *D* & *E*) respectively, (ii) the deviation of the random portfolio's systematic risk from the associated P/E portfolio beta ($\hat{\beta}_p$), $\hat{\beta}_d$ (e.g. for portfolio *RA*, $\hat{\beta}_d = \hat{\beta}_A - \hat{\beta}_{RA}$) and (iii) the computed standard normal variates for Hollander's distribution-free test (see [14]) of the hypothesis $\hat{\beta}_d = 0$, $Z(\hat{\beta}_d)$. While the estimated systematic risks for portfolios *RA**, *RB*, *RC* and *RE* are extremely close to that of *A**, *B*, *C* and *E* respectively, the deviations are slightly higher for *RA* and *RD*. Hollander's test for the parallelism of two regression lines, however, indicates that none of the $\hat{\beta}_d$ are significantly different from zero. Therefore, from a statistical viewpoint, the estimated systematic risk for all of the random portfolios is not significantly different from the $\hat{\beta}$ of their associated P/E portfolios.

Consequently, a direct comparison between the returns on the random portfolios and those on the related P/E portfolio is possible. The mean annual return on each of the six random portfolios, $\bar{r}_R$, and the mean deviation from the return on associated P/E portfolio ($\bar{r}_p$), $\bar{r}_d$ (e.g. for portfolio *RA*, $\bar{r}_d = \bar{r}_A - \bar{r}_{RA}$) are shown in Panel *B* of Table 4. Consistent with the previous discussion, the low P/E portfolios

25. The basic technique employed in constructing random portfolios of equivalent risk is stratified random sampling. Beginning with April 1957 β for all n_s securities in the sample was estimated using 60 months of historical data. The n_p securities included in P/E portfolio p were then ranked on estimated β from minimum to maximum and the first 9 deciles from the distribution of β's in P/E portfolio $p, d_p(k)$, $k = 1,\ldots,9$, were identified. Fourth, all n_s securities included in the sample were then ranked on estimated β from minimum to maximum and 10 groups were formed using $d_p(k)$ as end points. If we let β_j be the beta for security j in the sample s, then sample group k for P/E portfolio p, $g_p(k)$ $k = 1,\ldots,10$, was formed as follows:

$$g_p(k) = \begin{cases} \{[j \in s \mid \beta_j \leqslant d_p(k)], j = 1,\ldots,n_s\} & k = 1 \\ \{[j \in s \mid d_p(k-1) < \beta_j \leqslant d_p(k)], j = 1,\ldots,n_s\} & k = 2,\ldots,9 \\ \{[j \in s \mid d_p(k-1) < \beta_j], j = 1,\ldots,n_s\} & k = 10 \end{cases}$$

Fifth, from each of these 10 sample groups for P/E portfolio p, $n_p/10$ securities were randomly selected by using a uniformly distributed random number generator. The n_p randomly selected securities then constituted one random portfolio associated with P/E class p, and this procedure was repeated to generate 10 random portfolios for each P/E class p. The monthly returns on each of these random portfolios were then computed for the next 12 months assuming an equal initial investment in each security and then a buy-and-hold policy. The above procedure was repeated annually on each April 1 to yield 14 years of return data for each of the random portfolios associated with P/E portfolio p.

26. Equation (1) was also estimated using after-tax return data. For the reason mentioned earlier, equation (2) was not estimated on an after-tax basis.

27. Results for all 10 random portfolios selected are not shown due to space limitations.

28. The before-tax results for the zero-beta version of CAPM are omitted since they generally parallel those reported in Table 4.

TABLE 4

SUMMARY STATISTICS FOR RANDOM PORTFOLIOS WITH SYSTEMATIC RISKS EQUIVALENT TO P/E PORTFOLIOS
(CAPM: $r_m - r_f$; April 1957–March 1971)

	Summary	Random Portfolio[1,2]											
		Before Tax						Net of Tax					
	Statistic[3]	*RA*	*RA**	*RB*	*RC*	*RD*	*RE*	*RA*	*RA**	*RB*	*RC*	*RD*	*RE*
PANEL A	$\hat{\beta}_R$	1.0789	1.0576	1.0321	0.9653	0.9603	0.9891	1.0844	1.0613	1.0385	0.9695	0.9650	0.9947
	$\hat{\beta}_d = \hat{\beta}_p - \hat{\beta}_R$	0.0332	0.0003	0.0066	0.0025	−0.0202	−0.0025	0.0317	−0.0002	0.0043	0.0016	−0.0199	0.0034
	$Z(\hat{\beta}_d)$	0.92	0.80	0.06	−0.29	−0.00	0.16	1.08	0.14	−0.06	0.28	−0.22	−0.14
PANEL B	$\bar{r}_R$	0.1177	0.1102	0.1345	0.1136	0.1253	0.1310	0.0835	0.0777	0.0952	0.0796	0.0881	0.0925
	$\bar{r}_d = \bar{r}_p - \bar{r}_R$	−0.0243	−0.0147	−0.0417	0.0029	0.0101	0.0320	−0.0136	−0.0074	−0.0305	0.0014	0.0060	0.0220
	$t(\bar{r}_d)$	−1.95	−1.07	−4.00	0.34	1.12	2.74	−1.44	−0.72	−3.94	0.21	0.87	2.49
	$Z(\tilde{r}_d)$	−2.17	−1.08	−3.45	0.36	1.39	2.62	−1.71	−0.83	−3.35	0.21	1.16	2.43
PANEL C	$\hat{\delta}_R$	−0.0060	−0.0118	0.0146	−0.0010	0.0111	0.0145	−0.0041	−0.0084	0.0106	−0.0006	0.0081	0.0106
	$t/\hat{\delta}_R$	−0.71	−1.23	1.73	−0.13	1.30	1.55	−0.66	−1.19	1.71	−0.11	1.27	1.54
	$\hat{\delta}_d = \hat{\delta}_p - \hat{\delta}_R$	−0.0270	−0.0147	−0.0423	0.0027	0.0117	0.0322	−0.0157	−0.0074	−0.0309	0.0012	0.0072	0.0222
	$\bar{r}'_R / \hat{\beta}_R$	0.0748	0.0692	0.0945	0.0920	0.0752	0.0950	0.0599	0.0558	0.0739	0.0631	0.0722	0.0744
	$(\bar{r}'/\hat{\beta})_d$	−0.0240	−0.0139	−0.0408	0.0029	0.0127	0.0287	−0.0139	−0.0070	−0.0296	0.0013	0.0078	0.0225
	$\bar{r}'_R / \sigma(\tilde{r}'_R)$	0.1354	0.1247	0.1709	0.1658	0.1362	0.1709	0.1448	0.1343	0.1785	0.1525	0.1737	0.1787
	$(\bar{r}'/\sigma[\tilde{r}'])_d$	−0.0451	−0.0269	−0.0742	0.0039	0.0228	0.0555	−0.0354	−0.0190	−0.0721	0.0018	0.0187	0.0506

1. Continuously compounded annual rates; details are described in footnote 13.

2. Portfolios *RA* through *RE* refer to random portfolios with systematic risks equivalent to P/E portfolio *A* through *E* respectively.

3. $\hat{\beta}_p, \hat{\beta}_R$ = estimated systematic risk of P/E portfolio p and related random portfolio R respectively; $Z(\hat{\beta}_d) = N(0,1)$ variates for Hollander's distribution-free test for the parallelism of two regression lines (P/E portfolio and its associated random portfolio); $\bar{r}_p, \bar{r}_R$ = average annual return on P/E portfolio p and related random portfolio R; $t(\bar{r}_d) = \bar{r}_d/(\sigma(\tilde{r}_d)/\sqrt{n}) = t$-value for $\bar{r}_d = \bar{r}_p - \bar{r}_R$ and $n = 168$; $Z(\tilde{r}_d) = N(0,1)$ variates for Wilcoxon's distribution-free test of the hypothesis $\tilde{r}_d = 0$; $\hat{\delta}_p, \hat{\delta}_R$ = estimated differential return for P/E portfolio p and related random portfolio R; $t(\hat{\delta}_R) = t$-value for $\hat{\delta}_R$; $\bar{r}'_R/\hat{\beta}_R$ = reward-to-volatility ratio for R; $(\bar{r}'/\hat{\beta})_d$ = reward-to-volatility ratio for P/E portfolio minus that for related random portfolio; $\bar{r}'_R/\sigma(\tilde{r}'_R)$ = reward-to-variability ratio for R; $(\bar{r}'/\sigma[\tilde{r}'])_d$ = reward-to-variability ratio for P/E portfolio minus that for related random portfolio.

(E and D) have generally earned returns higher than random portfolios of equivalent risk ($\bar{r}_d > 0$), while the high P/E's (A, A^* and B) have generally earned returns lower than their related random portfolios ($\bar{r}_d < 0$). Results of the parametric t-test, $t(\bar{r}_d)$, and Wilcoxon's distribution-free test (see [14]), $Z(\tilde{r}_d)$, however, indicate that $\bar{r}_d$ is significantly different from zero at the 0.05 level or higher for portfolios A, B and E only.

Panel C in Table 4 includes Jensen's differential return, Treynor's reward-to-volatility and Sharpe's reward-to-variability performance scores for the various random portfolios, as well as the mean differences in the scores between the P/E portfolios and their randomly selected counterparts. As might be expected, these results bear out the same general relationship just discussed.

An analysis of the distributions of the wealth relatives[29] for the various P/E and randomly selected portfolios provides additional insight into the differential performance of the P/E classes. Table 5 shows selected fractiles (deciles) from those distributions. In substantially all of the nine deciles shown, the low P/E portfolios, E and D, have earned a higher return (wealth relative) than their randomly selected equivalents. This, however, does not seem to be the case for the high P/E's. Furthermore, in all of the nine deciles, the highest wealth relative is obtained on the low P/E portfolios.[30]

Three additional comments may be made. The percentage of securities in each of the P/E portfolios with one-year wealth relatives greater than the median of their associated randomly selected portfolio, and the standard normal variates for the binomial test of the hypothesis that these percentages differ from 0.50 are shown in the last two columns. These results are consistent with the analysis at the portfolio level (Panel B in Table 4). Second, Table 5 shows that *all* of the portfolios consist of securities that may be considered to be "winners" and "losers". Investors who held relatively small undiversified portfolios of securities in a particular P/E class (or for that matter across such classes) during the period 1957–71 could have earned returns that were considerably higher or lower than the averages previously reported. Finally, an analysis of the tails of the distributions of wealth relatives revealed that none of the portfolios had significantly more outliers. In short, the performance of the various P/E portfolios is not dominated by the related performance of a few securities.

P/E Ratios & Trading Profits

One final issue remains outstanding: Was the performance of the lowest P/E portfolio (E), after adjustments for portfolio-related costs (e.g., transactions, search and information processing costs) and tax effects, superior to that of portfolios composed of randomly selected securities with the same overall level of risk? Could alternative classes of investors have capitalized on the market's reaction to P/E information during 1957–71?

Ten randomly selected portfolios with betas similar to that of E are considered.

29. $1 was assumed to be invested in each security every April 1 and dividends received during the year were reinvested in their respective securities; the natural logarithm of the one-year wealth relative of a security is the continuously compounded annual return on that specific security.

30. Strictly speaking, the wealth relatives of low P/E portfolios are not comparable with those of the high P/E's since the portfolios do not have the same overall level of risk.

TABLE 5

SELECTED FRACTILES FROM THE DISTRIBUTIONS OF ONE-YEAR WEALTH RELATIVES
(April 1957–March 1971 Data Pooled)

	Portfolio	Fractile[1] 0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	% Above Random Portfolio Median	$N(1,0)$ Variates[2]
Before Tax	*A*	0.7110	0.8354	0.9167	0.9845	1.0556	1.1311	1.2171	1.3412	1.5445	44.14	−4.33
	(*RA*)	(0.7579)	(0.8702)	(0.9518)	(1.0229)	(1.1019)	(1.1684)	(1.2484)	(1.3440)	(1.5318)		
	*A**	0.7355	0.8504	0.9376	1.0065	1.0670	1.1364	1.2198	1.3401	1.5187	48.73	−0.80
	(*RA**)	(0.7651)	(0.8663)	(0.9375)	(1.0055)	(1.0755)	(1.1412)	(1.2313)	(1.3437)	(1.5308)		
	B	0.7644	0.8694	0.9356	1.0009	1.0634	1.1406	1.2093	1.3129	1.4848	43.98	−4.47
	(*RB*)	(0.7800)	(0.8899)	(0.9639)	(1.0386)	(1.1085)	(1.1756)	(1.2658)	(1.3744)	(1.5774)		
	C	0.7925	0.8974	0.9686	1.0358	1.1078	1.1729	1.2437	1.3376	1.4897	52.44	1.80
	(*RC*)	(0.7946)	(0.9006)	(0.9556)	(1.0174)	(1.0909)	(1.1556)	(1.2334)	(1.3284)	(1.5038)		
	D	0.8209*	0.9185*	0.9880	1.0542*	1.1150	1.1870	1.2599	1.3539	1.5268	52.09	1.53
	(*RD*)	(0.7889)	(0.8916)	(0.9746)	(1.0344)	(1.1018)	(1.1590)	(1.2450)	(1.3559)	(1.5201)		
	E	0.8209*	0.9149	0.9892*	1.0509	1.1233*	1.1997*	1.2844*	1.4106*	1.6066*	54.49	3.34
	(*RE*)	(0.7769)	(0.8901)	(0.9667)	(1.0325)	(1.0951)	(1.1715)	(1.2592)	(1.3584)	(1.5587)		
	S	0.7784	0.8858	0.9612	1.0247	1.0959	1.1649	1.2468	1.3504	1.5316		

Net of Tax	*A*	0.7795	0.8790	0.9428	0.9945	1.0433	1.1002	1.614	1.2553	1.3934	45.37	−3.42
	(*RA*)	(0.8157)	(0.9012)	(0.9622)	(1.0194)	(1.0713)	(1.1212)	(1.1801)	(1.2464)	(1.3793)		
	*A**	0.7971	0.8912	0.9590	1.0067	1.0546	1.1031	1.1630	1.2530	1.3711	50.24	0.12
	(*RA**)	(0.8182)	(0.8968)	(0.9530)	(1.0005)	(1.0534)	(1.1063)	(1.1653)	(1.2461)	(1.3814)		
	B	0.8203	0.8989	0.9476	1.0003	1.0456	1.0996	1.1534	1.2258	1.3419	44.48	−4.09
	(*RB*)	(0.8309)	(0.9140)	(0.9729)	(1.0250)	(1.0756)	(1.1284)	(1.1911)	(1.2703)	(1.4100)		
	(*C*)	0.8375	0.9187	0.9727	1.0222	1.0759	1.1238	1.1724	1.2405	1.3493	52.59	1.90
	(*RC*)	(0.8411)	(0.9198)	(0.9676)	(1.0097)	(1.0638)	(1.1099)	(1.1662)	(1.2369)	(1.3556)		
	D	0.8571	0.9358*	0.9877*	1.0350*	1.0794	1.1320	1.1847	1.2516	1.3668	51.80	1.31
	(*RD*)	(0.8371)	(0.9169)	(0.9779)	(1.0211)	(1.0712)	(1.1166)	(1.1764)	(1.2531)	(1.3740)		
	E	0.8617*	0.9289	0.9848	1.0335	1.0864*	1.1447*	1.2021*	1.2890*	1.4317*	53.85	2.86
	(*RE*)	(0.8326)	(0.9147)	(0.9766)	(1.0215)	(1.0674)	(1.1244)	(1.1869)	(1.2572)	(1.3981)		
	S	0.8306	0.9127	0.9687	1.0162	1.0675	1.1189	1.1784	1.2510	1.3806		

1. (i) Underscored items indicate that the P/E portfolio under consideration has a higher wealth relative than its random counterpart in a given decile; and (ii) * denotes the portfolio yielding the highest wealth relative in a given decile.

2. Computed standard normal variates for the binomial test of the hypothesis that the observed fraction above random portfolio median (previous column) is significantly different from 0.50.

Panel A in Table 6 shows for each of these random portfolios the (i) estimated systematic risk (Sharpe-Lintner model) on a before- and after-tax basis, $\hat{\beta}_R$ and $\hat{\beta}_R'$ respectively; (ii) deviation of $\hat{\beta}_R$ and $\hat{\beta}_R'$ from portfolio E's systematic risk, $\hat{\beta}_d$ and $\hat{\beta}_d'$; and (iii) standard normal variates for Hollander's distribution-free test of the hypothesis that $\hat{\beta}_d$, $\hat{\beta}_d'=0$, $Z(\hat{\beta}_d)$ and $Z(\hat{\beta}_d')$. With the exception of random portfolio 7, the beta's of the various portfolios are not significantly different from that of E.[31] This finding makes it possible to directly compare the returns on E, after adjusting for portfolio-related costs and tax effects, with those of the randomly selected portfolios. The adjustments for transactions costs,[32] search and information processing costs and taxes, however, are related to the type of investor.

Four classes of investors, who are assumed to trade or rebalance their portfolios annually, are considered. They are: (I) tax-exempt reallocator, (II) tax-paying reallocator, (III) tax-exempt trader and (IV) tax-paying trader. The first two groups include investors who enter the securities market for some pre-specified portfolio readjustment reason other than speculation (e.g. adjustment of portfolio β and diversification). On the other hand, the next two categories are composed of "traders" or "speculators" who wish to capitalize on the market's reaction to P/E information per se. The distinction between "reallocator" and "trader" is important for evaluating the performance of E versus a randomly selected portfolio of equivalent risk, R, because of the different effective costs of transacting.[33] In addition to transactions costs, three further types of adjustments were made. First, marginal costs of search and information processing for portfolio E were assumed to be $\frac{1}{4}$th of 1% per annum. Second, the returns on E and R accruing to tax-paying investors were stated on an after-tax basis by assuming that capital gains (net of commissions, if any) and dividends (net of search costs, if any) were taxable annually at the 25% and 50% rates respectively.[34] Finally, in evaluating the profitability of a tax-paying trader investing in E as opposed to R, the effect of tax deferral by trading R at the end of the 14-year period rather than annually was deducted from E.[35]

31. Since random portfolio 7 and E do not have similar betas, due caution should be exercised in comparing the performance of the two portfolios. Incidentally, random portfolio 8 was employed in our earlier analysis and was designated as RE.

32. The data on round-lot commissions were obtained primarily from the 1956–71 issues of the *New York Stock Exchange Fact Book*. In the month of purchase, the security price plus commission is assumed to be invested and commission is deducted from the selling price in the month of sale. Commissions for reinvestment of dividends were ignored.

33. The effective transactions costs of acquiring E for a reallocator are the incremental commissions associated with acquiring E rather than R. However, a trader could have avoided incurring annual commissions on R by holding that portfolio over the 14-year period. Accordingly, a trader's effective transactions costs of acquiring E annually are equal to the actual commissions on E. The April 1, 1957 and March 31, 1971 commissions on R are ignored.

Computations of transactions costs also reflect the fact that a rational trader would not have incurred unnecessary charges by selling at the end of one year and then purchasing at the beginning of the next, those securities included in portfolio E in both years. On average, only 51% of the securities in E are traded annually.

34. Tax savings on capital losses are assumed to accrue to investors.

35. The capital gain earned on R over the 14-year period was assumed to be realized on March 31, 1971 and taxable at the 25% rate.

TABLE 6

AN ANALYSIS OF THE PROFITABILITY OF INVESTING IN PORTFOLIO E FOR ALTERNATIVE INVESTOR CLASSES

	Summary Statistic[2]	Random Portfolio[1] 1	2	3	4	5	6	7	8	9	10
PANEL A	$\hat{\beta}_R$	1.0029	1.0103	0.9919	0.9832	1.0159	1.0099	1.0355	0.9891	1.0088	1.0050
	$\hat{\beta}_d=\hat{\beta}_E-\hat{\beta}_R$	−0.0163	−0.0237	−0.0043	0.0034	−0.0293	−0.0233	−0.0489	−0.0025	−0.0222	−0.0184
	$Z(\hat{\beta}_d)$	−0.18	−0.21	−0.47	−0.15	−0.71	−1.30	−1.84	0.16	−0.81	−0.68
	$\hat{\beta}'_R$	1.0087	1.0143	0.9971	0.9859	1.0211	1.0147	1.0384	0.9947	1.0121	1.0082
	$\hat{\beta}'_d=\hat{\beta}'_E-\hat{\beta}'_R$	−0.0174	−0.0230	−0.0058	−0.0054	−0.0298	−0.0234	−0.0471	0.0034	−0.0208	−0.0169
	$Z(\hat{\beta}'_d)$	−0.31	−0.42	−1.02	−0.64	−1.14	−1.41	−2.08	−0.14	−0.58	−0.73
PANEL B	I. TAX-EXEMPT PORTFOLIO REALLOCATOR										
	$\bar{r}_d=\{(\overline{r_E-C_E})-S\}-\{\overline{r_R-C_R}\}$	0.0332	0.0372	0.0277	0.0254	0.0307	0.0247	0.0360	0.0280	0.0381	0.0284
	$t(\bar{r}_d)$	3.832	3.375	2.558	2.172	3.955	2.051	2.531	2.179	3.041	2.478
	Wilcoxon: $Pr(\tilde{r}_d=0)$	0.000	0.003	0.021	0.045	0.000	0.029	0.021	0.025	0.008	0.015
	II. TAX-PAYING PORTFOLIO REALLOCATOR										
	$\bar{r}_d=\{(\overline{r'_E-C'_E})-S'\}-\{\overline{r'_R-C'_R}\}$	0.0247	0.0278	0.0203	0.0187	0.0229	0.0184	0.0269	0.0208	0.0285	0.0212
	$t(\bar{r}_d)$	3.490	3.205	2.364	2.004	3.611	1.962	2.414	2.071	2.898	2.308
	Wilcoxon: $Pr(\tilde{r}_d=0)$	0.002	0.003	0.029	0.052	0.001	0.034	0.021	0.034	0.008	0.025
	III. TAX-EXEMPT TRADER										
	$\bar{r}_d=\{(\overline{r_E-C^*_E})-S\}-\bar{r}_R$	0.0229	0.0269	0.0178	0.0149	0.0204	0.0145	0.0257	0.0182	0.0281	0.0180
	$t(\bar{r}_d)$	2.579	2.341	1.619	1.264	2.555	1.197	1.805	1.399	2.282	1.548
	Wilcoxon: $Pr(\tilde{r}_d=0)$	0.021	0.025	0.077	0.196	0.029	0.163	0.059	0.134	0.012	0.121
	IV. TAX-PAYING TRADER										
	$\bar{r}_d=\{(r'_E-C^{*\prime}_E)-S'\}-\{\bar{r}'_R+d'_R\}$	0.0111	0.0147	0.0060	0.0038	0.0088	0.0036	0.0135	0.0066	0.0158	0.0062
	$t(\bar{r}_d)$	1.533	1.626	0.689	0.402	1.361	0.378	1.212	0.648	1.634	0.670
	Wilcoxon: $Pr(\tilde{r}_d=0)$	0.086	0.086	0.232	0.476	0.213	0.207	0.232	0.313	0.045	0.359

1. Continuously compounded annual rates; portfolio construction is described in footnote 25.

2. $\hat{\beta}_R, \hat{\beta}'_R$ = estimated systematic risk (Sharpe-Lintner model) for random portfolio R on a before and after tax basis respectively; $\hat{\beta}_d$ = estimated systematic risk of E (0.9866) minus $\hat{\beta}_R$; $\hat{\beta}'_d$ = estimated net of tax systematic risk of E (0.9913) minus $\hat{\beta}'_R$; $Z(\hat{\beta}_d), Z(\hat{\beta}'_d) = N(0,1)$ variates for Hollander's distribution-free test of parallelism of two regression lines; r_E, r_R = before-tax annual return on E and R; r'_E, r'_R = after-tax annual return on E and R; C_E, C_R = transactions costs on E and R, assuming all securities traded annually; C'_E, C'_R = transactions costs, net of tax savings, on E and R, assuming all securities traded annually; $C^*_E, C^{*\prime}_E$ = before-tax and after-tax effective (actual) transactions costs on E; S, S' = before-tax and after-tax search and information processing costs; d'_R = tax-savings from deferring payments by trading R once over 14 years, rather than annually; $t(\bar{r}_d) = \bar{r}_d/(\sigma(\bar{r}_d)/\sqrt{n})$ = t-value for $\bar{r}_d$, the mean return on E minus that on R, net of applicable portfolio-related costs, and $n = 14$; and Wilcoxon: $Pr(\tilde{r}_d=0)$ = significance levels for Wilcoxon's one sample distribution-free test of the hypothesis $\tilde{r}_d=0$.

Panel *B* in Table 6 shows, for each of these four categories of investors, the mean incremental returns ($\bar{r}_d$) that could have been earned by acquiring *E* rather than *R*, after adjusting for portfolio-related costs and taxes. Also shown are the *t*-values and the computed significance levels for Wilcoxon's one sample distribution-free test of the hypothesis $\bar{r}_d = 0$. By investing in *E* the portfolio reallocators could have earned returns, after cost and after tax, amounting to 2%–3$\frac{1}{2}$% per annum *more* than the associated random portfolios of equivalent risk. These incremental returns are statistically significant at the 0.05 level or higher. On the other hand, although the traders could also have earned $\frac{1}{2}$%–2$\frac{1}{2}$% per annum *more* by investing in *E* rather than in the randomly selected portfolios, the differences in returns are generally not significantly different from zero.

IV. Summary and Conclusions

In this paper an attempt was made to determine empirically the relationship between investment performance of equity securities and their P/E ratios. While the efficient market hypothesis denies the possibility of earning excess returns, the price-ratio hypothesis asserts that P/E ratios, due to exaggerated investor expectations, may be indicators of future investment performance.

During the period April 1957–March 1971, the low P/E portfolios seem to have, on average, earned higher absolute and risk-adjusted rates of return than the high P/E securities. This is also *generally* true when bias on the performance measures resulting from the effect of risk is taken into account. These results suggest a violation in the joint hypothesis that (i) the asset pricing models employed in this paper have descriptive validity and (ii) security price behavior is consistent with the efficient market hypothesis. If (i) above is assumed to be true, conclusions pertaining to the second part of the joint hypothesis may be stated more definitively. We therefore assume that the asset pricing models are valid.

The results reported in this paper are consistent with the view that P/E ratio information was not "fully reflected" in security prices in as rapid a manner as postulated by the semi-strong form of the efficient market hypothesis. Instead, it seems that disequilibria persisted in capital markets during the period studied. Securities trading at different multiples of earnings, on average, seem to have been inappropriately priced vis-a-vis one another, and opportunities for earning "abnormal" returns were afforded to investors. Tax-exempt and tax-paying investors who entered the securities market with the aim of rebalancing their portfolios annually could have taken advantage of the market disequilibria by acquiring low P/E stocks. From the point of view of these investors a "market inefficiency" seems to have existed. On the other hand, transactions and search costs and tax effects hindered traders or speculators from exploiting the market's reaction and earning net "abnormal" returns which are significantly greater than zero. Accordingly, the hypothesis that capital markets are efficient in the sense that security price behavior is consistent with the semi-strong version of the "fair game" model cannot be rejected unequivocally.

In conclusion, the behavior of security prices over the 14-year period studied is, perhaps, not completely described by the efficient market hypothesis. To the extent low P/E portfolios did earn superior returns on a risk-adjusted basis, the propositions of the price-ratio hypothesis on the relationship between investment performance of equity securities and their P/E ratios seem to be valid. Contrary to the growing belief that publicly available information is instantaneously impounded in security prices, there seem to be lags and frictions in the adjustment process. As a result, publicly available P/E ratios seem to possess "information content" and may warrant an investor's attention at the time of portfolio formation or revision.

REFERENCES

1. Ray Ball and Philip Brown. "An Empirical Evaluation of Accounting Income Numbers", *Journal of Accounting Research* (Autumn 1968), pp. 159–178.
2. Fischer Black. "Capital Market Equilibrium with Restricted Borrowing", *Journal of Business* (July 1972), pp. 444–455.
3. Fischer Black, Michael C. Jensen and Myron Scholes. "The Capital Asset Pricing Model: Some Empirical Tests", in *Studies in the Theory of Capital Markets*, Michael C. Jensen, ed. (New York: Praeger, 1972), pp. 79–121.
4. Fischer Black and Myron Scholes. "The Effects of Dividend Yield and Dividend Policy on Common Stock Prices and Returns", *Journal of Financial Economics*, I (1974), pp. 1–22.
5. William Breen. "Low Price-Earnings Ratios and Industry Relatives", *Financial Analysts Journal* (July–August 1968), pp. 125–127.
6. William Breen and James Savage. "Portfolio Distributions and Tests of Security Selection Models", *Journal of Finance* (December 1968), pp. 805–819.
7. Michael J. Brennan. "Investor Taxes, Market Equilibrium and Corporate Finance" (Unpublished Ph.D. thesis, Massachusetts Institute of Technology, June 1970).
8. Eugene F. Fama. "Efficient Capital Markets: A Review of Theory and Empirical Work", *Journal of Finance* (May 1970), pp. 383–417.
9. ———. "Risk, Return and Equilibrium: Some Clarifying Comments", *Journal of Finance* (March 1968), pp. 29–40.
10. ———. "The Behavior of Stock-Market Prices", *Journal of Business* (January 1965), pp. 34–105.
11. Eugene F. Fama and James D. MacBeth. "Risk, Return and Equilibrium: Some Empirical Tests", *Journal of Political Economy* (May–June 1973), pp. 607–636.
12. Lawrence Fisher. "Some New Stock Market Indices", *Journal of Business* (January 1966), pp. 191–225.
13. Irwin Friend and Marshall Blume. "Measurement of Portfolio Performance Under Uncertainty", *The American Economic Review* (September 1970), pp. 561–575.
14. Myles Hollander and Douglas A. Wolfe. *Nonparametric Statistical Methods* (New York: John Wiley, 1973).
15. J. Johnston. *Econometric Methods*, 2nd Edition (New York: McGraw Hill, 1972).
16. Henry A. Latane and William E. Young. "Test of Portfolio Building Rules", *Journal of Finance* (September 1969), pp. 595–612.
17. John Lintner. "The Valuation of Risky Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets", *Review of Economics and Statistics* (February 1965), pp. 13–37.
18. James D. McWilliams. "Prices, Earnings and P. E. Ratios", *Financial Analysts Journal* (May–June 1966), pp. 137–142.
19. Paul F. Miller and Ernest R. Widmann. "Price Performance Outlook for High & Low P/E Stocks", *1966 Stock and Bond Issue, Commercial & Financial Chronicle* (September 29, 1966), pp. 26–28.
20. Francis Nicholson. "Price Ratios in Relation to Investment Results", *Financial Analysts Journal* (January–February 1968), pp. 105–109.
21. ———. "Price-Earnings Ratios", *Financial Analysts Journal* (July–August 1960, pp. 43–45).
22. Aharon R. Ofer. "Investors' Expectations of Earnings Growth, Their Accuracy and Effects on the Structure of Realized Rates of Return", *Journal of Finance* (May 1975), pp. 509–523.

23. R. Richardson Pettit and Randolph Westerfield. "Using the Capital Asset Pricing Model and the Market Model to Predict Security Returns", *Journal of Financial and Quantitative Analysis* (September 1974), pp. 579–605.
24. H. A. Scheffé. *The Analysis of Variance* (New York: Wiley, 1960).
25. W. F. Sharpe. *Portfolio Theory and Capital Markets* (New York: McGraw Hill, 1970).
26. ———. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk", *Journal of Finance* (September 1964), pp. 425–442.
27. Seymour Smidt. "A New Look at the Random Walk Hypothesis", *Journal of Financial and Quantitative Analysis* (September 1968), pp. 235–262.
28. J. P. Williamson. *Investments—New Analytic Techniques* (New York: Praeger, 1970).