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EXPECTATIONS AND SHARE PRICES*

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It is generally believed that security prices are determined by expectations concerning firm and economic variables. Despite this belief there is very little research examining expectational data. In this paper we examine how expectations concerning earning per share effect share price. We first show that knowledge concerning analyst's forecasts of earnings per share cannot by itself lead to excess returns. Any information contained in the consensus estimate of earnings per share is already included in share price. Investors or managers who buy high growth stocks where high growth is determined by consensus beliefs should not earn an excess return. This is not due to earnings having no effect upon share price since knowledge of actual earnings leads to excess return. Much larger excess returns are earned if one is able to determine those stocks for which analysts most underestimate return. Finally, the largest returns can be earned by knowing which stocks for which analysts will make the greatest revision in their estimates. This pattern of results suggests that share price is affected by expectations about earnings per share. Given any degree of forecasting ability managers can obtain best results by acting on the differences between their forecasts and concensus forecasts.

(FINANCE; FINANCE—INVESTMENT)

1. Introduction

A central theme of modern investment theory is that expectations about firm characteristics are incorporated into security prices. This theme can be found in most investment texts and is utilized in much of the current research in finance. Not only does this belief pervade academia it is commonly held by the financial community.

Surprisingly, in light of the strength of this belief, there is very little empirical evidence to support it. Almost all research which attempts to measure the impact of expectations utilizes not expectational data but historical extrapolations of past data that the authors hope will serve as a proxy for expectational data. This is true for most tests of valuation models as well as almost all tests in the efficient markets literature.

The purpose of this article is to examine the importance of expectations concerning one variable, earnings per share, in the determination of share price. Earnings per share is considered a key variable in determining share price and has been studied extensively in the efficient markets literature. In almost all studies, expectations of future earnings per share are formulated as an extrapolation of past earnings.[1] Justification for using historical extrapolation is sometimes found in tests of the accuracy of extrapolated data in forecasting future earnings.

While tests such as those found in [3], [4], and [5] provide some evidence of the relative accuracy of historical extrapolation versus expectational data as forecasts of the future, they do not address the question of the role of expectations in share price formation. The purpose of this paper is to directly address this question. More

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[1] Malkiel and Cragg [8] used expectational data on earnings growth in a valuation model. However, their sample of expectational data was very limited.

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specifically, we will address the question of the role of actual future changes in earnings on stock returns, the role of expected changes in earnings, and finally the role of changes in expectations.

In addition to examining the importance of expectations and earnings, we briefly explore the issue of the scale of returns that can be earned by being "more accurate" than average forecasts. If market prices reflect average expectations, then superior forecasting ability should be rewarded with excess returns. We will explore both the size of these returns and the timing of their occurrence.

2. Overview: Variables Examined and Sample Design

The testing of the impact of earnings expectations has awaited the development of a broad consistent data base. Lynch, Jones and Ryan have constructed a data base which contains one and two-year consensus earnings estimates on all corporations followed by one or more analysts at most major brokerage firms.[2] Lynch, Jones, and Ryan define the consensus earnings estimate for any stock as a simple arithmetic average of the estimates prepared by all of the analysts following that stock. Given this data base, a study can be made of the role of average expectations in price formation and in particular the importance of earnings expectations in determining share price.

In order to study the role of expectations, we need some measure of the excess returns that can be earned from knowledge concerning future earnings. To examine this, we analyzed the actual growth rate in earnings. The actual growth rate was defined as actual earnings for the forecast year minus actual earnings in the previous fiscal year, divided by actual earnings in the previous fiscal year. This variable is computed only for those firms for which the denominator is positive. This does not bias the results of our tests as the denominator is known at the time this variable is formulated. However, the population of stocks to which our tests apply is restricted. Letting G_t stand for the growth rate in earnings,

$$G_t = \frac{E_t - E_{t-1}}{E_{t-1}} \quad \text{for } E_{t-1} > 0 \tag{1}$$

where E_t is reported earnings per share at time t.

Anticipating our results for a moment, we will find that knowledge of actual growth will allow a significant risk adjusted excess return to be earned. This indicates that growth in earnings is an important variable affecting share price, and that expectations concerning this variable are worth studying.

If expectations determine share price, then knowledge of the average value of these expectations should already be incorporated in the share price, and buying on the basis of average expectations should not lead to excess returns. Thus, the second variable we examined was the consensus forecast of the growth rate in per share

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[2] Lynch, Jones and Ryan, a New York-based brokerage firm, have available in computer readable form consensus (average) earnings estimates updated monthly for the current and next fiscal year as well as forecasts of each individual analyst following each stock. They designate this as the I/B/E/S service. During the time period studied Lynch, Jones and Ryan surveyed brokerage firms. Our sample consisted of all stocks listed on the New York Stock Exchange which were followed by three or more analysts. The average number of analysts following each of these firms was slightly above seven. Furthermore, slightly less than 70 stocks were followed by ten or more analysts. The maximum number of analysts following any stock was 18.

earnings. We call this the forecasted growth rate. It is formulated as the consensus forecast of fiscal year earnings minus the actual earnings in the previous fiscal year divided by the actual earnings that occurred in the previous fiscal year. Since this measure cannot be interpreted for a negative denominator, it is computed only for those companies for which the denominator is positive. To be more explicit, let

$$FG_t = \frac{C_t - E_{t-1}}{E_{t-1}} \quad \text{for } E_{t-1} > 0, \tag{2}$$

where C_t is the consensus forecasts of the earnings per share that will occur at time t, and FG_t is the consensus forecast of the growth rate in earnings per share.

If expectations are important and are incorporated in present prices, then one should observe larger excess returns by having knowledge concerning the error in the growth estimate, than by knowing actual growth itself. Investment in a firm with high actual growth should not necessarily lead to excess returns unless investors were forecasting low growth. Thus, if expectations are important, knowledge concerning differences between actual growth and forecasted growth should lead to higher excess returns than knowledge concerning growth itself. Thus, the third variable we examine is actual growth minus forecasted growth. This differential growth can be expressed as

$$DG_t = G_t - FG_t. \tag{3}$$

Since the effect of differences between expectations and realizations is the key phenomena that we wish to study, we have measured this phenomena in two additional ways. The first is the error in the earnings forecast defined as the actual earnings in the forecast year minus the forecast earnings. If we denote this variable by M_t for misestimate in consensus forecast of earnings, then

$$M_t = E_t - C_t. \tag{4}$$

The second is the percentage forecast error, which is measured as the actual earnings in the forecast year minus the forecast earnings divided by the absolute value of the actual earnings. If we use $\%M_t$ to stand for the percentage, then

$$\%M_t = \frac{E_t - C_t}{|E_t|}. \tag{5}$$

While most of our analysis consists of an examination of one year forecasts, we decided to take a brief look at the excess returns associated with errors in two year forecasts. We duplicated the one-year measures and examined the error in earnings forecast for two years and the percentage error in earnings forecast for two years.

If consensus forecasts are more important than the actual level of future earnings in determining prices, then one should be able to do a better job of selecting stocks by knowing the change in consensus forecasts than by knowing actual earnings. To test this hypothesis, a variable measuring the percentage adjustment in forecasts over time was used. This variable is formulated as negative of the following quantity: the forecast of earnings prepared for the next (as opposed to this) fiscal year minus the forecast of earnings for the same fiscal year made one year later divided by this latter number. To better understand this variable, let ${}_{t-a}C_t$ stand for the consensus forecast for earnings at time t which are produced at time $t - a$, and ${}_{(t-a+12)}C_t$ stands for the forecast for time t which is produced 12 months later. Then the forecast revision denoted by FR_t can be represented as

$$FR_t = -\frac{{}_{(t-a)}C_t - {}_{(t-a+12)}C_t}{{}_{(t-a+12)}C_t}. \tag{6}$$

3. The Sample

The raw data consisted of a monthly file of one and two-year earnings forecasts prepared in the years 1973, 1974, and 1975. We limited our sample of data in several ways. First, the sample was restricted to firms having fiscal years ending on December 31. By confining our sample to firms with fiscal years ending on the same date, forecasts prepared a certain number of months (e.g., nine) in advance of the end of the fiscal year, fall on the same calendar date. This procedure assures that the same general economic influences (e.g., the economy, the market, etc.) were available to all forecasters at the time forecasts were prepared. The date of December 31 was selected because more companies had fiscal years ending on that date than on any other.

Second, forecasts are restricted to two forecast dates, March and September. March was selected because it is the earliest date on which financial data for the previous fiscal year would be reported by most companies. September was selected as a month that is far enough from the first forecast and far enough into the fiscal year that significant evidence on companies' performance during the year should be available. Yet it is not so far into the year that earnings are known with certainty. Both dates are used for all variables involving one-year forecasts. However, so few two-year forecasts were available in March that only the September date could be used when examining two-year forecasts.

Finally, because we are interested in the impact of consensus forecasts, the sample was restricted to companies which were followed by three or more analysts. The consensus prepared from less than three forecasts could be idiosyncratic and not typical of broad feelings about the stock.

The final sample consisted of a total of 919 one-year forecasts of the fiscal years 1973, 1974, and 1975 and a total of 710 two-year forecasts of fiscal years 1974, 1975, and 1976. Because of negative earnings, some firms had to be eliminated over several measures. This caused the sample size to fall to as low as 913 and 696 for one and two-year forecasts, respectively. As discussed earlier Lynch, Jones and Ryan survey most large brokerage firms. Since we have included all stocks followed by three or more analysts, the group of stocks in our sample can be considered a universe of all stocks with important analyst interest. Since brokerage firms are interested in providing information to their customers, our sample should include most stocks of major institutional interest.

4. Methodology

The first step in our procedure was for each time period studied (March and September) and for each year to rank all stocks on each variable and to divide the stocks into deciles by each variable. For example, we formed deciles for the forecasted growth rates made in September 1973 with the first decile containing the 10% of the stocks with the highest forecasted growth rate. For each decile, we calculated the average value of the variable being studied (in this case, forecasted growth).

In order to determine whether certain types of information lead to excess returns, it is necessary to have a measure of what return is expected. If we have a measure of expected return, then excess return is the difference between actual return and expected return. In order to measure expected return, we use the market model. The market model is a relationship between the return on a security and the return on a market index.

Let

1. r_{it} be the return on portfolio i in period t.
2. r_{mt} be the return on the market in period t.
3. α_i and β_i be parameters for portfolio i.
4. e_{it} be deviations from the model.

The market model is:

$$r_{it} = \alpha_i + \beta_i r_{mt} + e_{it}$$

Using the market model leads to expected returns being determined by the security's normal relationship with the market (β_i), the market return in the period (r_m) and the security's average nonmarket return (α_i). Using the market model excess return is

$$r_{it} - (\alpha_i + \beta_i r_{mt}).$$

Although the market model is frequently used in finance, there are some problems with its use that can lead to biased tests. First there is measurement error in the coefficients and if this varies systematically with the test statistic, it can lead to an appearance of a relationship when none exists. This was guarded against in several ways.

First we calculated the market model for the deciles discussed earlier. Using grouped data is one way of reducing the measurement error. The one variable where measurement error can be especially bothersome is beta. As Blume [1] has shown the error in measuring beta varies systematically with its difference from one. The use of grouped data helps. In addition, we examined the individual betas on the groups. There was no systematic pattern, nor did any group beta differ very much from one (the range was 0.93 to 1.09). Given this result, we judged that any further adjustment in beta was unnecessary. In the original CAPM tests grouping data was common. Litzenberger and Ramaswamy [7] and Ross and Roll [9] have criticized this on the grounds that the CAPM is a theory of the pricing of single assets and as such has to be shown to explain differences in asset returns. Our purpose here is not to test CAPM but rather to examine the effect of expectations on share price. Hence grouping is a reasonable procedure for dealing with measurement error.

The second problem in the use of the market model is its difference from a capital asset pricing model. There are numerous general equilibrium models that have been derived. If one of these ultimately is shown to be correct, then better estimates of returns should be obtained by using that model rather than the market model. Brennan [2] has shown that the use of alternative models can make some difference. However, in this study the magnitude of the results, the grouping techniques, and the spread in the β_i's should mean that there is minimal chance of this source of potential bias explaining the results.[3] For example, assuming that the beta for each group was equal to one would not change any of our conclusions.

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[3] We could have used differences from R_m, rather than the market model in reporting our results. However the reader might then question to what extent our conclusions were due to differences in market risk. Alternatively we could have followed Watts [10] methodology to force the Beta on each Portfolio to be exactly one. However since the differences in Beta from one were neither large nor systematically related to any criteria across our deciles we did not take this additional step.

The market model was estimated by treating each decile as an equally weighted portfolio of the stocks which composed it and estimating the market model parameters for each decile. The market index we used was the Standard and Poor's index adjusted for dividends. The parameters of the model were estimated in each case using 60 monthly observations on returns up to and including the forecast month. The data dissemination procedure followed by Lynch Jones and Ryan means that forecasts are in the hands of the subscriber by the end of the month. The estimated parameters of the market model were then used in conjunction with actual market returns to forecast normal risk adjusted returns for each of the deciles during each of the 24 months after the forecast month. The risk adjusted returns in each month were close to but not exactly equal to zero. This should not be surprising to the reader. The sum of the residuals in any one month should equal zero only if they are weighted in market proportions and include all stocks in the index. Our sample meets neither of these conditions. We adjusted our residuals to have a mean (across all deciles) of zero for ease of presentation. Our primary statistical test is a *rank* correlation test, subtracting a constant from each entry can not effect the rank. Thus our adjustment had very little effect on the numbers reported and had no effect on their statistical significance or on our conclusions.

As discussed earlier, we calculated risk adjusted excess returns for each of the deciles for each of the variables for the 24 months after the forecast month. In the case of the March data we calculated risk adjusted excess returns from April on and in the case of September from October on. This was done for each of the three years for which we had data. We combined these years and have reported the average risk adjusted return across the three years for each decile.

To aid in understanding the results, we report the sum of the risk adjusted excess returns from the month after the forecast month to the month under consideration, rather than reporting the risk adjusted excess returns in any one month.[4] Thus, for March forecasts, the entry in month 3 is the sum of the risk adjusted excess returns earned in April, May, and June. This allows the reader to more easily determine the cumulative effect of any influence.

After examining the data we determined that there were no further effects after month 15 for March data and month 9 for September data. Thus, we have not reported results beyond these dates.

In reporting results we have combined the deciles in two ways. First, we report the cumulative risk adjusted excess returns in the upper 30%, middle 40%, and lowest 30% of firms ranked on each variable. Second, we report the cumulative risk adjusted excess returns in the upper 50%. Since the risk adjusted excess returns add to zero, across all deciles the risk adjusted excess return in the upper 50% is the negative of the lowest 50%. We chose to present the data in this way since using the ungrouped deciles increases the size of the tables substantially without providing additional insights.

The reader can judge the economic significance of the results by examining the cumulative residuals in Tables 1 through 4. These excess returns are reported before

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[4] Many authors accumulate residuals by calculating the product of one plus the residuals. The justification for this is that return over N periods is the product of the N one period returns. There is a difficulty with this procedure. The null hypothesis is that the residuals average zero. If this hypothesis is true, it is easy to show that the product of one plus the one period residuals minus one becomes negative and significantly so as N gets large. The sum of the residuals is zero under the null hypothesis and deviations from zero are indications of real effects.

TABLE I

Time Series of Cumulative Excess Returns Ranked by Error in the Forecast of the Growth Rate (Equation (3)) for March Data

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upper 30%	0.0166	0.0221	0.0221	0.0321	0.0630	0.0698	0.0767	0.0782	0.0855	0.0664	0.0729	0.0775	0.0909	0.0801	0.0897
Middle 40%	− 0.0069	− 0.0037	+ 0.0037	− 0.0001	− 0.0139	− 0.0170	− 0.0038	− 0.0041	− 0.0063	− 0.0162	− 0.0107	− 0.0120	− 0.0144	− 0.0209	− 0.0126
Bottom 30%	− 0.0075	− 0.0169	− 0.0173	− 0.0320	− 0.0444	− 0.0470	− 0.0719	− 0.0726	− 0.0773	− 0.0448	− 0.0588	− 0.0731	− 0.0717	− 0.0523	− 0.0729
Rank Correlation[a]	0.71**	0.73**	0.76**	0.83*	0.83*	0.76**	0.84*	0.87*	0.89*	0.90*	0.85*	0.87*	0.93*	0.92*	0.89*

[a] Rank correlation coefficients

*Indicates significance at the 1% level.

**Indicates significance at the 5% level.

TABLE 2

Time Series of Cumulative Excess Returns for the Error in the Forecast of Growth Rate Using September Data (Equation (3))

	1	2	3	4	5	6	7	8	9
Upper 30%	0.0187	0.0272	0.0421	0.0429	0.0466	0.0506	0.0618	0.0638	0.0680
Middle 40%	0.0100	0.0092	0.0014	− 0.0035	− 0.0036	− 0.0045	− 0.0069	− 0.0065	− 0.0034
Lower 30%	− 0.0318	− 0.0394	− 0.0441	− 0.0384	− 0.0421	− 0.0445	− 0.0526	− 0.0550	− 0.0635
Rank Corre-lation[a]	0.77*	0.88*	0.84*	0.88*	0.99*	0.92*	0.95*	0.94*	0.85*

[a] Rank correlation coefficients are computed across deciles.

* Indicates significance at 1% level.

** Indicates significance at 5% level.

TABLE 3

Excess Returns for Months 7 and 13 March Data

Time of Analysis		Forecasted Growth Equation (2)	Actual Growth Equation (1)	Error in Growth Equation (3)	Error in Forecast (One Year) Equation (4)	Percentage Error in Forecast Equation (5)
MONTH 7	Upper 30%	− 0.0064	+ 0.0591	+ 0.0767	0.0633	+ 0.0711
	Middle 40%	0.0068	0.0006	− 0.0033	0.0092	− 0.0033
	Lower 30%	− 0.0028	− 0.0597	− 0.0719	− 0.0754	− 0.0719
	Upper 50%	− 0.0080	0.0463	0.0426	0.0462	0.0426
	Rank Correlation[a]	− 0.35	0.90*	0.84*	0.98*	0.90*
MONTH 13	Upper 30%	+ 0.0006	+ 0.0748	+ 0.0908	+ 0.0715	+ 0.0861
	Middle 40%	− 0.0093	− 0.0191	− 0.0144	+ 0.0022	− 0.0156
	Lower 30%	+ 0.0019	− 0.0493	− 0.0717	− 0.0743	− 0.0651
	Upper 50%	− 0.0139	0.0411	0.0577	0.0571	0.0554
	Rank Correlation[a]	− 0.30	0.88*	0.93*	0.96*	0.85*

[a] Rank Correlation coefficients are computed across deciles.

* Indicates significance at the 1% level.

** Indicates significance at the 5% level.

TABLE 4

Excess Returns for Month 7 from September Data

	Forecasted Growth Equation (1)	Actual Growth Equation (2)	Error in Growth Equation (3)	Error in Forecast (One Year) Equation (4)	Error in Forecast (One Year) Equation (5)	Error in Forecast (Two Years) Equation (4)	Error in Forecast (Two Years) Equation (5)	Forecast Revision Equation (6)
Upper 30%	0.0135	0.0399	0.0618	0.0567	0.0652	0.0773	0.0792	0.0889
Middle 40%	– 0.0079	– 0.0161	– 0.0069	– 0.0053	– 0.0084	– 0.0023	– 0.0062	– 0.0141
Lower 30%	– 0.0029	– 0.0186	– 0.0526	– 0.0497	– 0.0541	– 0.0741	– 0.0711	– 0.0701
Upper 50%	0.0073	0.0245	0.0405	0.0402	0.0409	0.0496	0.0498	0.0512
Rank Correlation[a]	0.37	0.53	0.95*	0.95*	0.89*	0.96*	0.98*	0.83[c]

[a] Rank correlation coefficients are computed across deciles.

* Indicates significance at the 1% level.

** Indicates significance at the 10% level.

TABLE 5

Mean Values for Each Variable

	Equat. (1) Forecasted Growth	Equat. (2) Actual Growth	Equat. (3) Error in Growth	Equat. (4) Forecast Error (1 yr)	Equat. (5) Percentage Forecast Error (1 yr)	Equat. (4) Percentage Forecast Error (2 yrs)	Equat. (5) Percentage Forecast Error (2 yrs)	Equat. (6) Forecast Revision
March Data								
Upper 30%	56.61%	107.45%	63.62%	1.08%	26.24%			
Middle 40%	6.9	8.27	1.35	0.01	– 0.32			
Lower 30%	– 9.16	– 34.95	– 38.88	1.05	– 159.24			
Sept. Data								
Upper 30%	81%	98.83%	26.36%	0.53%	14.72%	0.13%	26.74%	43.76%
Middle 40%	9.34	8.32	– 0.17	– 0.07	– 0.23	– 0.09	– 3.75	1.19
Lower 30%	– 15.75	– 32.95	– 27.02	– 0.67	– 94.01	– 1.64	– 155.29	– 27.34

transaction costs. While estimates of round trip transaction costs differ, a reasonable estimate is in the range of two to four percent. Thus, cumulative residuals in excess of 4% can be accepted as of economic significance.

It is also logical to examine whether the relationship between any of the variables under study and excess return is statistically significant. This was examined by computing Spearman rank order correlation coefficient between the decile and the rank order of the cumulative excess return for each decile. A statistically significant rank order correlation coefficient would indicate that there was a significant relationship between the variable under study and cumulative excess returns. Furthermore, by using a nonparametric test this statement is free of any distributional assumptions (across deciles) about the pattern of excess returns and/or the variables under study. Note that when we compute, the statistical significance of the cumulated residuals in successive periods these tests are not independent.

Table 5 presents the average values for each variable studied in this paper.

5. Results

The first question to analyze is: Can an investor earn excess returns by selecting stocks on the basis of the consensus growth rate forecasted by security analysts (Equation (2))? The answer is no. There is no discernable pattern in the cumulative excess returns. In some months the stocks for which high growth was forecasted had positive risk adjusted cumulative excess returns; in other months they had negative ones. As a further check we performed a rank order correlation test on the deciles in each month. The rank order correlation between forecasted growth and risk adjusted cumulative excess return was never significantly different from zero at the 1% level and only significantly different from zero from the 5% level in two months. In the months it was significant it was negative, which is opposite to what one would expect if growth estimates contained information which was not incorporated in stock prices. The lack of a pattern was even more evident in the September data. In no month was the cumulative excess return significantly different from zero at even the 5% level and the average cumulative excess return varied frequently from positive to negative. The results for each individual month is not reported in the paper but the results for selected months can be seen by examining Tables 3 and 4.

This lack of risk adjusted excess returns occurs even though the analysts were projecting some very large growth rates. In September the analysts were projecting that the average growth rate for the top decile would be over 100% and the growth rate in the second decile would be 33%. In contrast the earnings of stocks in the last decile were expected to decline by 34%.

A number of financial institutions purchase growth stocks as an investment strategy. In the three years we examined, pursuing such a strategy based on consensus estimates would not have led to superior returns, growth forecasts were already incorporated in the security prices. This is what one would expect if expectations are incorporated into security price.

On the other hand, our results show that growth is an important determinant of security returns. Investors with perfect forecasting ability could make risk adjusted excess returns. The results for individual months are not reported. However, the results for selected months, can be seen by examining Tables 3 and 4. From month 4 on, the rank order of excess returns for the deciles is significant at the 1% level. The excess return builds up to 7.23% for the upper 30% of all stocks by month 9. It then declines and builds up again to over 7%. A similar but less distinct pattern can be seen by examining the lowest 30%.

The risk adjusted excess returns from possessing perfect forecasting ability in September are much lower than they were from possessing perfect forecasting ability in March. Furthermore in most months the rank order of the deciles is insignificant at the 1% level (although it's still sometimes significant at the 5% level). This is what one would expect. By September investors have a much better idea of actual growth than they do in March.

If prices reflect consensus forecasts, then knowing the error in the consensus estimate of growth should lead to larger profits than just knowing actual growth. How large is the mis-estimate of actual growth by the analysts? In March, the average error for the 30% of the companies for which earnings growth was most underestimated was 63.6%, while the average error for the 30% of the companies for which growth was most overestimated was 38.9%. The corresponding numbers for September forecasts are 26.4% and 20.3%. It is apparent that while there are still large size errors in the September forecasts, the size of the error has decreased markedly between March and September. Analysts can improve the accuracy of their forecasts as interim earnings reports or as other information comes out and more information is available on company performance.

Tables 1 and 2 show the time series of cumulative risk adjusted excess return for the errors in the March and September estimates (Equation (3)). The rank order of the deciles is significant from the first month for both the September and March estimates.

The risk adjusted excess returns build up very quickly in both cases. For the March forecasts, the risk adjusted excess returns are close to 7% by month 6 (September), the major increase occurring in month 5. Once again, the risk adjusted excess returns have a temporary peak in month 9 and then increase to a global peak in month 13. This rapid build-up is consistent with information about true earnings growth being disseminated over time and the market correctly incorporating the information.

Even in September investors with a better estimate of growth than the consensus had an opportunity for excess profits. Notice that while knowledge of the forecast error as of September allows an excess profit to be earned, perfect forecast ability did not allow an excess profit to be earned. This suggests that on average forecasts are accurate enough in September that excess profits can be earned only by isolating those cases where forecasted growth is very much different than actual.

The time pattern for all variables is very similar with March forecasts producing excess returns which level out after month 13 and September forecasts producing excess returns which level out after month 7. Consequently, we shall only report results for these months. The cumulated excess returns in these months are reported in Table 3 and Table 4. In addition, in Table 3 we show the risk adjusted cumulative excess returns 7 months after the March forecasts for comparison with the effect 7 months after the September forecast.

Note that among the variables discussed so far for both March and September forecasts, the risk adjusted excess return was highest for the error in the growth rate, next highest for actual growth and close to zero for the forecasted growth. What an investor desirous of making excess profits should be most concerned with is finding securities where his forecasts are not only good in the sense of being right but where they are both accurate and different from the consensus.

The same conclusion can be reached by examining errors in the earnings estimates. Tables 3 and 4 present the analysis of excess returns for the error in forecast earnings and the percentage error in earnings forecasts for one year forecasts as of March and September and two-year forecasts as of September. In each case the excess returns appear to be sufficient to cover transaction costs and the rank order correlation coefficient is significant at the 1% level.

Furthermore, the amount of excess returns that can be earned vary with the magnitude of the forecast error. The two-year estimates made in September and the one-year estimates made in March were considerably less accurate than the one-year forecast made in September. They also produced higher risk adjusted excess returns. However, even in September there is a considerable forecast error in year-end earnings. In September, the percentage forecast error was 26% for the top decile, 11.6% in the next decile, and 6.3% in the next. These errors, while lower, were still significant enough to lead to an excess risk adjusted return.

We have now examined evidence that consensus forecasts are incorporated into price. Further, we have seen that the ability to forecast with more accuracy than the consensus forecast can lead to an excess risk adjusted return. If consensus forecasts play a major role in price determination, then the ability to forecast consensus forecasts themselves should lead to a superior return. Since we have estimates of the earnings for each company made 15 months in advance (the two-year forecast as of September) and estimates of the same earnings made 12 months later (one-year forecast made in September of the following year), we can measure the impact of being able to forecast the change in the estimate (Equation (6)). As shown in Table 4, the

TABLE 6

*Error in Growth**

(Forecast-actual)

Percentage of Firms eliminated	Excess return if completely accurate	Excess return if 50% error	Excess return if 90% error
0%	0	0	0
10%	1.56	0.78	0.16
20%	2.88	1.44	0.29
30%	3.07	1.53	0.31
40%	4.32	2.16	0.43
50%	5.77	2.88	0.58
60%	7.35	3.67	0.74
70%	9.08	4.54	0.91
80%	9.90	4.95	0.99
90%	10.42	5.21	1.04

*Forecasts of one year growth rates prepared in March. Cumulative returns calculated as of April of the following year.

returns from being able to estimate forecast revision are substantial. In fact, the return from forecasting future forecasts themselves is higher than the return from being able to forecast actual earnings. This is consistent with our other evidence that it is consensus forecasts which determine security prices.

All of the results presented in this section could be used to analyze the amount of accuracy necessary to earn excess returns. Assume the analysts can identify firms that are in various deciles with respect to the error in estimated earnings. For example, suppose he could identify the 10% of the firms with the largest forecast error. Column 2 of Table 6 shows the cumulative excess return he would earn. Columns 3 and 4 assumes that he identifies the members of a decile with error. Column 3 assumes that 50% of the time he identifies a firm as a member of a decile he is randomly selecting from among all firms and 50% of the time he is accurate. Column 4 assumes that 90% of the time he is randomly selecting from all firms.

For example, if an analyst is attempting to select from among the 30% of the firms for which the consensus forecast most underestimate true earnings, and he is right 50% of the time, he will earn an excess risk adjusted return of 4.54%.

As can be seen from an examination of the table, a little bit of information leads to substantial cumulative excess returns. These kinds of excess returns provide some justification for the effort undertaken by many organizations to forecast earnings.

6. Conclusions

In this study we present evidence in support of the hypothesis that expectations are incorporated into security prices. In addition, we have analyzed the timing and size of returns from forecasts which are more accurate than the consensus. Since prices reflect consensus forecasts, the payoff from being accurate in forecasting is increased markedly as the consensus forecast becomes inaccurate. Finally, we have demonstrated that the payoff from being able to forecast the consensus estimate is higher than the payoff from being able to forecast earnings. The market reacts to expectational data. But despite this, or rather because of it Lord Keynes [6] appears to have been right when he likened professional investing to participating in a newspaper contest on a beauty contest, where "... each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of other competitors, all of whom are looking at the contest from the same point of view."

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FINANCIAL ANALYSTS' FORECASTS OF EARNINGS

A Better Surrogate for Market Expectations*

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The specification of the market expectation of accounting numbers is a common feature of many empirical studies in accounting and finance. Givoly and Lakonishok (1979) found that financial analysts' forecasts have information content. This study evaluates the quality of analysts' forecasts as surrogates for the market expectation of earnings and compares it with that of prediction models commonly used in research. Results indicate that prediction errors of analysts are more closely associated with security price movements, suggesting that analysts' forecasts provide a better surrogate for market expectations than forecasts generated by time-series models. The study also identifies factors that might contribute to the performance of the financial analysts' forecasts. The broadness of the information set employed by analysts and, to a lesser extent, their reliance on information released after the end of the fiscal year appear to be important contributors to their performance.

1. Introduction

The specification of market expectations of stock returns and of accounting numbers is a common feature of empirical studies in accounting and finance. While expected returns in these studies have been derived customarily by the theoretically founded and empirically supported market model, no such underlying theory exists for the specification of a surrogate for market expectation of earnings. To a great extent, the expectation models selected by researchers relied exclusively on past time-series behavior of the variable.[1] Since no established theory could guide the selection of the earnings expectations models, many researchers used a wide set of time-series

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[1] A short list of such studies, which is by no means exhaustive, includes Ball and Brown (1968), Barnea et al. (1976), Beaver and Dukes (1972), Brown and Kennelly (1972), Foster (1977), and Watts (1978).

models so that some assessment of the robustness of the results to model selection could be made.

The selection of a time-series model as a surrogate for market expectations is further impaired by the underlying assumptions that the earnings generating processes are stationary with stable parameters and that the model characteristics are applicable to all firms. There is evidence suggesting that models applicable to one period are not necessarily relevant for other periods. Brooks and Buckmaster (1976), for example, showed that while the martingale process might describe the earnings changes in normal years, earnings behavior in periods following unusual fluctuations in earnings may best be described by a mean-reverting process. The use of such models as a proxy for market expectations of earnings thus may limit the validity and the scope of any conclusions.[2]

The purpose of this paper is to examine the performance of an alternative surrogate for market expectations, earnings forecasts made by financial analysts. These forecasts were obtained from the *Earnings Forecaster*, a weekly publication by Standard and Poor that first appeared in 1967. The *Earnings Forecaster* lists the outstanding EPS forecasts for about 1500 companies. The forecasts are those made by S & P and by about 70 other security analysts and brokerage houses who agreed to submit their forecasts, upon release, to the publication.

Givoly and Lakonishok (1979) showed that financial analysts' forecasts of earnings have information content. Their study found a significant price reaction to the disclosure of revisions in FAF. The wide dissemination of FAF in the financial community[3] further reinforces the notion that FAF might proxy for market expectations.

Given the above evidence, tests on the information content of earnings that use FAF as a surrogate for market expectations are likely to be better specified than those based on time-series models. The first objective of this study is to evaluate FAF as a surrogate for market expectation of earnings, and to compare them with prediction models widely used in the literature. The findings show that FAF are a better surrogate for market expectation of earnings and suggest that the use of other prediction models may have weakened the tests employed by previous research.

The tests of the association between the *API* and the prediction errors, to be described later, follow those employed by Ball and Brown (1968) and Beaver et al. (1979) and rely on the correlation between *API* and forecasts made about a year before the release of the earnings report. Tests on the

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[2] This limitation was recognized in the literature [see, for example, Beaver and Dukes (1972) and Collins (1975)]. As Beaver and Dukes conclude: '...any inferences are conditioned upon the prediction models used to test the accounting measures tested...any findings are the joint results of prediction models and accounting method and only appropriately specified joint statements are warranted' (p. 332).

[3] See, for example, the report of the SEC Advisory Committee on Corporate Disclosure (1977).

information content of earnings, however, are best carried out by examining the association between prediction errors from forecasts based on the most up-to-date accounting information available, and *API* calculated on a daily basis in the immediate period surrounding the earnings release date. Nonetheless, the results herein are useful in that they suggest that FAF may serve as a better proxy if used in such studies.

The finding that FAF are a better surrogate for earnings expectation of the market is important for other reasons. Stock valuation models as well as P/E studies often rely on expected earnings or derivation thereof, as a basic parameter. The results of this study would thus offer valuable input to these studies in providing better identification of earnings expectations used by investors.

The existence of an empirical surrogate for earnings expectations will enable researchers to examine more thoroughly the formation of earnings expectations. Questions concerning the rationality of earnings expectations, the extent to which they employ accounting information and their consistency with the observed time-series behavior of earnings might be addressed. Some interesting work on the time-series behavior of FAF has been done by Abdel-Khalik and Espejo (1978) and by Brown et al. (1978, 1979, 1980). Establishing that FAF provide a satisfactory surrogate for market expectations would underscore the relevance of these studies and provides a motivation for further research.

The second objective of this study is to analyze the factors that contribute to FAF having information content. While forecasts of earnings based solely on past accounting data are revisable only in certain time intervals (annual or quarter),. FAF incorporate presumably all publicly available (firm-specific, industry, and market) information, and can be continuously updated with the arrival of any new information. These characteristics suggest two factors which explain FAF superiority, and which will come under examination in this study: one is the broadness of the information set available to them, and the other is their timing advantage, in that they employ information that becomes available only after the last accounting report.

The paper is organized as follows. Section 2 describes the data and discusses the statistical tests concerning identification of the best surrogate for market expectations. Section 3 explores the broadness of information and timing issues and provides evidence on their effect on the performance of FAF. Concluding remarks are made and implications for future research are suggested in the final section.

2. FAF vs. time-series models as surrogates for market expectations

The model evaluation methodology follows the one used by Beaver and

Dukes (1972), Collins (1975) and Patell (1976), and which was articulated by Patell (1979). The presumption is made that accounting earnings possess information content. Alternative models are then evaluated by their ability to correctly classify the signal produced by the accounting number and hence by their usefulness in developing profitable trading strategies for which the buy/sell decisions are determined by this signal classification.

The association between the signals (e.g., the prediction error) produced by each expectation model (time-series or FAF) and abnormal stock return is analyzed. The expectation model whose signals (concerning future earnings) are the most strongly associated with stock price behavior is considered the best surrogate for the true, unobservable, market expectation.

This section is divided into four subsections. In the first we describe our data and the forecasting models, and present some results on the forecasting accuracy of the models. The next subsection describes the measure used to gauge stock market reaction. The third subsection discusses the tests to be used for the evaluation of the models; results of these tests are presented and discussed in the fourth subsection.

2.1. Data and forecasting models

Financial analysts' forecasts of earnings of a sample of companies listed in the *Earnings Forecaster* were evaluated in each of the eleven years 1969 to 1979. Considered each year were the FAF of that year's earnings outstanding at the beginning of April. These forecasts were first issued to the public typically in early March. The time of the forecast is between the release of the annual report for the previous year [which is made on average, in February — see Givoly and Palmon (1981)] and the release of the first quarterly report (typically late April).

Included in the sample each year were companies which satisfied these criteria:

(1) fiscal year ending December 31,
(2) N.Y.S.E. listing,
(3) existence of at least four forecasts (by different forecasters) of the current year's earnings,
(4) availability of monthly return data for the forecast year, the following year and the preceding four years.
(5) availability of actual earnings numbers for the forecast year and the preceding nine years.

The third criterion was introduced to allow the derivation of a reliable measure for the average or 'consensus' forecast.

All the contemporaneous company forecasts were for primary EPS before extraordinary items. To ensure that the comparison between the forecast and the actual EPS was not unduly affected by changes in capitalization not incorporated in the forecasts, we adjusted any earnings forecasts announced prior to the disclosure of the change in capitalization.

The final sample consists of 1247 cases (company–years) with a total of 6020 forecasts. The number of cases in each year differs and varies from 95 (1972) to 173 (1969). This sample represents 424 distinct companies. The FAF for each company–year are represented by their simple average.

Two alternative models of earnings expectation were employed to define the news content of earnings announcements:

$$\text{(a)} \qquad P_t = f(A_{t-1}, A_{t-2}, \ldots),$$

$$\text{(b)} \qquad P_t = A_{t-1} + \gamma_t + \delta_t E(\Delta A_{mt}),$$

where A_t is the realized earnings. The earnings variable was the primary earnings per share before extraordinary items (EPS) of year t adjusted for capitalization, P_t is the expected (predicted) value of A_t, γ_t and δ_t are regression parameters,[4] and $E(\Delta A_{mt})$ is the expected change in market earnings. A_m is represented by the average EPS of the S & P's Composite 500. The expected change in market earnings is derived from a submartingale model using the (arithmetic) average growth over years $t-6$ to $t-1$ as an estimate of the drift term.[5] The regression parameters are re-estimated each year from the available past annual EPS data (the first available year is 1958).

The first model is a univariate time-series model derived from the results of Brooks and Buckmaster (1976). For most of our observations, the submartingale model of the form

$$P_t = A_{t-1} + C_t$$

was used, where C_t is the (arithmetic) average growth in EPS computed over the years $t-6$ to $t-1$.

This model was found by recent studies to represent quite adequately the time-series behavior of earnings [see Albrecht et al. (1977) and Watts and Leftwich (1977)]. Furthermore, as a general representative firm model, the martingale with drift was found to perform as well as the firm-specific Box–Jenkins models in describing the time-series characteristics of annual earnings

[4] These regression parameters were estimated over the first differences series of ΔA_t and ΔM_t.

[5] The expectation is formed consistent with the model used to predict individual firm's earnings. We also used in all tests a version of the IM in which the *realized* market index is employed. The two versions yielded essentially the same results.

(see also Albrecht et al.). However, periods that follow extreme earnings fluctuations were found by Brooks and Buckmaster — B & B — (1976) to behave in a way more consistent with a mean reverting process. To provide better specification of the earnings time-series, the sample was stratified each year according to the size of the deviation of previous year's earnings from some 'norm'. The model used for the extreme strata was, in accordance with B & B's findings, an exponential smoothing rather than the martingale with trend.[6] About 23% of the cases (company–years) in our sample fell in these extreme strata. For the stratification procedure and the specification of the exponential smoothing models, see the appendix. We shall refer to the univariate time-series model used as the modified submartingale (MSM).

The use of Model b, the index model (IM), is supported by the relationship that was found between the first differences in individual company earnings and an economy-wide index of earnings such as the differences in earnings across all firms [see Ball and Brown (1968) and Gonedes (1973)].

The relative prediction error was defined as

$$e_{it}^{k} = (A_{it} - P_{it}^{k})/|A_{it}|, \tag{1}$$

where k denotes the expectation model, i the observation index ($i = 1, \ldots, N$), and t the year.

In the few cases (3–4% of the cases, depending on the model) where $|e_{it}^{k}| > 1.00$, the error measure was equated to ± 1.0. This truncation of the distribution of e_{it} was introduced to avoid the distortive effect of a small denominator and to suppress the effect of possible data and measurement errors.

One measure of accuracy of model k in period t is the mean absolute relative error,

$$|e_{t}^{k}| = (1/N)\sum_{i} |e_{it}^{k}|. \tag{2}$$

The corresponding measure of bias in model k in period t is the mean relative error,

$$e_{t}^{k} = (1/N)\sum_{i} e_{it}^{k}. \tag{3}$$

The relative accuracy of the forecasts is presented in table 1. The table reveals that in almost all years the accuracy of FAF measured by the mean relative error is greater than that of the competing models both for cases of

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[6] The smoothing parameter, α, used for each strata was the one found by B & B to be the best smoothing constant (see table 8).

Table 1

Mean relative earnings prediction errors — annual models (percentages).[a]

	All years[b]	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Cases of positive errors												
FAF (608)	10.4	4.8	5.2	7.5	8.9	14.5	19.4	8.9	10.2	10.1	10.9	14.2
MSM (767)	13.8	8.1	8.2	10.9	14.6	20.1	19.7	9.7	17.5	11.5	14.7	16.9
IM (801)	16.3	9.8	3.6	16.8	15.1	18.8	20.6	17.0	22.0	16.4	16.3	17.9
Cases of negative errors												
FAF (639)	−20.4	−18.5	−31.1	−23.8	−12.3	−17.1	−26.0	−25.0	−11.3	−22.0	−19.2	−17.9
MSM (480)	−24.2	−17.8	−34.1	−29.3	−13.4	−17.5	−36.4	−37.5	−13.9	−24.1	−24.9	−17.0
IM (446)	−24.3	−17.7	−35.6	−26.3	−15.3	−23.5	−33.4	−39.4	−15.8	−19.1	−23.4	−17.4
All cases (accuracy results)[c]												
FAF (1247)	16.4	14.0	25.9	17.6	10.4	15.4	22.0	18.6	10.7	17.1	13.7	15.0
MSM (1247)	19.3	13.1	26.2	18.3	14.4	19.6	24.9	28.0	16.8	16.7	17.4	16.9
IM (1247)	20.3	13.6	26.0	20.3	15.1	19.4	24.5	30.1	20.9	17.6	18.1	17.7
All cases (bias results)[d]												
FAF (1247)	−5.3	−10.9	−23.9	−11.8	−0.5	4.3	1.6	−11.6	1.2	−8.7	0.6	1.4
MSM (1247)	−1.2	−5.2	−21.5	−5.2	8.1	12.5	2.4	−21.3	11.2	−3.2	4.2	4.9
IM (1247)	1.4	−3.2	−19.8	1.1	8.7	12.9	4.4	−15.9	15.3	0.1	6.5	5.5

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model. Number of all cases given in parentheses.

[b] Simple average of the 11 years.

[c] See expression (2) in the text.

[d] See expression (3) in the text.

positive prediction error (i.e., actual earnings are above expectation) and for cases of negative prediction error. The average prediction error of FAF is significantly lower than that of the other models for both types of cases. For the positive errors, the *t* values (computed from the 11 observations) are 5.27 and 6.57 for the comparison with MSM and IM, respectively. For the negative errors, the values are 5.02 and 3.04, and for all cases 3.14 and 3.37. The critical *t*-value for one-tail test with 10 degrees of freedom and 1% significance level is 2.76.

The bias of each model is provided by the fourth (bottom) panel in the table which shows the mean relative error measured over all cases. The results indicate some tendency for FAF to overestimate next year's earnings.[7] Yet, the bias of FAF is present only in 6 of the 11 years and, except for the first three years, appears to be quite small. The finding of some bias conforms to the persistent optimism of FAF reported by previous studies [Barefield and Comiskey (1971) and McDonald (1973)].[8]

Any comparison between the performance of the models is, however, incomplete if it ignores the potential for improvement inherent in each. The existence of a systematic behavior of the model's errors may allow forecast users to improve upon (increase accuracy and eliminate the bias of) the original forecast. To the extent that stationarity of the prediction and realization processes is assumed, forecast users will rely for that improvement on all available past information.[9]

To examine the potential improvement of each model, we employed the linear correction procedure suggested by Mincer and Zarnowitz [see Mincer (1969)] and Theil (1966). The results reveal that all three models offer very little in terms of potential reduction in error through a linear correction of the forecasts. The tests conducted for the corrected forecasts yielded results similar to those obtained for the raw forecasts; therefore, we report only the latter.

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[7] Given the general increase over time in the EPS of *all* firms (the average annual increase in the average EPS, adjusted for capitalization, of S&P's 500 firms over the 20-year period, 1958 to 1977, was 12.4%), the upward bias in the prediction of earnings' *levels* by FAF implies also an overestimation of the change in earnings. This finding contrasts with the observed tendency of economic forecasters to underestimate changes in variables such as GNP and Personal Consumption [see Theil (1966, ch. V) and Mincer (1969, ch. 1)]. Two explanations might be offered for the finding: first, time-series behavior of earnings is apparently less regular and monotonic than that of economic variables leading to less reliance of earnings forecasts on past levels. Second, financial analysts who, as part of the 'establishment' of the investor community and unlike most economic forecasters have a direct stake in the prosperity of the stock market, are perhaps more likely to issue an optimistic outlook than a dim one.

[8] Since only aggregate results are produced, the findings are not comparable neither to those reported by Brown and Rozeff (1979), which show that analysts predict in an adaptive manner — changing the forecasts in a direction opposite to last period's error — nor to those of Elton, Gruber and Gultekin (1981), which suggest persistence of error in consecutive years.

[9] Whether users actually employ corrected forecasts depends on the cost of adjustment and on the degree of stationarity in the systematic behavior of the forecast.

The accuracy of FAF is not necessarily related to the adequacy of their use as a surrogate for market expectations. It is conceivable that FAF are superior to other prediction models in terms of ex-post accuracy tests, but inferior in terms of association with stock price movements. In the next subsection, we describe the metric to be used to measure stock price movements.

2.2. Market reaction measure

Stock price movements are measured in this study by the abnormal return where the expected return was defined according to the familiar market model,

$$E(R_{it}) = \alpha_i + \beta_i R_{mt}, \tag{4}$$

where R_{it} denotes the return of security i for period t, α_i and β_i are parameters and R_{mt} is the actual market rate of return for period t. The market rate of return is represented by the value-weighted rate of return of New York Stock Exchange stocks. Monthly abnormal returns were measured by the difference

$$\hat{\varepsilon}_{it\tau} = R_{i\tau} - (\hat{\alpha}_{it} + \hat{\beta}_{it} R_{m\tau}), \tag{5}$$

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ were estimated from the 48 months preceding the test period, t is the year index, and τ is the month index.

The average β in the pooled sample (1247 observations) is 1.133. The slightly higher than one β's apparently reflect the simple averaging of β's which are computed from the value-weighted index.[10]

The test period for evaluating the models' predictions consisted of the 12-month period from April of year t ($\tau = 1$) to March of year $t+1$ ($\tau = 12$) and was designed to cover the period of approximately 11 months preceding the release of the annual report and the month that follows it.

Cumulative abnormal returns were computed as

$$CAR_{it} = \sum_{\tau=1}^{12} \hat{\varepsilon}_{it\tau}, \tag{6}$$

and the Abnormal Performance Index (API) was derived as

$$API^k_{it} = \mathrm{sign}(\dot{e}^k_{it}) \cdot CAR_{it}. \tag{7}$$

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[10] For randomly selected securities, an unweighted average β greater than one would be expected if securities with low value weights have relatively high β and vice versa. Higher β's for small firms is suggested by the results of Foster (1978) and Reinganum (1981).

2.3. Tests

The models will be tested according to the association of their errors with stock price movements. In examining prediction error and stock price behavior, the magnitude of the prediction error, in addition to its sign, will be considered. As shown by Beaver et al. (1979), the inclusion of the magnitude of the prediction error makes the association tests more powerful. In addition, using only the sign of the prediction error results in a serious limitation of the tests since they rely exclusively on those cases where the models disagree as to the sign of the prediction error. Thus, the only relevant observations would belong to a group which might be a very small subset of the total sample. The following two tests, which incorporate the magnitude of the prediction error, alleviate this problem by exploiting the entire sample.

(a) *Correlation test*: The correlation between the magnitude of the prediction error (e_{it}^k) and the stock price movement (CAR_{it}) is computed. The model which yields the highest correlation is considered to be superior. This association test was employed recently by Beaver et al. (1979) in measuring the relationship between abnormal returns and prediction errors of earnings expectation models.

(b) *Weighted API test*: The second test (magnitude of *API*) involves the evaluation of an 'investment strategy' under which long or short positions in a portfolio are taken in accordance with the direction and magnitude of the prediction error produced by each model. Previous research which looked at the sign of the prediction error implicitly assumed that the same amount is invested (or disinvested) regardless of the magnitude of the error. It is plausible that the amount invested will be in direct proportion to the magnitude of the error. Indeed, if the 'unexpected' earnings (conveyed by the error) are expected to be permanent (consistent with the random-walk behavior of earnings over time) and the security risk is unaltered, the abnormal return will be proportional to the error. This test, therefore, evaluates an investment strategy under which the cross-sectional prediction errors of a given model *k* served each year to determine the weight of each security in that year's portfolio *k*. The *API* of the portfolio was computed as the weighted average across individual securities. Specifically, the weight assigned to each security *i* in year *t* of portfolio *k* is

$$a_{it}^k = |e_{it}^k| / \sum_i |e_{it}^k|, \tag{8}$$

where *e* is the relative error from (1) and the portfolio's *API* is[11]

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[11] The model assumes realistically that the proceeds from short sales are not collected at the time of sale and that, in addition, collateral in the amount of the sale is required. Other weighting schemes were also employed but led to essentially the same results.

$$API_{k,t}=\sum_i a_{i,t}^k \cdot API_{k,t}. \tag{9}$$

In designing the statistical tests, one should be aware of the potential existence of cross-sectional dependence between contemporaneous residuals (or abnormal returns). The dependence, which could stem from various sources (e.g., nonlinearity of the return generating function or the omission of common factors, such as industry, from the index model), makes it likely that the sample estimate of the variance of the residuals will be biased in an unknown manner. Cross-sectional dependence is likely to exist also between contemporaneous prediction errors due to the common factors underlying the generation of earnings (e.g., GNP; the use of the 'index model' of earnings may have removed this source of dependence). For these reasons the t-tests to be reported here employ an estimate of the variance taken from a time-series in which the serial correlation is not expected to be significantly different from zero. Specifically, the mean of the variable of interest was computed each year from the cross-section of observations. The 11 mean values were treated as a sample of independent observations. Similar procedures have been used by Beaver et al. (1979), Jaffe (1974), and Mandelker (1974).

2.4. Results and discussion

Table 2 presents the frequency of cases in which the signs of the prediction error and the price movement (measured by *CAR*) during the test period were consistent, that is, in the same direction. Overall, the models produced errors whose sign was consistent with the sign of *CAR*. Of the 1247 cases (company–years), the sign of the FAF prediction error was consistent with the sign of the *CAR* in 743 cases (60%). This is somewhat superior to the performance of the MSM and the index model which experienced prediction errors' signs that were consistent with that of the *CAR* in 670 cases (55%) and 679 cases (54%), respectively.

A closer examination of the table reveals that FAF perform about equally well when the *CAR* is positive as when the *CAR* is negative (i.e., $337/561 \approx 406/686 \approx 743/1247 \approx 60\%$). However, the time-series models do very well in times of positive *CAR* (MSM yields 69% and IM yields 71% consistent classifications), but rather poorly when the *CAR* is negative (MSM $=44\%$, IM$=41\%$ consistent classifications).

The comparison between the models is more meaningful when only the disagreement cases are considered. Panel (b) of the table shows that FAF do poorer than the other models in periods of positive *CAR* (only $34/113=30\%$ of the cases) but do extremely well in periods of negative *CAR* ($125/152$ $=82\%$ of the cases).

The results of table 2 serve to highlight the limitation inherent in constructing *API* tests based on the sign (but not the magnitude) of the

Table 2

Frequency of cases in which the sign of the prediction error is consistent with the sign of the corresponding cumulative abnormal return (*CAR*).[a]

(a) *All cases*

	FAF errors		MSM errors		IM errors	
CAR realization	Consistent	Inconsistent	Consistent	Inconsistent	Consistent	Inconsistent
Positive	337	224	386	175	398	163
Negative	406	280	304	382	281	405
Total	743	504	690	557	679	568

(b) *Cases in which competing models disagree*

	FAF vs. MSM		FAF vs. IM		MSM vs. IM	
CAR realization	FAF errors consistent	MSM errors consistent	FAF errors consistent	IM errors consistent	FAF errors consistent	MSM errors consistent
Postivie	34	79	32	92	26	35
Negative	125	27	148	27	51	28
Total	159	106	180	119	77	73

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model. Consistent sign is said to exist when the difference between the realized value and the predicted value $(A-P)$ has the same sign as the *CAR*.

prediction errors. The difference between the *API*'s of two competing models, which is based on the sign of the prediction error will reflect only those cases in which the models disagree with respect to the sign of the prediction error (in all other cases the models will produce the same *API*). These cases, however, represent only a small percentage of all cases. Indeed, as table 2 reveals, the proportion of disagreement cases in our sample is low (for instance, out of the 1247 predictions made by both models, FAF and MSM produced prediction errors of opposite signs in only 263, or 21% of the cases). Results which utilize information on both the sign and magnitude of the prediction error (and therefore on the entire sample of 1247 observations) are presented in tables 3 and 4.

Table 3 presents the average cross-sectional correlation coefficients for all years, between the prediction error of each model and the corresponding *CAR*. The first three columns (under 'All cases') present the correlation coefficient calculated over the entire sample for each of the models. The next six columns show the correlation coefficient calculated for each model separately for cases with positive prediction errors and cases with negative

Table 3

Correlation coefficients between *CAR* and the earnings prediction error.[a]

	All cases			Cases of positive errors			Cases of negative errors		
	FAF	MSM	IM	FAF	MSM	IM	FAF	MSM	IM
All years[b]	0.33	0.27	0.27	0.23	0.18	0.18	0.17	0.18	0.17
1969	0.47	0.38	0.39	0.10	0.04	0.08	0.37	0.40	0.38
1970	0.41	0.33	0.31	−0.03	−0.02	0.09	0.37	0.32	0.43
1971	0.39	0.23	0.27	0.26	−0.02	0.02	0.38	0.36	0.32
1972	0.22	0.07	−0.01	−0.05	0.08	−0.13	0.08	0.08	−0.01
1973	0.35	0.46	0.44	0.43	0.45	0.47	0.19	0.21	0.15
1974	0.33	0.28	0.29	0.07	−0.02	0.00	0.30	0.23	0.30
1975	0.12	−0.20	−0.02	0.20	0.32	0.45	−0.04	−0.20	−0.20
1976	0.41	0.32	0.28	0.47	0.34	0.27	0.17	0.34	0.21
1977	0.37	0.43	0.36	0.33	0.19	0.17	0.24	0.21	0.26
1978	0.25	0.27	0.24	0.43	0.42	0.33	−0.17	−0.05	−0.07
1979	0.24	0.36	0.37	0.36	0.18	0.24	0.01	0.10	0.14

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model. The critical value for the correlation coefficient at the 5% significance level for H_0: $\rho = 0$ and one-tail test using the z-statistic [see Freund (1962, pp. 310–311)] is 0.13 for most cells ($n \geq 40$).

[b] Simple average of the 11 years.

Table 4

Mean *API* over the test period of a portfolio weighted by the magnitude of the earnings prediction errors of its members (percentages).[a]

	All cases			Cases of positive errors			Cases of negative errors		
	FAF	MSM	IM	FAF	MSM	IM	FAF	MSM	IM
All years[b]	14.12	9.97	9.45	7.45	2.73	3.32	17.48	17.03	17.63
1969	22.67	19.06	19.02	10.76	3.72	5.08	24.11	25.63	27.53
1970	17.51	15.17	14.57	7.51	2.47	−0.47	17.92	16.52	16.59
1971	18.55	10.53	9.27	1.40	−7.33	−4.11	21.92	20.43	24.25
1972	9.96	−1.45	−4.26	−0.19	−4.68	−8.48	19.22	10.18	11.40
1973	16.98	18.26	16.90	16.64	17.49	16.25	17.67	21.74	20.15
1974	13.56	11.00	11.11	3.76	0.59	0.67	25.02	23.57	26.51
1975	7.33	−3.05	1.82	6.63	−2.61	9.68	7.50	−3.11	−0.60
1976	13.92	5.89	5.39	13.37	3.98	4.00	14.61	15.29	14.30
1977	16.90	17.85	14.09	10.92	9.18	6.13	18.84	23.71	22.12
1978	7.34	6.97	6.06	9.20	7.12	6.33	5.32	6.74	5.49
1979	10.63	9.47	9.99	1.93	0.06	1.41	20.14	26.58	26.23

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model.

[b] Simple average of the 11 years.

prediction errors. Generally, errors of all models show positive and, in most cases, significant correlation with *CAR*. Overall, FAF prediction errors are more strongly associated with *CAR* than the prediction errors of the other two models: the average coefficient of correlation over the 11 years between *CAR* and separately FAF, MSM and IM's errors are 0.33, 0.27 and 0.27, respectively. The *t*-test results for the differences between the correlations produced by FAF and the MSM and IM models are significant at the 10% and the 5% level, respectively. Looking at the positive error and negative error cases separately, the superiority of FAF is evident for positive error cases ($0.23 > 0.18$), but disappears for negative error cases.

Table 4 provides *API* values [calculated using eqs. (8) and (9)] for a portfolio based on both sign and magnitude of the signal (prediction error). The table reveals that FAF errors appear to be more strongly associated with stock price movement than the other models. All models yielded significant average *API*'s for all cases and for negative error cases (the *t*-test was used over the 11 years). However, only FAF produced significant *API*'s for the positive error cases. The *API* average yielded by FAF (14.12%) is higher than that produced by the MSM (9.97%) and the IM (9.45) models. For all cases FAF performed better than each of the other two models in nine of the 11 years. For positive error cases FAF performed better (i.e., the *API* was higher) than MSM in 10 years and better than IM in all 11 years. The corresponding differences between the *API*'s are significant (at the 5% significance level) for all cases and for the positive error cases. There is no significant difference between the models for the negative error cases.[12]

The foregoing results are consistent with the hypothesis that FAF, or information closely correlated with FAF, serve as an input to investment decisions by market participants. Furthermore, the findings suggest that FAF, or at least those outstanding in early April, might be more representative of market expectation of earnings than some time-series models widely used in the financial literature.

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[12] We also derived *API* based only on the sign of the prediction error. The *API* based on FAF predictions calculated over the 11 years was on average 6.94%, while those based upon MSM and the IM yielded 3.79% and 3.42%, respectively. The difference between the FAF's *API* and the other model's *API* is significant at the 5% significance level.

The *API*'s in this study are lower than those reported by Ball and Brown (1968). Note, however, that the survey periods are different. Also, the models are not exactly identical: we use a modified submartingale and an ex-ante index model. Finally, Ball and Brown averaged the *API*'s cross-sectionally and over years giving an equal weight to each company–year. In our analysis, we first find the simple average for each year and then the average across years, giving each year an equal weight. So, for example, 1969, which has the highest average *API*, is given the same weight as any other year, despite the fact that it is represented in the sample by the largest number of cases.

3. Causes of FAF superiority

It can be argued that financial analysts' forecasts may have an edge over time-series prediction models for two main reasons:

(a) They use a broader information set which includes non-accounting information on the firm, its industry and the general economy.
(b) They have a timing advantage in that they are issued some time within the year being forecasted. As such, they can use more recent information about the firm's earnings which becomes available only after the end of the fiscal year.

In this study we provide an analysis of the contribution of each of the ingredients (broadness and timeliness of the information) to the performance of FAF.

3.1. Broadness of the information set

The FAF presumably utilize all publicly available (and occasionally unpublished) information while the time-series models examined rely exclusively on past earnings. There are several interesting questions in this context: the extent to which FAF are a product of a simple extrapolative procedure; the extent to which they incorporate other, autonomous information, unrelated to the time-series of earnings; and the degree to which they efficiently utilize all available extrapolative information.

In our analysis, the MSM and the index model of earnings serve as representatives of the family of extrapolative models.[13] The contribution of each component to the predictive power of FAF is measured by the partial correlation between actual earnings and FAF, given the time-series model's prediction or $r_{AP.X}$, where A denotes the realized value, P is the FAF, and X is the prediction of the time-series model.[14] The extent to which FAF exploit the extrapolative potential of past earnings series (offered by the examined models) is measured by the partial correlation $r_{AX.P}$.

Values of $r_{AP.X}>0$ suggest that FAF contain predictive power based not only on extrapolation but also on an autonomous component. In addition, the magnitude of $r_{AX.P}$ indicates the extent of underutilization of available extrapolative information by FAF, since $r_{AX.P}>0$ means that the time-series model contains some amount of predictive power that was not used in FAF.

The partial correlation results are presented in table 5. The average coefficient of the partial correlation between realization and FAF, given the

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[13] Other, more efficient extrapolative models probably exist. Thus, the conclusions from our analysis are expected to overstate the weight of the autonomous component and perhaps also the success of FAF in exploiting the available extrapolative information.

[14] The notations A, P, and X, as well as the results presented, are stated in terms of earnings levels. Similar results were obtained for earnings changes.

Table 5

Partial correlations between realization and predictions of different models.[a]

	Correlation coefficient between realization and the prediction by				
	FAF given MSM $(r_{AP.X_1})$	FAF given IM $(r_{AP.X_2})$	FAF given MSM and IM $(r_{AP.X_1X_2})$	MSM given FAF $(r_{AX_1.P})$	IM given FAF $(r_{AX_2.P})$
All years[b]	0.55	0.56	0.51	−0.04	0.01
1969	0.43	0.45	0.43	−0.08	−0.07
1970	0.38	0.23	0.26	0.02	0.15
1971	0.53	0.80	0.53	0.06	−0.04
1972	0.63	0.60	0.55	0.00	0.13
1973	0.56	0.40	0.40	−0.12	0.01
1974	0.73	0.63	0.61	−0.38	−0.28
1975	0.63	0.64	0.60	0.01	−0.02
1976	0.67	0.79	0.67	0.10	−0.03
1977	0.50	0.52	0.56	−0.20	0.03
1978	0.53	0.59	0.53	0.09	0.08
1979	0.49	0.52	0.49	0.01	0.05

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM-Index Model.

[b] A simple average of the 11 years.

time-series predictions, $r_{AP.X}$, is 0.55 and 0.56 for the comparison with MSM and IM, respectively. The values remain high, 0.51, when the correlation was conditional on the predictions of both of the other models. These values are significantly different from zero. Since $r_{AP.X}$ is a measure of the net contribution of the autonomous component, it appears that FAF utilize a considerable amount of information which is independent of the time series and cross sectional properties of the series as captured by our extrapolative models.

The coefficients of the partial correlation between realization and time-series predictions, given FAF $(r_{AX.P})$, are generally very small and close to zero (the hypothesis that their mean is zero could not be rejected at the 5% significance level). This means that, in addition to the utilization of autonomous information, analysts also fully exploit the time-series and cross-sectional properties of the earnings series that are captured by the MSM and IM models of earnings.

The apparent reliance of FAF on extrapolations is also evident in the association between the performance of FAF and that of the other models: the mean error of each model in each of the 11 years (see table 1) was ranked (from 1 to 11); the Spearman coefficients of rank correlation between the mean error of FAF and those of MSM and IM are 0.77 and 0.85, respectively. Both values are significant at the 5% level. These results suggest that periods which are characterized by unusual deviations of earnings from their past pattern present forecasting difficulties not only to time-series models but also to FAF.

3.2. *Timing of information*

Analysts presumably make use also of information that becomes available only after the end of the previous fiscal year. To gauge the effect of the use of a more recent information by analysts, it would be desirable to compare the performance of forecasts released at different points of time. For this aim, we collected from the *Earnings Forecaster* the release month of each forecast; this information was not available for 1969, the first year in our sample.

The distribution of forecasts for the remaining 10 years was as follows: 253 issued before January, 435 in January, 1219 in February, 1988 in March and 1299 in early April. We expect forecasts with a later release date to incorporate more (accounting and non-accounting) information and therefore to be superior to earlier forecasts.

To examine whether this is so, we divided our sample into two groups of FAF: one, denoted as 'early' forecasts, consists of forecasts released in January and February, and the other, denoted as 'late' forecasts, consists of those released in March and early April. This particular grouping results in forecasts that were released on average, about six weeks apart. Only companies for which both early and late forecasts were available in a given year were considered.[15] The number of companies considered each year differs and varies from 56 (1979) to 111 (1973).[16]

The research design for this investigation is essentially the one described in section 2, except that we concentrate on comparing early with late FAF. Table 6 exhibits the results of the *API* tests for the early and late FAF. The main findings are that a timing advantage does exist but has no significant impact on the comparative performance of the models considered. The average *API* over the 11 years is 12.78% and 13.15% for the early and late forecasts, respectively. The difference, although in the expected direction, when subjected to a t-test proved insignificant. The mean *API*'s for the time-

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[15] We also used another version of the test under which this restriction was not imposed. Under this version, however, the composition of the company sample of the early forecasts was not identical to that of the company sample of the late forecasts. The results were essentially similar.

[16] This particular definition of early and late forecasts allowed us to get a large sample size in each group. Looking at January's forecasts alone and comparing them to those made in March and April, although might theoretically accentuate the timing difference between the forecasts, resulted in a large drop in the sample size: in two of the years the number of available companies was less than six. The examination of the other eight years did not in fact show a larger difference between early and late FAF.

Table 6

Mean *API* over the test period of a portfolio weighted by the magnitude of the earnings prediction errors of its members — all cases (percentages).[a]

	Early FAF	Late FAF	MSM[b]	IM[b]
All years	12.78	13.15	8.85	8.60
1970	16.92	18.29	15.42	15.00
1971	17.29	17.88	9.01	7.71
1972	11.78	9.09	0.97	−1.36
1973	17.80	17.05	18.45	17.35
1974	8.34	8.56	17.77	7.04
1975	6.95	9.67	−2.83	2.19
1976	14.15	16.88	7.93	7.75
1977	16.72	16.45	17.39	13.65
1978	7.01	7.00	6.88	6.48
1979	10.83	10.66	7.47	10.22

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model. Averages calculated each year only for companies for which both early and late forecasts exist.

[b] The results for the MSM and IM do not correspond to those reported in table 4 since the sample now covers only the years 1970–1979 and consists of companies for which both early and late forecasts were available.

series models computed over the same sample are lower than both FAF groups, 8.85% for the MSM and 8.60% for IM.

Table 7 provides other summary statistics pertinent to the comparison between early and late forecasts (the mean *API* results reported in table 6 are repeated here). The degree of correlation between the CAR and the earnings prediction error for the early forecasts is indistinguishable from that for the late forecasts (0.31 vs. 0.32).

The findings so far suggest that the timing advantage does not result in a significant improvement in the association of FAF with stock price movements. Another relevant consideration is the amount of information incorporated in the late vs. the early FAF. The partial correlation results reveal that late forecasts appear to rely somewhat less on extrapolation of past earnings data and more on autonomous information than early forecasts: the partial correlation between realization and prediction, given the predictions of both the MSM and IM is 0.46 and 0.51 for early and late forecasts, respectively. The timing advantage is more pronounced when we pit early and late forecasts against each other. While the partial correlation between realization and late forecasts, given the early forecasts is 0.26 (suggesting utilization of incremental information by late forecasts) the

Table 7
Comparative performance results for early and late FAF (over years averages).[a]

	Predictor			
Performance measure	Early FAF	Late FAF	MSM	IM
Correlation of prediction error with *CAR*	0.31	0.34	0.25	0.26
Mean *API*, considering magnitude of error (%)	12.78	13.15	8.85	8.60
Partial correlation of realization and prediction, given both MSM and IM	0.46	0.51		
Partial correlation of realization and prediction, given early FAF		0.26	0.01	0.07
Partial correlation of realization and prediction, given early FAF, MSM and IM		0.23		

[a] FAF = Financial Analysts' Forecasts of Earnings, MSM = Modified Submartingale, and IM = Index Model. The averages are calculated over the company-years for which both early and late FAF existed.

partial correlation between realization and early forecasts (not presented in the table) was practically zero.

The findings indicate that the timing advantage of two months that late forecasts have over early forecasts affect their relative performance. Late forecasts employ a greater amount of autonomous information and their performance is somewhat better than that of early forecasts. Both early and late forecasts outperform the time-series models,[17] and it appears that the main factor behind the better performance of FAF is the broader information set used by them.

4. Concluding remarks

The study provides evidence which indicates that, overall, analyst forecasts are a better surrogate for market expectation of earnings than time-series

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[17] It should be noted that the comparison between the early FAF and the naive models is 'unfair' to the former: naive models utilize the most recent earnings numbers and have an advantage over FAF that do not incorporate these yet undisclosed audited results for the year.

models customarily used in the literature. This finding does not invalidate the results of studies which use time-series models to find an association between unexpected earnings and share price changes. In fact, it reinforces the results by indicating that the association is even stronger. This paper's results provide added motivation for the study of other important properties of FAF such as time-series behavior and cross-section dispersion.

The study also analyzes the cause of the superior performance of FAF. The results point to the existence of some timing advantage to forecasts that are made well after the end of the fiscal year and which presumably incorporate more recent information. However, the main contributor to the better performance of FAF is their ability to utilize a much broader set of information than that used by the univariate time-series models. The findings further suggest that analysts efficiently exploit the extrapolative power of the earning series itself.

The findings of the study should be analyzed cautiously. Only two extrapolation models were considered — the submartingale (or MSM) and the index model. It should be noted, however, that these models were found by previous research to perform well when compared to other, sometimes more complex, models.

The representative of FAF was the mean forecast. Even if FAF are associated with the true market expectations, the mean might not be the proper variable. A case can be made for other measures such as the median forecast. To the extent that the mean forecast is not the measure most strongly associated with market expectations, our results underestimate the superiority of FAF as an expectation surrogate.

Another potential source of a bias, possibly against FAF, is the sample selection criterion whereby only firms with at least four contemporaneous forecasts were considered. The criterion, which was introduced to assure a meaningful measure of 'consensus' forecast led inevitably to the exclusion of many small firms which do not attract considerable attention by analysts.[18] If the remaining firms, which are larger, experience smaller earnings variability, the performance of the extrapolative models in the sample is expected to be better than the entire population.

Further research might address the interesting issue of the relationship between the independent, or autonomous, component in analysts' forecasts, which may serve as a measure of the research efforts, and possibly of their costs, and stock characteristics such as risk and marketability.

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[18] Indeed, size and earnings variability are negatively correlated: the cross-section correlation coefficient between the market value of the equity and the variance of the rate of growth of earnings of the sample firms, averaged over the 11 years, is −0.20 (significant at the 5% level). Plausibly, the correlation coefficient in the population (which is more diversified in terms of size) is even more negative.

Appendix: Specification of the exponential smoothing models and their application to the sample

The selection of the order and coefficient of the exponential smoothing model was based on the findings of Brooks and Buckmaster (1976) — hereafter referred to as B & B. The stratification was according to the normalized first difference, defined as

$$d_t = (A_t - A_{t-1})/\sigma_{t-1},$$

where A_t is the EPS in year t and σ_{t-1} is the standard deviation of A over the available history of the company from 1959. Table 8 presents the distribution of company–years in the sample according to d, the comparative distribution in the much larger sample used by B & B, and the order and coefficient of the best smoothing model using the minimization of the mean-absolute-error as the optimization criterion. The distribution of cases in our sample is essentially similar to that of B & B. However, our sample has a somewhat lower percentage of extreme observations. This might be due to the special care that was taken in verifying the correctness of apparent anomalous earnings changes in the data. This verification procedure was obviously infeasible in the large sample of B & B. Note that for almost 70% of the cases (company–years) in our sample, the martingale process is the best predictor.

Table 8

Distribution of company–years by the magnitude of normalized first differences of earnings and the corresponding best predictor.

	This sample		B & B study[a]			
					Best smoothing model[b]	
Normalized first difference	No. of cases	% of cases	No. of cases	% of cases	Order	Constant
$9 < \text{difference}$	16	1.3	89	0.8	1	0.90
$6 < \text{difference} \leqq 9$	28	2.2	205	1.9	1	1.00
$4 < \text{difference} \leqq 6$	77	6.2	466	4.4	1	1.00
$2 < \text{difference} \leqq 4$	294	23.6	1,781	16.7	1	1.00
$1 < \text{difference} \leqq 2$	256	20.5	2,136	20.0	1	1.00
$0 \leqq \text{difference} \leqq 1$	309	24.8	2,977	28.4	1	1.00
$-1 \leqq \text{difference} < 0$	122	9.8	1,531	14.3	1	1.00
$-2 \leqq \text{difference} < -1$	70	5.6	686	6.4	1	0.65
$-4 \leqq \text{difference} < -2$	60	4.8	478	4.4	1	0.45
$-6 \leqq \text{difference} < -4$	12	1.0	137	1.3	1	0.33
$-9 \leqq \text{difference} < -6$	3	0.2	81	0.8	1	0.1
$\text{difference} > -9$			52	0.5	2	0.2
	1,247	100.0	10,619	100.0		

[a] See Brooks and Buckmaster (1976, table 3).

[b] The mean-absolute-error criterion is used.

The smoothing models for the *n*th order is

$$_nE(A_t)=\alpha A_{t-1}+(1-\alpha)_nE(A_{t-1}),$$

where $_nE(A_t)$ is the smoothing function of the *n*th order model at time *t* (see footnote 6).

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Choice among methods of estimating share yield

The search for the growth component in the discounted cash flow model.

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The yield at which a share of stock is selling, also called its expected return or required return, is an important statistic in finance. Firms use it in choosing among investment opportunities and financing alternatives, and investors use it in making portfolio decisions. Nevertheless, the yield at which a share is selling is a difficult quantity to measure, which has limited its use in the practice of finance. This paper develops and tests a basis for choice among alternative methods of estimating a share's yield.

A share's yield, like a bond's yield, is the discount rate that equates its expected future payments with its current price. A bond's yield is easy to measure under the common practice of ignoring default risk, as the future payments are then known with certainty. The future payments on a share, however, are dividends and market price, and these payments are uncertain.

The common practice is to represent these future dividend payments with estimates of two numbers: One is the coming dividend, and the other is a growth rate. The latter can be an estimate of the long-run growth rate in the dividend or of the growth rate in price over the coming period. In the latter case, the estimate is called the expected holding-period return (EHPR); in the former case, it is called the discounted cash flow yield (DCFY).[1] In either case, the estimate of a share's yield reduces to the sum of its dividend yield and a future growth rate, with the latter inferred in some way from historical data.

There is a wide variety of acceptable methods for using historical data to estimate future growth. This variation in method is illustrated in the testimony of expert witnesses before public utility commissions on the fair return for a public utility. In these cases, the estimates and the methods used are a matter of public record. Some idea of the various methods can be found in Morin (1984) and Kolbe, Read, and Hall (1984). The performance of alternative estimating methods has been examined in Gordon (1974), Kolbe, Read, and Hall (1984), Brigham, Shome, and Vinson (1985), and Harris (1986).

We have derived our basis for comparing the accuracy of alternative methods for estimating the DCFY on a share from the generally accepted propositions that yield should vary according to risk, and that beta is the best estimate of risk. Hence, the DCFY should vary among shares with beta, and, between two methods for estimating growth, the superior method is the one for which the variation in yield among shares is explained better by the variation in beta among the shares.

First we present simple, plausible, and objective measurement rules for implementing four popular and/or attractive methods for estimating the DCFY. We then describe how sample statistics may be used to judge the accuracy of each method. We also describe how the CAPM model has been used to estimate share yield and explain why we do not compare it with the various DCFY methods. The following section carries out the comparison with samples of utility and industrial shares, and the last section pre-

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sents the conclusions that may be drawn from the findings.

ALTERNATIVE MEASUREMENT RULES FOR A SHARE'S YIELD

Under the DCF method or model for estimating the expected return on a stock, the yield for the jth stock is:

$$DCFY_{jt} = DYD_{jt} + GR_{jt}, \tag{1}$$

where:

$DCFY_{jt}$ = DCF yield on the jth stock at time t,

DYD_{jt} = dividend yield on the jth stock at time t, and

GR_{jt} = long-run growth rate in the dividend on the jth stock that investors expect at time t.

In what follows, we omit the time and firm subscripts on the variables when they are not required. Also, DCFY will refer to the unknown true yield on a share.

The difficult problem in arriving at the DCFY is estimation of the long-run growth rate that investors expect. Four estimates of that quantity are:

EGR = rate of growth in earnings per share over a prior time period, usually the last five years;

DGR = rate of growth in dividend per share over a prior time period, usually the last five years;

FRG = consensus among security analyst forecasts of the growth rate in earnings, over the next five years; and

BRG = an average over the prior five years of the product of the retention rate b and rate of return on common equity r on a stock.

The estimate of share yield that incorporates each of these estimates of growth is denoted KEGR, KDGR, KFRG, and KBRG, respectively.

A case can be made for each of the four methods for estimating growth. KEGR, KDGR, and KBRG have been widely used in public utility testimony and in research on stock valuation models. The rationale for KEGR is the belief that the past growth rate in earnings is the best predictor of future growth in earnings and dividends. The rationale for KDGR is that the future growth rate in dividends is the statistic we want to estimate, and the past dividend record is free of the noise in past earnings.[2] The rationale for KBRG is that all variables will grow at this rate if the firm earns r and retains b. Furthermore, as Gordon and Gould (1980) show, KEGR and KDGR will be biased in one direction or another if r and b have changed over the last five years. As for KFRG, security analysts are professionals employed to forecast future performance; their forecasts are widely accepted by investors. The IBES collection of forecast growth rates of security analysts compiled by Lynch, Jones, and Ryan has increased the popularity of this estimate.

As stated earlier, we may also take the yield on a share as the sum of the dividend yield and the expected rate of growth in price over the coming period. This estimate of a share's yield is widely used in testing the CAPM, with the average HPR over the prior five years commonly used in such empirical work. On the other hand, this estimate of a share's yield varies so widely among firms and over time as to be patently in error as an estimate of share yield.[3]

BASIS OF COMPARISON

To compare the accuracy of the four estimates of the DCFY stated above, we regress the data under each estimate on beta for a sample of shares. If KEGR is the estimate,

$$KEGR_j = \alpha_0 + \alpha_1 BETA_j + \epsilon_j. \tag{2}$$

The rationale for this expression lies in the risk premium theory of share yield, where the share yield is equal to the interest rate plus a risk premium that varies with the share's relative risk. Hence, if BETA is an error-free index of relative risk, α_0 is equal to the interest rate, and α_1 is the risk premium on the market portfolio or standard share.[4]

The higher the correlation between KEGR and BETA, assuming that α_1 is positive, the greater the confidence we may have in KEGR as an estimate of DCFY. We cannot rely solely on the correlation, though, in selecting among the methods for estimating DCFY. Errors in KEGR as a basis for estimating the DCFY on the jth share have random and systematic components. The former is ϵ_j, and its average value can be taken as the root mean square error of the regression (MSE). The larger the root MSE of the regression, the less attractive KEGR is as an estimate of share yield, because the error makes the problem of choice between $KEGR_j$ and $KEGR_j - \epsilon_j$ more acute. (That problem will be discussed shortly.)

The systematic error is the difference between the unknown true yield on the jth share, $DCFY_j$, and the value predicted by Equation (2). There is no obvious measure of the systematic error, as we do not know $DCFY_j$, but sample values of α_0 may provide information on its average value. The difference between α_0 and the interest rate is an indicator of systematic error, because the difference is zero under the risk premium theory. Error in the measurement of BETA biases α_0 upward, but, with the same BETA for each share used in all four regressions, differences in α_0 are indicators of systematic error.[5]

In addition to regression statistics, the sample mean and standard deviation of KEGR is a source of information on its accuracy as a method for the estimation of DCFY. If the mean departs radically from the long-term bond rate, or if the standard deviation indicates an unreasonable range of variation among shares, the accuracy of the method is open to question. Also, the sample mean may be a source of information on the systematic error for a method of estimation. Hence, sample values for the mean, standard deviation, correlation, root MSE, and constant term all contribute to a judgment on a method's accuracy for estimating the DCFY on a share. Unfortunately, there is no simple criterion for choice among the alternatives.

Once a conclusion is reached on the most accurate method for estimating DCFY — say, KEGR — we then have the problem of choice between $KEGR_j$ and $KEGR_j - \epsilon_j$ for the jth share. If the random error in $KEGR_j$ is due to error in its measurement for the jth share, we simply use the value predicted by Equation (2), which is $KEGR_j - \epsilon_j$. On the other hand, KEGR and DCFY may vary among shares with other (omitted) variables as well as BETA, in which case ϵ_j is also due to the omitted variables, and $KEGR_j$ may be the better estimate of DCFY. Unfortunately, we have no basis for choice among these two hypotheses, and the smaller the root MSE the less troublesome the problem of choice between them.

A more favorable tax treatment of capital gains over dividends should make investors prefer capital gains to dividends. As Brennan (1973) has shown, the yield investors require on a share would then vary with the excess of its dividend yield over the interest rate. To recognize this, Equation (2) becomes

$$KEGR_j = \alpha_0 + \alpha_1 BETA_j + \alpha_2 DMI_j + \epsilon_j, \qquad (3)$$

with DMI_j the excess of the dividend yield over the interest rate for the jth firm. Although the tax effect should make α_2 positive, its information in DMI on share risk would tend to make α_2 negative. That is, dividend yield varies inversely with expected growth, and we would find α_2 negative insofar as growth is risky. To the extent that these two influences of the dividend yield offset each other, α_2 will tend toward zero.

The CAPM theory of how expected return varies among shares has been proposed as an alternative to the DCF model for measuring yield. Its value for the jth stock is

$$EHPR_j = INTR + BETA_j[EHPR_m - INTR], \qquad (4)$$

where:

$EHPR_j$ = expected holding-period return on the jth share,

$INTR$ = one-period risk-free interest rate,

$EHPR_m$ = expected holding-period return on the market portfolio.

There is an important difference between this CAPM model of share yield and the DCF model represented by Equation (1). The latter is merely an instrument for measuring share yield: There is nothing in the DCF model that explains the variation in yield among shares. The CAPM, on the other hand, is a theory on why and how yield varies among shares, but one must go outside of the theory to estimate the variables on the right-hand side of Equation (4). Given rules for estimating the variables, EHPR and BETA, empirical work then provides a joint test of the theory and the estimating rules, such as we are carrying out here.[6]

The CAPM nonetheless has been used to estimate share yield in testimony before regulatory commissions by assigning numbers to each of the quantities on the right-hand side of Equation (4). For INTR, a long-term bond yield is sometimes used instead of a one-period rate. BETA is estimated by conventional methods.

The big problem is the expected return on the market portfolio. Here the practice has been to use the average realized risk premium over a period of about fifty years as the estimate of $EHPR_m - INTR$ in Equation (4). Although the implicit assumption is that the risk premium is a constant over time, we would expect the premium to change from one period to the next for various reasons, among them changes in the interest rate, the risk premium on the market portfolio, and the relative taxation of interest and share income. Hence, this estimate of share yield is more or less in error at any particular time, but we have no way of estimating this error and comparing the method with the others.

COMPARATIVE PERFORMANCE

We carried out our empirical work with a sample of 75 large electric and gas utility firms and a sample of 244 firms that includes 169 industrial firms drawn from the S&P 400. We obtained share yield under the four methods for estimating it as of the start of the year for the years 1984, 1985, and 1986.

For the explanatory variables, BETA for each share on each date was obtained by regressing the monthly HPRs for the share on the monthly HPRs for the S&P 500 over the prior five years. DMI for a share is its dividend yield less the interest rate on the one-month Treasury bill at the start of each year. EGR and DGR are the growth rates in earnings and in dividends per share, respectively, over the prior five years as reported on the Value Line Tape. BRG is a weighted average of the retention growth rates over the prior five years,[7] and FRG is the average of forecast growth rates in earnings over the next five years reported by IBES. The corresponding estimates of share yield were obtained by adding the dividend yield at the start of each year to the estimate of growth.

Table 1 presents the statistics that we obtained with KBRG and KFRG as the estimates of DCFY for the sample of utility shares and of all shares. The means of KBRG for the utility shares seems reasonable, with the interest rate on ten-year government bonds the standard of comparison, the latter being 11.67%, 10.43%, and 9.19% at the start of 1984, 1985, and 1986, respectively.[8] The standard deviations for KBRG are small enough to make its range of variation well within the bounds of reason. The lower means for all shares reveal that the means for industrial shares are below the means for utility shares.[9] This casts doubt on the accuracy of KBRG as a basis for estimating the DCFY on industrial shares, because industrials are riskier than utility shares.

The beta model explains none of the variation in KBRG among utility shares, but the two-factor model is a substantial improvement. The DMI coefficient, α_2, is positive and significant in every year, meaning that the unfavorable tax effect of a high dividend yield dominates the favorable risk effect. The coefficient on BETA is positive and significant in two of the three years. The only disturbing feature of the data is the sharp fall in R^2 and the corresponding rise in the root MSE relative to the standard deviation of KBRG as we go from 1984 to 1986.

The KBRG statistics for all shares are substantially inferior to the utility share statistics. This forces the unhappy conclusion that, for industrial shares, BETA is a poor measure of risk, or KBRG is a poor measure of DCFY, or both.

The KFRG statistics for the utility sample are superior to the KBRG statistics. The means are reasonable under the two criteria of being above the interest rate and moving with it. The range of variation of KFRG suggested by its standard deviations seems reasonable. The statistics for the beta model are a slight improvement on the corresponding statistics for KBRG. Furthermore, the two-factor model does a good job of explaining the variation in KFRG among

TABLE 1

Sample and Regression Statistics for KBRG and KFRG, Utility Shares and All Shares, 1984, 1985, and 1986

	KBRG			KFRG		
	1984	1985	1986	1984	1985	1986
			UTILITY SHARES (75)			
Mean	14.84	14.38	12.93	15.64	14.56	12.93
Standard Deviation	2.51	1.87	1.80	2.26	1.43	1.42
Beta Model α_0	14.26	13.96	13.05	15.14	13.48	12.74
α_1	1.44	1.21	−0.28	1.25	3.09	0.42
t-statistic	(0.97)	(1.12)	(0.19)	(0.93)	(4.14)	(0.37)
Root MSE	2.52	1.87	1.81	2.26	1.29	1.43
R^2	0.013	0.017	0.001	0.012	0.190	0.002
Two-Factor Model α_0	12.45	12.75	12.42	13.30	12.46	11.97
α_1	3.45	2.11	0.11	3.28	3.85	0.89
t-statistic	(3.13)	(2.19)	(0.08)	(3.83)	(6.33)	(0.88)
α_2	0.68	0.45	0.34	0.68	0.38	0.41
t-statistic	(8.22)	(4.88)	(2.81)	(10.73)	(6.52)	(4.65)
Root MSE	1.82	1.63	1.73	1.41	1.03	1.26
R^2	0.491	0.262	0.100	0.620	0.491	0.232
			ALL SHARES (244)			
Mean	12.98	13.19	11.86	16.17	15.87	14.31
Standard Deviation	3.86	3.21	3.52	2.60	2.32	2.30
Beta Model α_0	15.00	14.71	13.90	15.56	14.50	12.57
α_1	−2.47	−1.91	−2.40	0.74	1.72	2.05
t-statistic	(4.23)	(4.15)	(4.25)	(1.83)	(5.29)	(5.70)
Root MSE	3.73	3.10	3.40	2.59	2.20	2.16
R^2	0.069	0.066	0.069	0.014	0.104	0.118
Two-Factor Model α_0	14.34	14.42	13.95	15.40	14.61	12.75
α_1	0.09	−1.18	−2.51	1.37	1.44	1.61
t-statistic	(0.13)	(2.04)	(3.45)	(2.69)	(3.52)	(3.49)
α_2	0.48	0.17	−0.02	0.12	−0.06	−0.10
t-statistic	(6.04)	(2.09)	(0.24)	(2.01)	(1.12)	(1.53)
Root MSE	3.49	3.08	3.41	2.57	2.20	2.16
R^2	0.191	0.083	0.070	0.030	0.108	0.127

utility shares. The R^2s are higher here than for KBRG in every year. Finally, α_2 is positive and significant in every year, and α_1 is not significant only in 1986.

The implicit means of KFRG for the industrial shares seem high but not beyond reason. On the other hand, the regression statistics for the all-shares sample are not good, which leads to the same unhappy conclusion for industrial shares as we reached for KBRG.

Table 2 presents the statistics that we obtained using KEGR and KDGR as estimates of the DCFY on the shares in our samples. Comparison of the regression statistics with those in Table 1 reveals that KEGR and KDGR, particularly the former, fall short by a wide margin of the performance of KBRG and KFRG as estimates of the DCFY on a share.

CONCLUSION

We have compared the accuracy of four methods for estimating the growth component of the discounted cash flow yield on a share: past growth rate in earnings (KEGR), past growth rate in dividends (KDGR), past retention growth rate (KBRG), and forecasts of growth by security analysts (KFRG). Criteria for the comparison were the reasonableness of sample means and standard deviations and the success of beta and dividend yield in explaining the variation in DCF yield among shares. For our sample of utility shares, KFRG performed well, with KBRG, KDGR, and KEGR following in that order, and with KEGR a distant fourth. If we had used past growth in price, it would have been an even more distant fifth. Nevertheless, none of the four estimates of growth performed well under the criteria for a sample that included industrial shares.

Before closing, we have three observations to make. First, the superior performance by KFRG should come as no surprise. All four estimates of growth rely upon past data, but in the case of KFRG a larger body of past data is used, filtered through a group of security analysts who adjust for abnormalities that are not considered relevant for future growth. We assume this is done by any analyst who develops retention growth estimates of yield for a firm. If we had done this for all seventy-five firms in our utility sample, it is likely that the correlations

TABLE 2

Sample and Regression Statistics for KEGR and KDGR, Utility Shares and All Shares, 1984, 1985, and 1986

	KEGR			KDGR		
	1984	1985	1986	1984	1985	1986
			UTILITY SHARES (75)			
Mean	16.16	0.32	14.91	16.49	15.76	14.13
Standard Deviation	3.31	3.47	4.66	3.12	2.41	2.21
Beta Model α_0	15.45	16.18	0.51	15.75	14.53	12.30
α_1	1.75	0.40	−7.87	1.83	3.53	3.99
t-statistic	(0.89)	(0.20)	(2.16)	(0.99)	(2.64)	(2.32)
Root MSE	3.32	3.49	4.55	3.12	2.32	2.15
R^2	0.010	0.001	0.060	0.013	0.087	0.069
Two-Factor Model α_0	14.20	15.83	18.76	14.10	13.56	12.64
α_1	3.13	0.66	−8.03	3.65	4.25	3.78
t-statistic	(1.66)	(0.32)	(2.18)	(2.23)	(3.26)	(2.20)
α_2	0.47	0.13	−0.13	0.61	0.35	−0.18
t-statistic	(3.32)	(0.66)	(0.42)	(5.02)	(2.86)	(1.21)
Root MSE	3.11	3.50	4.58	2.70	2.21	2.14
R^2	0.142	0.007	0.063	0.269	0.180	0.087
			ALL SHARES (244)			
Mean	11.14	9.42	7.88	15.08	13.63	11.35
Standard Deviation	10.67	11.67	11.45	6.08	6.30	6.71
Beta Model α_0	15.96	18.28	19.55	15.15	0.04	15.39
α_1	−5.90	−11.16	−13.70	−0.09	−1.78	−4.74
t-statistic	(3.62)	(7.07)	(8.10)	(0.09)	(1.92)	(4.41)
Root MSE	10.41	10.65	10.18	6.09	6.27	6.47
R^2	0.051	0.171	0.213	0.000	0.015	0.074
Two-Factor Model α_0	14.84	18.01	19.91	14.31	14.11	14.79
α_1	−1.56	−10.49	−14.62	3.17	0.63	−3.25
t-statistic	(0.77)	(5.27)	(6.72)	(2.73)	(0.55)	(2.36)
α_2	0.81	0.15	−0.21	0.61	0.55	0.34
t-statistic	(3.51)	(0.55)	(0.67)	(4.57)	(3.47)	(1.72)
Root MSE	10.18	10.67	10.19	5.86	6.13	6.45
R^2	0.097	0.172	0.215	0.080	0.062	0.085

would have been as good or better than those obtained with the analyst forecasts of growth.

Second, we examined shares and not portfolios, because our objective is to estimate the DCFY for shares and not for portfolios. As common practice in testing the CAPM has been to execute tests on portfolios instead of shares, we classified our population of shares into ten portfolios on the basis of their beta values. Regression statistics were substantially unchanged, except that correlations increased dramatically.

Finally, we must acknowledge that we have no basis for estimating the expected HPR or DCF yield for industrial shares with any confidence. Theories on financial decision-making in industrial corporations that rely on that statistic have a weak empirical foundation.

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[1] The EHPR is a one-period return, while the DCFY is a yield to maturity measure. The two may differ in actuality because of measurement problems, but they also may differ in theory. That is, they may differ in the same way that interest rates on bonds of different maturities may differ. See Gordon and Gould (1984a). This source of difference between EHPR and DCFY will be ignored here.

[2] A widely accepted hypothesis is that dividends contain information on earnings, because management sets the dividend to pay out a stable fraction of normal or permanent earnings.

[3] Over a five-year period, there may even be a negative rate of growth in price for a large number of firms. Furthermore, this negative growth rate may be larger in absolute value than the dividend yield, which leads to the conclusion that investors are holding such shares to earn a negative return. The frequency of negative rates of growth in price is reduced as the prior time period used in its calculation increases in length. As that takes place, however, the estimate of the expected return for a firm approaches a constant or a constant plus the dividend yield. The expected return on a share is one statistic for which it is an error to assume that expectations are on average realized.

[4] Equation (2) is similar to the CAPM according to Sharpe, Lintner, and Mossin. They arrived at this expression under very rigorous assumptions. The heuristic risk premium model is adequate for our purposes.

[5] It may be thought that Theil's (1966) decomposition of the difference between the actual and predicted values of a variable can be used here, but in fact that decomposition applies to a different problem. It assumes that the observed (actual) past values of a variable are free of error, and it decomposes the error in a model that is employed to explain the past values. The purpose of Theil's decomposition is to cast light on the possible error in using the model to predict future values of the dependent variable. Our problem is to determine which set of observed values is closest to the true values, with the risk premium theory of share yield and BETA as the source of information on the true values. Theil's method would be appropriate for decomposing the difference between the actual and predicted values of the *realized* holding-period return on a share. The actual values here can be observed without error.

[6] There is an enormous volume of empirical work devoted to discovering whether the theory is true, but this empirical work does not provide useful estimates of the EHPR on a share. To test the truth of Equation (4), the practice has been to regress EHPR on BETA for a sample of firms with the average realized HPR over the prior five or so years used as an estimate of the EHPR. Because of the large error in the realized HPR over a prior time period, as noted earlier, neither the actual values of the dependent variable nor the values predicted by the model are usable as estimates of share yield. See Fama and MacBeth (1973) and Friend, Westerfield, and Granito (1978).

[7] BRG for a year is earnings less dividend divided by the end-of-year book value. The estimate of the expected value as of the start of 1986 is 0.3BRG85 + 0.25BRG84 + 0.20BRG83 + 0.15BRG83 + 0.10BRG82. If any value of BRG was negative, it was set equal to zero.

[8] We expect the yields on shares to be above the risk-free interest rate, but with a high enough interest rate the more favorable tax treatment of shares can reduce the yield below the interest rate. Interest rates were not that high in these years. See Gordon and Gould (1984b).

[9] The statistics reported for all shares and for utility shares were also obtained for industrial shares. All methods of estimation performed so poorly for industrial shares, however, as to suggest no confidence can be placed in any of them. To save space, we do not present statistics for the industrial shares. Whatever we want to know about them can be deduced by comparing the data for all shares and utility shares.

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Investor growth expectations: Analysts vs. history

Analysts' growth forecasts dominate past trends in predicting stock prices.

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For the purposes of implementing the Discounted Cash Flow (DCF) cost of equity model, the analyst must know which growth estimate is embodied in the firm's stock price. A study by Cragg and Malkiel (1982) suggests that the stock valuation process embodies analysts' forecasts rather than historically based growth figures such as the ten-year historical growth in dividends per share or the five-year growth in book value per share. The Cragg and Malkiel study is based on data for the 1960s, however, a decade that was considerably more stable than the recent past.

As the issue of which growth rate to use in implementing the DCF model is so important to applications of the model, we decided to investigate whether the Cragg and Malkiel conclusions continue to hold in more recent periods. This paper describes the results of our study.

STATISTICAL MODEL

The DCF model suggests that the firm's stock price is equal to the present value of the stream of dividends that investors expect to receive from owning the firm's shares. Under the assumption that investors expect dividends to grow at a constant rate, g, in perpetuity, the stock price is given by the following simple expression:

$$P_S = \frac{D(1+g)}{k-g} \tag{1}$$

where:

P_S = current price per share of the firm's stock;

D = current annual dividend per share;

g = expected constant dividend growth rate; and

k = required return on the firm's stock.

Dividing both sides of Equation (1) by the firm's current earnings, E, we obtain:

$$\frac{P_S}{E} = \frac{D}{E} \cdot \frac{(1+g)}{k-g} \tag{2}$$

Thus, the firm's price/earnings (P/E) ratio is a nonlinear function of the firm's dividend payout ratio (D/E), the expected growth in dividends (g), and the required rate of return.

To investigate what growth expectation is embodied in the firm's current stock price, it is more convenient to work with a linear approximation to Equation (2). Thus, we will assume that:

$$P/E = a_0(D/E) + a_1 g + a_2 k. \tag{3}$$

(Cragg and Malkiel found this assumption to be reasonable throughout their investigation.)

Furthermore, we will assume that the required

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rate of return, k, in Equation (3) depends on the values of the risk variables B, Cov, Rsq, and Sa, where B is the firm's Value Line beta; Cov is the firm's pretax interest coverage ratio; Rsq is a measure of the stability of the firm's five-year historical EPS; and Sa is the standard deviation of the consensus analysts' five-year EPS growth forecast for the firm. Finally, as the linear form of the P/E equation is only an approximation to the true P/E equation, and B, Cov, Rsq, and Sa are only proxies for k, we will add an error term, e, that represents the degree of approximation to the true relationship.

With these assumptions, the final form of our P/E equation is as follows:

$$\begin{aligned} P/E = {} & a_0(D/E) + a_1 g + a_2 B + \\ & a_3 Cov + a_4 Rsq + a_5 Sa + e. \end{aligned} \tag{4}$$

The purpose of our study is to use more recent data to determine which of the popular approaches for estimating future growth in the Discounted Cash Flow model is embodied in the market price of the firm's shares.

We estimated Equation (4) to determine which estimate of future growth, g, when combined with the payout ratio, D/E, and risk variables B, Cov, Rsq, and Sa, provides the best predictor of the firm's P/E ratio. To paraphrase Cragg and Malkiel, we would expect that growth estimates found in the best-fitting equation more closely approximate the expectation used by investors than those found in poorer-fitting equations.

DESCRIPTION OF DATA

Our data sets include both historically based measures of future growth and the consensus analysts' forecasts of five-year earnings growth supplied by the Institutional Brokers Estimate System of Lynch, Jones & Ryan (IBES). The data also include the firm's dividend payout ratio and various measures of the firm's risk. We include the latter items in the regression, along with earnings growth, to account for other variables that may affect the firm's stock price.

The data include:

Earnings Per Share. Because our goal is to determine which earnings variable is embodied in the firm's market price, we need to define this variable with care. Financial analysts who study a firm's financial results in detail generally prefer to "normalize" the firm's reported earnings for the effect of extraordinary items, such as write-offs of discontinued operations, or mergers and acquisitions. They also attempt, to the extent possible, to state earnings for different firms using a common set of accounting conventions.

We have defined "earnings" as the consensus analyst estimate (as reported by IBES) of the firm's earnings for the forthcoming year.[1] This definition approximates the normalized earnings that investors most likely have in mind when they make stock purchase and sell decisions. It implicitly incorporates the analysts' adjustments for differences in accounting treatment among firms and the effects of the business cycle on each firm's results of operations. Although we thought at first that this earnings estimate might be highly correlated with the analysts' five-year earnings growth forecasts, that was not the case. Thus, we avoided a potential spurious correlation problem.

Price/Earnings Ratio. Corresponding to our definition of "earnings," the price/earnings ratio (P/E) is calculated as the closing stock price for the year divided by the consensus analyst earnings forecast for the forthcoming fiscal year.

Dividends. Dividends per share represent the common dividends declared per share during the calendar year, after adjustment for all stock splits and stock dividends). The firm's dividend payout ratio is then defined as common dividends per share divided by the consensus analyst estimate of the earnings per share for the forthcoming calendar year (D/E). Although this definition has the deficiency that it is obviously biased downward — it divides this year's dividend by next year's earnings — it has the advantage that it implicitly uses a "normalized" figure for earnings. We believe that this advantage outweighs the deficiency, especially when one considers the flaws of the apparent alternatives. Furthermore, we have verified that the results are insensitive to reasonable alternative definitions (see footnote 1).

Growth. In comparing historically based and consensus analysts' forecasts, we calculated forty-one different historical growth measures. These included the following: 1) the past growth rate in EPS as determined by a log-linear least squares regression for the latest year,[2] two years, three years, . . ., and ten years; 2) the past growth rate in DPS for the latest year, two years, three years, . . ., and ten years; 3) the past growth rate in book value per share (computed as the ratio of common equity to the outstanding common equity shares) for the latest year, two years, three years, . . ., and ten years; 4) the past growth rate in cash flow per share (computed as the ratio of pretax income, depreciation, and deferred taxes to the outstanding common equity shares) for the latest year, two years, three years, . . ., and ten years; and 5) plowback growth (computed as the firm's retention ratio for the current year times the firm's latest annual return on common equity).

We also used the five-year forecast of earnings per share growth compiled by IBES and reported in mid-January of each year. This number represents the consensus (i.e., mean) forecast produced by analysts from the research departments of leading Wall Street and regional brokerage firms over the preceding three months. IBES selects the contributing brokers "because of the superior quality of their research, professional reputation, and client demand" (IBES *Monthly Summary Book*).

Risk Variables. Although many risk factors could potentially affect the firm's stock price, most of these factors are highly correlated with one another. As shown above in Equation (4), we decided to restrict our attention to four risk measures that have intuitive appeal and are followed by many financial analysts: 1) B, the firm's beta as published by Value Line; 2) Cov, the firm's pretax interest coverage ratio (obtained from Standard & Poor's Compustat); 3) Rsq, the stability of the firm's five-year historical EPS (measured by the R^2 from a log-linear least squares regression); and 4) Sa, the standard deviation of the consensus analysts' five-year EPS growth forecast (mean forecast) as computed by IBES.

After careful analysis of the data used in our study, we felt that we could obtain more meaningful results by imposing six restrictions on the companies included in our study:

1. Because of the need to calculate ten-year historical growth rates, and because we studied three different time periods, 1981, 1982, and 1983, our study requires data for the thirteen-year period 1971-1983. We included only companies with at least a thirteen-year operating history in our study.
2. As our historical growth rate calculations were based on log-linear regressions, and the logarithm of a negative number is not defined, we excluded all companies that experienced negative EPS during any of the years 1971-1983.
3. For similar reasons, we also eliminated companies that did not pay a dividend during any one of the years 1971-1983.
4. To insure comparability of time periods covered by each consensus earnings figure in the P/E ratios, we eliminated all companies that did not have a December 31 fiscal year-end.
5. To eliminate distortions caused by highly unusual events that distort current earnings but not expected future earnings, and thus the firm's price/earnings ratio, we eliminated any firm with a price/earnings ratio greater than 50.
6. As the evaluation of analysts' forecasts is a major part of this study, we eliminated all firms that IBES did not follow.

Our final sample consisted of approximately sixty-five utility firms.[3]

RESULTS

To keep the number of calculations in our study to a reasonable level, we performed the study in two stages. In Stage 1, all forty-one historically oriented approaches for estimating future growth were correlated with each firm's P/E ratio. In Stage 2, the historical growth rate with the highest correlation to the P/E ratio was compared to the consensus analyst growth rate in the multiple regression model described by Equation (4) above. We performed our regressions for each of three recent time periods, because we felt the results of our study might vary over time.

First-Stage Correlation Study

Table 1 gives the results of our first-stage correlation study for each group of companies in each of the years 1981, 1982, and 1983. The values in this table measure the correlation between the historically oriented growth rates for the various time periods and the firm's end-of-year P/E ratio.

The four variables for which historical growth rates were calculated are shown in the left-hand column: EPS indicates historical earnings per share growth, DPS indicates historical dividend per share growth, BVPS indicates historical book value per share growth, and CFPS indicates historical cash flow per share growth. The term "plowback" refers to the product of the firm's retention ratio in the currennt year and its return on book equity for that year. In all, we calculated forty-one historically oriented growth rates for each group of firms in each study period.

The goal of the first-stage correlation analysis was to determine which historically oriented growth rate is most highly correlated with each group's year-end P/E ratio. Eight-year growth in CFPS has the highest correlation with P/E in 1981 and 1982, and ten-year growth in CFPS has the highest correlation with year-end P/E in 1983. In all cases, the plowback estimate of future growth performed poorly, indicating that — contrary to generally held views — plowback is not a factor in investor expectations of future growth.

Second-Stage Regression Study

In the second stage of our regression study, we ran the regression in Equation (4) using two different measures of future growth, g: 1) the best historically oriented growth rate (g_h) from the first-stage correlation study, and 2) the consensus analysts' forecast (g_a) of five-year EPS growth. The regression results, which are shown in Table 2, support at least

TABLE 1

Correlation Coefficients of All Historically Based Growth Estimates by Group and by Year with P/E

Current Year	*Historical Growth Rate Period in Years* 1	2	3	4	5	6	7	8	9	10
1981										
EPS	-0.02	0.07	0.03	0.01	0.03	0.12	0.08	0.09	0.09	0.09
DPS	0.05	0.18	0.14	0.15	0.14	0.15	0.19	0.23	0.23	0.23
BVPS	0.01	0.11	0.13	0.13	0.16	0.18	0.15	0.15	0.15	0.15
CFPS	-0.05	0.04	0.13	0.22	0.28	0.31	0.30	0.31	-0.57	-0.54
Plowback	0.19									
1982										
EPS	-0.10	-0.13	-0.06	-0.02	-0.02	-0.01	-0.03	-0.03	0.00	0.00
DPS	-0.19	-0.10	0.03	0.05	0.07	0.08	0.09	0.11	0.13	0.13
BVPS	0.07	0.08	0.11	0.11	0.09	0.10	0.11	0.11	0.09	0.09
CFPS	-0.02	-0.08	0.00	0.10	0.16	0.19	0.23	0.25	0.24	0.07
Plowback	0.04									
1983										
EPS	-0.06	-0.25	-0.25	-0.24	-0.16	-0.11	-0.05	0.00	0.02	0.02
DPS	0.03	-0.10	-0.03	0.08	0.15	0.21	0.21	0.21	0.22	0.24
BVPS	0.03	0.10	0.04	0.09	0.15	0.16	0.19	0.21	0.22	0.21
CFPS	-0.08	0.01	0.02	0.08	0.20	0.29	0.35	0.38	0.40	0.42
Plowback	-0.08									

two general conclusions regarding the pricing of equity securities.

First, we found overwhelming evidence that the consensus analysts' forecast of future growth is superior to historically oriented growth measures in predicting the firm's stock price. In every case, the R^2 in the regression containing the consensus analysts' forecast is higher than the R^2 in the regression containing the historical growth measure. The regression coefficients in the equation containing the consensus analysts' forecast also are considerably more significant than they are in the alternative regression. These results are consistent with those found by Cragg and Malkiel for data covering the period 1961-1968. Our results also are consistent with the hypothesis that investors use analysts' forecasts, rather than historically oriented growth calculations, in making stock buy-and-sell decisions.

TABLE 2

Regression Results
Model I

Part A: *Historical*

$P/E = a_0 + a_1 D/E + a_2 g_h + a_3 B + a_4 Cov + a_5 Rsq + a_6 Sa$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	$\hat{a}_5$	$\hat{a}_6$	R^2	F Ratio
1981	-6.42*	10.31*	7.67*	3.24	0.54*	1.42*	57.43	0.83	46.49
	(5.50)	(14.79)	(2.20)	(2.86)	(2.50)	(2.85)	(4.07)		
1982	-2.90*	9.32*	8.49*	2.85	0.45*	-0.42	3.63	0.86	65.53
	(2.75)	(18.52)	(4.18)	(2.83)	(2.60)	(0.05)	(0.26)		
1983	-5.96*	10.20*	19.78*	4.85	0.44*	0.33	32.49	0.82	45.26
	(3.70)	(12.20)	(4.83)	(2.95)	(1.89)	(0.50)	(1.29)		

Part B: *Analysis*

$P/E = a_0 + a_1 D/E + a_2 g_a + a_3 B + a_4 Cov + a_5 Rsq + a_6 Sa$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	$\hat{a}_5$	$\hat{a}_6$	R^2	F Ratio
1981	-4.97*	10.62*	54.85*	-0.61	0.33*	0.63*	4.34	0.91	103.10
	(6.23)	(21.57)	(8.56)	(0.68)	(2.28)	(1.74)	(0.37)		
1982	-2.16*	9.47*	50.71*	-1.07	0.36*	-0.31	119.05*	0.90	97.62
	(2.59)	(22.46)	(9.31)	(1.14)	(2.53)	(1.09)	(1.60)		
1983	-8.47*	11.96*	79.05*	2.16	0.56*	0.20	-34.43	0.87	69.81
	(7.07)	(16.48)	(7.84)	(1.55)	(3.08)	(0.38)	(1.44)		

Notes:

* Coefficient is significant at the 5% level (using a one-tailed test) and has the correct sign. T-statistic in parentheses.

Second, there is some evidence that investors tend to view risk in traditional terms. The interest coverage variable is statistically significant in all but one of our samples, and the stability of the operating income variable is statistically significant in six of the twelve samples we studied. On the other hand, the beta is never statistically significant, and the standard deviation of the analysts' five-year growth forecasts is statistically significant in only two of our twelve samples. This evidence is far from conclusive, however, because, as we demonstrate later, a significant degree of cross-correlation among our four risk variables makes any general inference about risk extremely hazardous.

Possible Misspecification of Risk

The stock valuation theory says nothing about which risk variables are most important to investors. Therefore, we need to consider the possibility that the risk variables of our study are only proxies for the "true" risk variables used by investors. The inclusion of proxy variables may increase the variance of the parameters of most concern, which in this case are the coefficients of the growth variables.[4]

To allow for the possibility that the use of risk proxies has caused us to draw incorrect conclusions concerning the relative importance of analysts' growth forecasts and historical growth extrapolations, we have also estimated Equation (4) with the risk variables excluded. The results of these regressions are shown in Table 3.

Again, there is overwhelming evidence that the consensus analysts' growth forecast is superior to the historically oriented growth measures in predicting the firm's stock price. The R^2 and t-statistics are higher in every case.

CONCLUSION

The relationship between growth expectations and share prices is important in several major areas of finance. The data base of analysts' growth forecasts collected by Lynch, Jones & Ryan provides a unique opportunity to test the hypothesis that investors rely more heavily on analysts' growth forecasts than on historical growth extrapolations in making security buy–and–sell decisions. With the help of this data base, our studies affirm the superiority of analysts' forecasts over simple historical growth extrapolations in the stock price formation process. Indirectly, this finding lends support to the use of valuation models whose input includes expected growth rates.

TABLE 3

Regression Results
Model II

Part A: *Historical*

$P/E = a_0 + a_1 D/E + a_2 g_h$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F Ratio
1981	−1.05	9.59	21.20	0.73	82.95
	(1.61)	(12.13)	(7.05)		
1982	0.54	8.92	12.18	0.83	167.97
	(1.38)	(17.73)	(6.95)		
1983	−0.75	8.92	12.18	0.77	107.82
	(1.13)	(12.38)	(7.94)		

Part B: *Analysis*

$P/E + a_0 + a_1 D/E + a_2 g_a$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F Ratio
1981	3.96	10.07	60.53	0.90	274.16
	(8.31)	(8.31)	(20.91)	(15.79)	
1982	−1.75	9.19	44.92	0.88	246.36
	(4.00)	(4.00)	(21.35)	(11.06)	
1983	−4.97	10.95	82.02	0.83	168.28
	(6.93)	(6.93)	(15.93)	(11.02)	

Notes:
* Coefficient is significant at the 5% level (using a one-tailed test) and has the correct sign. T-statistic in parentheses.

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[1] We also tried several other definitions of "earnings," including the firm's most recent primary earnings per share prior to any extraordinary items or discontinued operations. As our results were insensitive to reasonable alternative definitions of "earnings" we report only the results for the IBES consensus.

[2] For the latest year, we actually employed a point-to-point growth calculation because there were only two available observations.

[3] We use the word "approximately," because the set of available firms varied each year. In any case, the number varied only from zero to three firms on either side of the figures cited here.

[4] See Maddala (1977).

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The Valuation of Public Utility Equities

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The valuation of public utility equities

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This paper reports on a cross-sectional valuation study of public utility equities during the year-end periods from 1961 through 1967. The ratios of market prices to earnings are related to such factors as anticipated earnings growth, dividend payout, and various proxy variables designed to measure the risk or quality of the earnings stream. The distinguishing feature of the study is that it uses the actual expectations of security analysts for variables that heretofore had to be estimated from historical data alone. The results of the regressions using expectations data are contrasted with results relying on historical data. Results of alternative risk proxies are compared, and the stability and predictive power of the model over time are examined.

1. Introduction

■ Much of the analytic financial literature of the past decade has assumed that the managers of firms are trying to make the shareholders as well off as possible. In many models this goal is stated in terms of maximizing the value of the common shares. If indeed managers do try to maximize this objective function in even some of their decisions, it is clearly essential that they know how their decisions affect the market prices of the shares. For example, if a firm's management is trying to decide on dividend policy, or on questions of financial structure, it must have some understanding of the effect of alternative possibilities on the price of the stock.

The valuation of a firm's common shares is also critically important to any study of the firm's cost of capital. While no attempt is made in this paper to estimate the cost of equity capital directly, cost estimates can be calculated from the expectations data used in the current study. It is worth emphasizing that public utilities are heavily dependent on outside capital; they have been accounting for over 20 percent of all new equity issues.[1] In view of the importance of outside sources of funds, knowledge of valuation relationships becomes a matter of great interest not only to utility managements but

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This paper was presented to the Conference on Public Utility Regulation sponsored by the AT&T Company and held at Stanford University on June 20, 1969. The empirical work is based on techniques developed jointly with John G. Cragg in a study of the valuation of corporate securities. The author acknowledges helpful comments made by the editors of the BELL JOURNAL OF ECONOMICS AND MANAGEMENT SCIENCE and by Myron Scholes. He is also indebted to Jeffrey Balash, Raymond Hartman, Jane Ingersoll, and James Mann for their assistance in collecting and processing the expectations data, for programming assistance, and for carrying out the computations. This research was supported by the Institute for Quantitative Research in Finance and by the National Science Foundation.

[1] See [19], p. 17.

also to their investment bankers and, of course, to those charged with the responsibility of regulating public utilities.

Finally, a study of the valuation of public utility equities should be of considerable interest to investors concerned with knowing the relationship between stock prices and variables such as growth, payout, and risk. It is also important to know whether such relationships are stable through time or whether they change with market conditions, especially if one wishes to use empirical valuation models as a method of selecting "underpriced" stocks that might be expected to out-perform the market. Valuation models have been employed by Whitbeck and Kisor [27] and Peck [22] to select securities by comparing actual market prices with those predicted by cross-sectional regression analysis. It was assumed that the stock would seek its "warranted price" (the price indicated by the regression analysis) faster than that warranted price might itself change.[2] In the concluding section of this paper the results of such experiments with the present model are examined.

2. A model for the valuation of public utility equities

■ The typical stock-valuation model indicates that the present value of an equity share to the investor is the stream of returns to be expected from the security. In the simplest model, this is the present value of the stream of dividends, which is assumed to grow at a constant rate, g, over time.[3] Letting D stand for the (annual) dividend per share in the year just past and ρ the appropriate rate of discount, we have the present value of a share

$$P = D \sum_{i=1}^{\infty} (1 + g)^i/(1 + \rho)^i = D(1 + g)/(\rho - g), \qquad (1)$$

provided $g < \rho$. Dividing by current earnings, E, we obtain

$$P/E = \frac{D(1 + g)}{E(\rho - g)}. \qquad (2)$$

The price-earnings ratio is seen to depend on the long-term rate of growth and the dividend-payout ratio.[4]

The model presented above has several drawbacks. It cannot be employed when no dividends are currently paid, it leads to an infinite value for the shares when $g > \rho$, and it requires projecting a constant growth rate over an infinitely long horizon.[5] Such difficulties have led to the formulation of a finite-horizon model of share prices.[6] The basic idea of the finite-horizon approach is that dividends and earnings are assumed to grow at some rate g for T periods, and then to grow at some normal rate such as the general growth rate of the

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[2] See [27], p. 344.

[3] See, for example, Williams [22] for one of the earliest statements of the problem and Gordon [8] for a more recent treatment.

[4] The price-earnings ratio will be used as the dependent variable in the empirical work that follows, both because it seems more suitable when growth rates are a principal variable and because this specification helps reduce heteroscedasticity.

[5] Moreover, since the growth-rate estimates used in this study were specifically made for only the next five years, it would seem that this model is not consistent with the data.

[6] See, for example, Holt [10] and Malkiel [14]. Wendt [26] presents a useful survey of a number of the alternative models.

utility industry as a whole.[7] The present value of the estimated terminal price of the shares (at the end of T periods), plus the sum of the present values of the stream of dividends received through the T^{th} period, is taken to be the present worth of the shares. This approach can be illustrated by the following very simple model,[8]

$$P_0 = \sum_{i=1}^{T} D_1 \frac{(1+g)^{i-1}}{(1+\rho)^i} + (m_s)_0 E_0 \frac{(1+g)^T}{(1+\rho)^T}, \tag{3}$$

where $(m_s)_0$ is the average current price-earnings ratio for the utility group and D_1 is the dividend expected to be paid next year. It will be noted that the formulation in equation (3) capitalizes the terminal year's earnings, $E_0(1 + g)^T$, at the average multiple for the utility group. This is consistent with the simplifying assumption that after the horizon period all utility stocks will enjoy (approximately) the same growth rate and thus revert to the same average condition.

Note that when $T = 1$ the P/E ratio for a share may be expressed as a linear combination of the growth rate and dividend-payout ratio

$$\frac{P_0}{E_0} = (m_s)_0\left[\frac{1}{1+\rho}\right] + \frac{D_1}{E_0}\left[\frac{1}{1+\rho}\right] + g\left[\frac{(m_s)_0}{1+\rho}\right]. \tag{4}$$

As T increases, the expression for P_0/E_0 becomes complicated with terms involving higher powers of the growth rate and dividend payout as well as cross-product terms in these variables. Fortunately, however, a linear approximation to the true expression seems to work reasonably well for T as small as five, the period for which growth-rate estimates are available.[9]

Thus far we have considered only the expected value of the stream of returns accruing to the shareholder. But a central feature of security evaluation is the expected uncertainty or instability (I) of these returns. Assuming that the typical investor is risk averse, he will prefer, other things equal, that this stream of returns be as stable and dependable as possible. Moreover, the horizon (T) over which extraordinary growth is forecast may itself be a function of the variance or dependability of the returns stream. Security buyers are more likely to project extraordinary earnings growth over a long horizon if the anticipated variance of earnings is low.[10] Since $\partial(P/E)/\partial T > 0$ for a growth stock according to the finite-horizon model developed above,[11] it follows that price-earnings multiples should be negatively related to a term estimating the expected variance of the earnings stream.[12]

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[7] In some models the growth rate is assumed to decline in stages to the final "mature" growth rate of the economy. In other models the initial and terminal growth rates are estimated on the basis of such factors as the retention rate and the rate of return on equity.

[8] The rationale for this approach and the derivation of equation (3) is contained in [14].

[9] The closeness of the proposed linear approximation was examined by the following experiment. Postulating values for the parameters $(m_s)_0$ and ρ that were consistent with experience during the 1961–1967 period, a series of theoretical price-earnings ratios for alternative pairs of payout rates and growth rates were calculated by equation (3). The theoretical P_0/E_0 ratios were then regressed on the alternative assumed values for payout and growth. The coefficient of determination was over 0.97. When the square of the growth rate and the cross-product term $(D_1/E_0)g$ were included, the R^2 rose to approximately 1.00.

[10] See Peck [22].

[11] See Malkiel [14], pp. 1028–9.

[12] A more sophisticated argument for the inclusion of a variance term rests on recent theoretical work by Sharpe [24], Lintner [12], Mossin [20], and Malkiel and Cragg [15] extending the Markowitz [16] portfolio selection model. Under certain stylized assumptions the market es-

The preceding argument has focused on individual securities and not on each security's contribution to a total portfolio. A central feature of the Markowitz [16] portfolio model is that an "optimal" portfolio is not necessarily obtained by selecting those particular assets that are thought to be individually most desirable. To the extent that securities having low covariance can be found, the returns from a portfolio of such issues are likely to be more stable since a decline in the price of one security may be offset by independent behavior in the price of another. In Sharpe's [24] ingenious simplification of the Markowitz model, the returns from each security (R_i) are first related to the returns from some standard index of security prices, such as the Standard and Poor's composite average

$$R_i = \alpha_i + \beta_i(\text{Return From Index}) + \mu_i . \quad (5)$$

Thus, covariances are assumed to arise because all returns depend on the common factor of the over-all market return. By analogy with the argument presented for the Markowitz model, we would expect investors to prefer those securities with low or negative β_i's. Other things being equal, a stock that tends to move against or only slightly with the market will tend to reduce the variability and, thus, the risk of the stock portfolio.

The final risk variable employed was a leverage variable. This is an index of the amount of debt in the firm's capital structure, i.e., the firm's "financial risk." The justification for its inclusion rests on the celebrated work of Modigliani and Miller [18] showing that, with perfect capital markets, the required rate of return on equity (which under certain simplifying assumptions is simply the inverse of the price-earnings ratio) will rise linearly with leverage. Even if one does not fully accept their analysis, however, earnings multiples still should be negatively related to leverage, since increasing leverage tends to increase the variance of the firm's earnings and also increases the firm's risk of ruin. Thus, while leverage should play no role in an equation where a fully adequate measure of risk is already included, leverage may well serve as a useful proxy both for the expected variability of the earnings stream and for the expected covariance with the market, β, as well.

This discussion may be summarized by outlining the following expected relationships. Price-earnings ratios should be positively related to expectations of future growth and dividend payout and negatively related to risk. The following alternative risk variables were employed: 1) the expected instability of the earnings stream, 2) an index of the conformance between an individual security's performance and that of the market, and 3) a leverage variable. In the following section we shall discuss the specific data employed in the study and indicate how they were collected.

3. Data sources and variables

■ The source of the principal data used in the study was a number of securities firms whose security analysts provided forecasts of the long-term growth rates of earnings, as of the seven year-end periods from 1961 through 1967, for a sample of electric utility common

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tablishes "prices" for expected returns and for the variance of return associated with each security. Specifically, if we assume that the returns from different securities are uncorrelated with each other, it turns out that the price of a security should be a linear function of the expected return and the variance associated with the security.

stocks. Data were also collected on the analysts' estimates of "normal" earnings for the preceding year and their expectations about the future variability of earnings for the sample companies. Certain historical financial data were also used to provide a contrast with the expectations data. These included the past growth rate of earnings and three calculated risk proxies.[13] A detailed description of the data used in the study follows:

☐ **1. Normalized Earnings.** It is well known that the market does not necessarily capitalize the reported (after-tax) accounting earnings for a firm during the preceding year. Instead, investors employ some concept of normal earnings for each firm. Consider, for example, the hypothetical case of an electric utility that has been earning $5 per share for a number of years. Suppose that during 1969, as a result of damage caused by Hurricane Camille, earnings decline to $3 a share, the $2 difference being a nonrecurring loss. Will the market capitalize the $3 per share earnings? It is more likely that investors will recognize that this is a temporary dip in earnings and apply an appropriate price-earnings multiple to the amount they consider represents the normal earning power of the company. Indeed, one of the first jobs of a security analyst is to adjust the firm's accounting earnings to arrive at an indication of true earning power.[14]

The problem is particularly acute for utilities that market a large share of their output to cyclical industrial companies. The market does not apply a constant multiplier to cyclically varying earnings. Earnings multiples tend to fall as earnings rise, and rise as earnings fall. Thus, the price-earnings ratios that are relevant for valuation may be the ratios of prices to "normalized earnings" rather than ratios of prices to reported earnings. These normalized earnings are estimated to be the earnings that would obtain at a normal level of economic activity if the company were experiencing normal operations—that is, operations not affected by such nonrecurring items as strikes, natural disasters, and so forth.

There is an additional problem in using published accounting earnings figures as the basis of a valuation study. Reported earnings depend on a number of variable accounting procedures and management decisions. Consequently, the use of reported earnings figures would not be likely to put companies on a comparable basis. As Adam Smith puts it in the *The Money Game*,[15] there is the unique case of Zilch Consolidated, whose earnings can be played like a guitar by the use of different accounting treatments for depreciation, investment credits, inventories, and acquistions. While some of the more serious problems caused by acquisitions are largely absent in the case of utilities, many difficulties remain. Thus, one of the most important reasons for using normalized-earnings figures is to ensure that the same accounting conventions are applied to all companies. The convention applied to the normalized utility earnings figures used in the current study is that all data are adjusted by the analysts to allow tax savings from investments to "flow through" to earnings. The specific normalized-earnings figures used in the present study

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[13] All historical data were taken from the COMPUSTAT tapes made available by Standard and Poor's Corporation.

[14] See Graham, Dodd, and Cottle [9], ch. 34.

[15] See [25], p. 182.

were averages of estimates supplied by the security analysts of two investment firms. The estimates were made by the analysts as of the end of each calendar year. Thus, estimates of, say, 1967 normalized earnings were made without any knowledge about subsequent earnings or even about the actual reported accounting earnings for 1967, which would not usually be reported until sometime early in 1968. While the estimates did differ somewhat between the two securities firms, care was taken to ensure that the same conventions were used by both firms in arriving at the normalized-earnings figures.[16]

☐ **2. Future Growth Rates.** As was mentioned above, several theoretical models of stock valuation have all focused on the expected growth rates of earnings and dividends as a central explanatory variable. Most previous empirical studies, however, were forced to rely entirely on published accounting data and past growth rates.[17] Whitbeck and Kisor [27] were able to increase the explanatory ability of their regressions by substituting the estimates of security analysts of one firm for fabricated values of expectational variables based on simple extrapolations of past performance. The present study substitutes the average estimates of earnings growth from several securities firms for the expectations of a single predictor.

Two types of growth rates were employed in the study, those collected from security analysts and those constructed entirely from historical data. The subjective long-term rates of growth were estimated by nine major securities firms.[18] Each growth rate figure was reported as an average annual rate of growth of (normal) earnings per share expected to occur over the next five years. The figures used in the study were the averages of the nine predictors. These expectations are not limited to published information. The security analysts involved frequently visit the companies they follow and discuss each company's prospects with its executives. Insofar as other security analysts follow the same sorts of procedures as our participating firms, the growth-rate estimates of other institutional investors and securities firms may resemble those employed in this study. Consequently, these predictions may well serve as acceptable proxies for market expectations.

In order to contrast the use of historical and expected growth rates, forty alternative historical growth rates were examined to find those that showed the closest correlation with market price-earnings multiples over each of the seven years covered by the study. These growth rates differed with respect to the period of calculation, the method of calculation, and the financial data upon which the calculation was made. From the forty candidates, one calculated growth rate was either clearly superior or, at least, no worse than any of the others in each of the seven years and was used in the regressions based on historical data. This was the ten-year growth rate of cash earnings

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[16] Further information on the nature of the expectations data can be found in Cragg and Malkiel [5].

[17] For examples, see [2], [3], [4], [6], [7], [8], [10], [11], and [21].

[18] These data were mainly provided by the sponsoring members of the Institute for Quantitative Research in Finance. Five of the predictors were those described in Cragg and Malkiel [5]. All predictors were either securities firms or financial institutions that manage portfolios of common stocks. Growth-rate estimates were not available for the same sample of companies for each of the seven years included in the study. Consequently, sample sizes may vary from year to year.

TABLE 1
VARIABLES USED IN VALUATION
STUDY OF PUBLIC UTILITIES

P	End-of-year market price per share.
D	Total dividends paid per share (adjusted to number of shares outstanding at year end).
E	Reported earnings per share (adjusted to exclude nonrecurring items).
$\overline{NE}$	Average "normalized" earnings estimates of security analysts.
$D/\overline{NE}$	Dividend-payout ratio.
$\bar{g}_p$	Average predicted future long-term growth rate of earnings per share.
g_H	Historical long-term growth rate of cash earnings per share.
I_p	Predicted instability index of the future earnings stream.
I_H	Historical instability index–semideviation of pre-tax earnings per share before fixed charges from trend.
β	The slope of a regression of the annual returns from a company's shares on the annual returns to the market index.
$F/(E+F)$	The ratio of fixed charges to earnings before fixed charges–a leverage variable.

per share (i.e., earnings plus depreciation and amortization) calculated as the geometric mean of first ratios.[19]

☐ **3. Dividend Payout.** The measurement of the dividend-payout ratio is not quite as straightforward as it might appear. If one simply takes the ratio of dividends to earnings, short-run disturbances to reported earnings that do not produce corresponding changes in dividends can make calculated payouts differ from target payout ratios. For this reason, payout ratios were calculated by dividing dividends by normal rather than reported earnings. In regressions using only historical data, the payout ratio was estimated from an average of the past seven years.

☐ **4. Risk Variables.** As mentioned above, three types of alternative risk measures were employed. The first was an instability index of earnings. An expected instability index was collected from one of the participating firms. It represented a measure of the past variability of earnings (around trend), adjusted by the security analyst to indicate potential future variability. A purely historical instability index was also employed. It was calculated as the semideviation of earnings before taxes and fixed charges around trend. As will be explained below, this variable is used as a proxy for the firm's "operating risk."

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[19] A study, covering the 1962–1963 period, of the similarities between past growth rates and analysts' estimates of future growth, and of the accuracy of both sets of growth rates, is contained in Cragg and Malkiel [5].

TABLE 2

COMPARISON OF REGRESSIONS USING HISTORICAL AND EXPECTATIONAL VARIABLES

A. REGRESSION RESULTS USING $P/\overline{NE}$ AS THE DEPENDENT VARIABLE											
$P/\overline{NE} = a_0 + a_1\bar{g}_p + a_2 D/\overline{NE}$						$P/\overline{NE} = a_0 + a_1 g_H + a_2 D/E$					
YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F	YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F
1962	3.28	2.31 (0.27) 8.44	8.59 (5.49) 1.56	0.75	47.00 (2,31)	1962	4.85	1.64 (0.28) 5.87	10.86 (7.54) 1.44	0.61	24.55 (2,31)
1963	−4.80	2.99 (0.28) 10.67	14.79 (5.32) 2.78	0.81	67.39 (2,31)	1963	−4.58	2.11 (0.29) 7.40	19.93 (7.66) 2.60	0.68	33.55 (2,31)
1964	−2.58	2.97 (0.26) 11.48	12.58 (4.97) 2.53	0.84	80.77 (2,31)	1964	8.05	1.67 (0.35) 4.71	7.29 (9.27) .79	0.51	16.07 (2,31)
1965	3.02	2.45 (0.24) 10.23	5.01 (4.51) 1.11	0.84	86.60 (2,31)	1965	6.36	1.70 (0.29) 5.76	6.00 (7.37) .81	0.67	30.91 (2,31)

B. REGRESSION RESULTS USING P/E AS THE DEPENDENT VARIABLE											
$P/E = a_0 + a_1\bar{g}_p + a_2 D/\overline{NE}$						$P/E = a_0 + a_1 g_H + a_2 D/E$					
YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F	YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	R^2	F
1962	2.59	2.39 (0.28) 8.46	8.62 (5.64) 1.53	0.75	47.51 (2,31)	1962	6.40	1.58 (0.31) 5.12	8.76 (8.31) 1.05	0.56	19.65 (2,31)
1963	−1.02	2.78 (0.24) 11.83	10.62 (4.47) 2.38	0.85	87.83 (2,31)	1963	0.56	1.89 (0.27) 7.06	14.07 (7.20) 1.95	0.68	33.24 (2,31)
1964	−3.91	3.10 (0.24) 13.02	12.81 (4.55) 2.81	0.87	104.65 (2,31)	1964	9.24	1.62 (0.37) 4.37	5.30 (9.75) .54	0.48	14.54 (2,31)
1965	−2.42	2.91 (0.26) 11.16	8.82 (4.92) 1.79	0.86	92.14 (2,31)	1965	3.38	1.93 (0.36) 5.42	8.17 (8.88) .92	0.63	26.17 (2,31)

C. LINEAR APPROXIMATION OF THEORETICAL RELATIONSHIP	
$P/\overline{NE} = -3.94 + \underset{(0.02)}{2.22}\bar{g}_p + \underset{(0.62)}{12.11} D/\overline{NE}$	$R^2 = 0.97$

N.B. STANDARD ERRORS ARE RECORDED DIRECTLY BELOW THE COEFFICIENTS
WHILE "t VALUES" ARE RECORDED ON THE FOLLOWING LINE.
NUMBERS BELOW THE "F VALUES" ARE DEGREES OF FREEDOM.

The second type of risk measure introduced was the historical conformance between returns on each individual security and a market index. The variable employed was an estimate of the slope of a regression, where the dependent variable was the annual return from the i^{th} security and the independent variable was the annual return from Standard and Poor's 500-stock Average. Ten years of data were used in the calculation.

Finally, the leverage variable employed was the ratio of fixed charges per share to earnings, plus fixed charges per share. This variable, rather than the debt-equity ratio, was used to avoid the simultaneity problem of having the stock price depend on the leverage ratio whereas the debt-equity ratio by definition depends on the stock price.[20] Table 1 summarizes the variables used in the valuation study.

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[20] For a discussion of the problems involved in using the debt-equity ratio itself, see Barges [1] and Wippern [29].

4. Analysis of the regression results

■ In this section the results of the basic certainty model (i.e., taking no account of risk) are first presented. Next, a comparison is made of the regression results for equations including comparable historical and expectational variables. Then, regressions employing the alternative risk variables are compared. Finally, results for the most satisfactory expectational equations are presented and the behavior of the coefficients over time is examined.

☐ **1. Results of the Basic Certainty Model.** In the left-hand side of part A in Table 2, results of the basic certainty valuation model are presented. Normalized utility earnings multiples are regressed only on growth and dividend payout, and no risk variables are included. We note that from 1962 through 1965 about 80 percent of the variance in price-earnings multiples is explained by the regressions. In all years the growth-rate variable is highly significant. The payout ratio always has the expected sign, but it is significant in only two of the four years. Plots of the data displayed no evidence of a nonlinear relationship between $P/\overline{NE}$ and $\bar{g}_p$.

In part C of Table 2, the equation of the linear approximation of the theoretical relationship is presented for comparison.[21] It will be noted that for most years the empirical valuation relationships are roughly similar to the theoretical one. However, the average growth rate coefficient over the four years studied is 2.68—about 20 percent higher than the theoretical coefficient of 2.22. On the other hand, the average dividend coefficient of 10.24 is almost 20 percent below the theoretical coefficient of 12.11. It would appear that investors in public utility stocks value dividends somewhat less than would be expected from the (nontax) theoretical present value model, whereas growth is valued more highly. These results are consistent with present tax laws, whereby returns are valued more when they are received as capital gains than as dividend income.

☐ **2. Comparison of Regressions Using Historical and Expectational Variables.** In the right-hand side of Table 2 the results of regressions using only variables calculated from readily available historical data are presented for comparison with the regressions employing expectations data. On the right-hand side of part A the (normal) earnings multiple is regressed on the historical 10-year growth rate of cash earnings and the actual dividend-payout ratio (averaged over the preceding 7 years). In part B of Table 2 the same comparison is made, but in these cases the actual earnings multiple rather than the normalized multiple is used as the dependent variable.

It will be noted that the fits are much better using the expectational variables than with the historical ones. It should also be mentioned that better fits were obtained by using the average growth

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[21] The theoretical relationship was estimated by fitting a linear approximation to the finite-horizon valuation model described in equation (3). Specifically, estimates of $\hat{a}$, $\hat{b}$, and $\hat{c}$ were obtained by fitting a regression of the form

$$\frac{D_{j0}}{E_{j0}} \sum_{T=1}^{5} \frac{(1+g_j)^T}{(1+r)^T} + (m_s)_0 \frac{(1+g_j)^5}{(1+r)^5} = a + bg_j + c\frac{D_{j0}}{E_{j0}} .$$

A standard price-earnings multiple, $(M_s)_0$, of 17 (roughly the average over the four years studied) was used to compute the theoretical earnings multiples. The discount rate, r, was estimated to be 9 percent. (Assuming an average payout for utilities of 60 percent, this implies a growth rate for the earnings of the market average of approximately 5½ percent per annum. See Malkiel [14], pp. 1011–12, for an explanation of these relationships.) As was mentioned above (footnote 9) a linear approximation fits the theoretical relationship quite closely.

TABLE 3

COMPARISON OF RISK VARIABLES: 1962–1965

INSTABILITY INDEX						INDEX OF CONFORMANCE WITH MARKET						LEVERAGE INDEX					
$P/\overline{NE} = a_o + a_1\bar{g}_p + a_2D/\overline{NE} + a_3I_p$						$P/\overline{NE} = a_o + a_1\bar{g}_p + a_2D/\overline{NE} + a_3\beta$						$P/\overline{NE} = a_o + a_1\bar{g}_p + a_2D/\overline{NE} + a_3F/(E+F)$					
YEAR	$\hat{a}_o$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	YEAR	$\hat{a}_o$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	YEAR	$\hat{a}_o$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2
1962	5.51	2.26 (0.28) 8.01	7.33 (5.71) 1.28	−0.03 (0.03) −0.88	0.76	1962	3.94	2.29 (0.29) 8.01	8.10 (5.79) 1.40	−0.71 (2.27) −0.31	0.75	1962	3.86	2.31 (0.28) 8.35	9.37 (5.65) 1.66	−3.75 (5.45) −0.69	0.76
1963	−4.31	2.99 (0.28) 10.58	15.14 (5.41) 2.80	−0.02 (0.03) −0.55	0.82	1963	−4.14	2.98 (0.29) 10.46	14.22 (5.74) 2.48	−0.68 (2.36) −0.29	0.81	1963	−2.56	3.01 (0.24) 12.40	17.88 (4.70) 3.81	−15.23 (4.53) −3.36	0.86
1964	−1.81	2.96 (0.26) 11.20	12.56 (5.03) 2.50	−0.01 (0.02) −0.57	0.84	1964	−2.83	2.98 (0.27) 11.19	12.79 (5.29) 2.42	0.27 (2.07) 0.13	0.84	1964	−1.23	3.04 (0.24) 12.73	14.66 (4.62) 3.18	−11.23 (4.24) −2.65	0.87
1965	3.95	2.44 (0.24) 10.11	5.03 (4.53) 1.11	−0.02 (0.02) −0.85	0.85	1965	3.91	2.41 (0.25) 9.71	4.58 (4.59) 1.00	−1.00 (1.46) −0.69	0.84	1965	3.42	2.49 (0.24) 10.51	6.48 (4.54) 1.43	−6.06 (4.11) −1.47	0.85

N.B. STANDARD ERRORS ARE RECORDED DIRECTLY BELOW THE COEFFICIENTS WHILE "t VALUES" ARE RECORDED ON THE FOLLOWING LINE. NUMBERS BELOW THE "F VALUES" ARE DEGREES OF FREEDOM.

CORRELATIONS AMONG RISK VARIABLES—1963.

	F/(E+F)	β
β	0.02	1.00
I_p	−0.17	−0.19

rates of all predictors than by employing the forecasts of any single investment firm. This suggests that a reasonable proxy has been obtained for what might be considered the expectations of the "representative" investor. It should also be noted that there was not too much difference in the regressions when the actual earnings multiple was substituted for the normal earnings multiple as the dependent variable.

The strong correlation between price-earnings multiples and predicted growth rates leads one to question the line of causality. Do stocks with high expected growth rates tend to sell at high price-earnings multiples because investors actively bid up the shares of companies with favorable prospects? Or does the security analyst see a large price-earnings ratio in the market and decide from this that the firm in question must indeed be a "growth stock?" One is reminded of the brokerage firm that was recommending a particular security because of its generous dividend yield. When the price of the security subsequently rose so that its dividend yield fell below average, the firm continued to recommend the security but simply transferred it from its "yield" list to its "growth-stock" list. Then, in order to justify the company's identification as a growth stock, the security analyst raised his estimate of the firm's long-term earnings growth.

Since past growth rates are also closely correlated with earnings multiples, however, it seems clear that the growth record of a company does influence the earnings multiples. This is not to deny, however, that expected growth rates may not be affected to some extent by the earnings multiples themselves. Nevertheless, this should not interfere with the basic purpose of this paper. The point is that even if these growth rates are simply the security analysts' estimates

TABLE 4

REGRESSION RESULTS EMPLOYING A
LEVERAGE VARIABLE AND AN
OPERATING-RISK PROXY

$P/\overline{NE} = a_0 + a_1\bar{g}_p + a_2 D/\overline{NE} + a_3 F/(E+F) + a_4 I_H$

YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	R^2	CORRELATION BETWEEN $F/(E+F)$ AND I_H
1962	4.18	2.32	10.00	−4.38	−0.20	0.76	−0.09
		(0.28)	(5.70)	(5.50)	(0.21)		
		8.37	1.75	−0.80	0.97		
1963	−2.23	2.99	18.30	−15.78	−0.12	0.87	−0.12
		(0.25)	(4.77)	(4.63)	(0.17)		
		12.20	3.84	−3.41	−0.74		
1964	−0.20	2.99	14.51	−11.89	−0.17	0.87	−0.16
		(0.24)	(4.62)	(4.30)	(0.17)		
		12.32	3.14	−2.76	−0.97		
1965	4.03	2.48	6.26	−6.54	−0.09	0.85	−0.28
		(0.24)	(4.63)	(4.31)	(0.20)		
		10.23	1.35	−1.52	−0.45		

N.B. STANDARD ERRORS ARE RECORDED DIRECTLY BELOW THE COEFFICIENTS WHILE "t VALUES" ARE RECORDED ON THE FOLLOWING LINE. NUMBERS BELOW THE "F VALUES" ARE DEGREES OF FREEDOM.

of what the growth rate ought to be to justify the price, the regression results can still be used to gain an understanding of the structure of utility share valuations at any given time.

☐ **3. Analysis of the Alternative Risk Variables.** Table 3 presents an analysis of the alternative risk variables in the four years for which data on each of the three risk variables were available. Each risk variable was added in turn to the basic certainty equation employing predicted growth and normal payout. It will be noted that the leverage variable seems to be the most satisfactory risk index for utility shares. It always has the right sign and is comfortably significant in two of the four years. On the other hand, neither of the other two risk variables was ever significant, and β, the index of conformance with the market, has the wrong sign in 1964.[22] The table also suggests that leverage may itself work better as an *ex ante* instability index than the predicted instability index itself. It is also worth noting that the correlations among the risk variables tended to be insignificant. A typical correlation matrix for 1963 is presented at the bottom of Table 3.

In fact, however, the leverage coefficient may be biased toward zero if leverage is negatively related to operating or business risk. For example, utilities with low operating risk (i.e., stable revenues and earnings) may be willing to incur more debt than utilities with volatile operating earnings. High leverage might then compensate for low business risk, and the risk to the shareholder may be no

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[22] It turned out, however, that the measured β's for utility stocks tended to cluster around the same value. Malkiel and Cragg [15] found considerably more variation in the β's for industrial securities, and, as one might expect, β added much more to an explanation of the $P/\overline{NE}$ ratios for industrials than for utilities.

TABLE 5

REGRESSION RESULTS: 1961–1967

$P/\overline{NE} = a_0 + a_1\bar{g}_p + a_2 D/\overline{NE} + a_3 F/(E+F)$

YEAR	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
1961	8.11	2.63 (0.33) 8.07	1.95 (7.58) 0.26	−0.17 (8.39) −0.02	0.79	30.64 (3,25)
1962	3.86	2.31 (0.28) 8.35	9.37 (5.65) 1.66	−3.75 (5.45) −0.69	0.76	30.88 (3,30)
1963	−2.56	3.01 (0.24) 12.40	17.88 (4.70) 3.81	−15.23 (4.53) −3.36	0.86	63.75 (3,30)
1964	−1.23	3.04 (0.24) 12.73	14.66 (4.62) 3.18	−11.23 (4.24) −2.65	0.87	66.67 (3,30)
1965	3.42	2.49 (0.24) 10.51	6.48 (4.54) 1.43	−6.06 (4.11) −1.47	0.85	57.77 (3,30)
1966	2.42	2.32 (0.23) 10.09	1.93 (3.37) 0.57	−3.79 (3.18) −1.19	0.76	59.84 (3,57)
1967	−1.70	2.08 (0.20) 10.30	4.51 (3.13) 1.44	0.76 (2.74) 0.28	0.70	44.12 (3,57)

N.B. STANDARD ERRORS ARE RECORDED DIRECTLY BELOW THE COEFFICIENTS WHILE "t VALUES" ARE RECORDED ON THE FOLLOWING LINE. NUMBERS BELOW THE "F VALUES" ARE DEGREES OF FREEDOM.

CORRELATION MATRIX FOR INDEPENDENT VARIABLES—1963

	$\bar{g}_p$	$D/\overline{NE}$
$D/\overline{NE}$	−0.53	1.00
$F/(E+F)$	−0.20	0.34

greater than for a utility with low leverage but more unstable operating income. In order to test for the importance of this phenomenon, a term was added to the regressions employing the leverage variable to account for the instability of the utility's pre-tax operating earnings before fixed charges. This instability index was calculated from a regression of the log of these earnings on time. It represented the semi-deviation of these earnings from trend. As Table 4 indicates, leverage is negatively correlated with the operating-risk proxy. When operating risk is added to the regression equation, the leverage coefficient becomes slightly more negative (and more significant) as expected, but the effects are so small as to be insignificant. Moreover, the operating-risk proxy itself is never significant, although it has the correct sign in all years.

□ **4. Regression Results: 1961–1967.** In Table 5 results are presented for the regressions employing predicted growth, normal payout, and leverage as independent variables. Data were available to estimate equations with these variables for the seven year-end periods from 1961 through 1967. At the bottom of the table a typical correlation matrix of independent variables is presented. The only pair of entries displaying any substantial correlation is the payout ratio and the predicted long-term growth rate. This is hardly surprising, since, *ceteris paribus*, the more of its earnings a firm retains the larger its earnings should be in the future. Indeed, in many valuation models a firm's growth rate is estimated as the product of the firm's retention rate and its rate of return on equity.

It will be noted that the fits are extremely close for cross-sectional work. The regression results suggest that if one were given the most recent expectations figures regarding earnings growth, and if figures were available for dividend payout and leverage, then these data—together with the current values of the estimated coefficients—could be used to make a reasonably close prediction of the price-earnings multiple of the utility. However, these estimates, each for a particular year, only throw light on relative prices of stocks and not directly on the actual price level of any stock. In essence, the result merely says that the higher the anticipated growth rate the higher the normalized earnings multiple for the stock will be. This is hardly surprising, but it tells us that at least to this extent the market acts as an efficient allocator of capital. If many utilities were seeking capital at the same time, then those with the best growth prospects could sell their shares at a higher price than firms with lower expected growth rates.

☐ **5. Changes in the Valuation Relationship Over Time.** It is of considerable interest to examine whether or not the coefficients of the valuation equations are the same in each year or whether they change. This is important to investors who wish to use such valuation equations in connection with assigned values of the independent variables to estimate the "intrinsic worth" (or future price) of a security. Constancy of the relationship is also important if a firm is to seek to follow policies that will maximize the value of its shares. On the other hand, there is no reason to suppose that the valuation coefficients will be stable over time. As Table 5 indicates, the coefficients vary considerably over time.

We can observe how the individual coefficients of the valuation equation change from year to year. It will be recalled that at the end of 1961 "growth stocks were in high favor," and it is not surprising to find the growth coefficient in 1961 to be among the three highest coefficients recorded during the period studied. During 1962, however, there was a considerable change in the structure of share prices, which was acknowledged in the financial press as the revaluation of growth stocks. This revaluation is reflected in the coefficient of the growth rate, which declined considerably from 1961 to 1962. On the other hand, it is interesting to note that the dividend coefficient, which was among the lowest coefficients recorded in 1961, rose sharply by the end of 1962 as investors tended to put much lower weight on dividend payout. Similarly, the leverage variable, which was almost ignored by the market in 1961, becomes substantially more negative during the ensuing years.

It is also interesting to observe the behavior of the dividend and leverage coefficients during the 1966 and 1967 stock markets. It will be noted that the dividend coefficient falls to very low levels in these two years. Investors for whom utilities served as a substitute for fixed-income securities might well have forsaken utility stocks in favor of much higher yielding bonds.

The estimated dividend coefficients require some further explanation as the results are only partly consistent with some widely held notions about the valuation of public utility stocks. Most people believe that dividends are valued more highly for utility stocks than for the market as a whole. There is some support for this conjecture. Comparing the dividend coefficients for the utility stocks with those of a sample of industrials studied by Malkiel and Cragg [15], one finds that the utility coefficients tend to be higher than those estimated for the industrial stocks as a whole, although the differences between the two relationships are not statistically significant.

Utilities are often classified as stocks suitable especially for "widows and orphans," people dependent on their investment for a steady stream of income. Indeed, many security analysts believe that deviations from a high payout will have a particularly deleterious effect on the price-earnings multiples of utility shares. Furthermore, it is argued that another class of large holders of utilities is composed of tax-exempt foundations and educational institutions who gain no tax advantage by obtaining their returns in the form of capital gains rather than dividends. In addition, a number of these institutions adopt a convention of restricting their expenditures to the "income" from their portfolios, where this income is defined to include only dividends (and interest) received. Neither realized nor unrealized capital gains are considered as spendable income. Thus, because a large number of utility holders specifically desire income through dividend payments and are not affected by income taxes, it would appear that dividends would indeed contribute great weight to share valuations in the utility industry. While it is reasonable that dividends are valued more highly for utilities than for industrials, it must still be emphasized that the dividend coefficients tend to be lower than those we would expect from a theoretical present-value model. As was noted above, this is consistent with the differential tax treatment of dividend and capital-gain income for taxable investors.

The behavior of the leverage coefficients during the 1966–1967 period is somewhat difficult to explain. The coefficient associated with the leverage index becomes less negative during this period of very high interest rates. In 1967 the coefficient is actually positive but not significant. One might argue that as interest rates rise utilities with high leverage ought to be penalized more than utilities with low leverage, particularly if their outstanding debt tends to have a short average maturity. This is so because such firms will be faced with the prospect of refunding outstanding low-coupon debt issues with bonds of considerably higher cost. On the other hand, the leverage index may be directly related to the maturity of a utility's outstanding debt. Since leverage is defined as the ratio of fixed charges to earnings plus fixed charges, a firm that put out most of its debt several years ago may have relatively low fixed charges because of the low coupons prevailing at the time the bonds were issued. Of course, it is precisely such a firm that will suffer most from high interest rates, since it will have to refund all of its low-coupon debt at considerably higher cost. This may provide some explanation for the actual behavior of the leverage coefficient.

5. The empirical valuation model and security selection

■ One of the most intriguing questions concerning empirical valuation models is whether they can be used to aid investors in security selection. It has been suggested that empirical valuation models can be employed for security selection in the following way: The estimated valuation equation shows us, at a moment in time, the average way in which variables such as growth, payout, and leverage influence market price-earnings multiples. Given the value of these variables applicable to any specific utility, we can compute an estimated price-earnings ratio based on the empirical valuation equation. The next step is to compare the actual market earnings multiple with that predicted by the valuation equation. If the actual earnings multiple is greater than the predicted multiple, we designate the security as temporarily "overpriced" and recommend sale. If the actual price-earnings multiple is less than the predicted multiple, we designate the security as temporarily "underpriced" and recommend purchase. Such a procedure was employed by Whitbeck and Kisor [27] and Peck [22] with considerable success. They claimed that an underpriced group of securities selected by the above procedure consistently outperformed an "overpriced" group.

Of course, even on *a priori* grounds, it is possible to think of many reasons why such a procedure would prove nugatory. For example, consider what would happen if high P/E (high growth rate) stocks were overpriced in one period. In such a case, the estimated growth-rate coefficient will be larger (by assumption) than is warranted. However, the recommended procedure will not indicate that high P/E stocks are overpriced. This is so because the predicted earnings multiples for these securities will themselves be higher than is warranted since they come from regressions where the dependent variables are the actual earnings multiples themselves. Moreover, the very high correlations achieved cast doubt on our ability to forecast future performance. Indeed, if we were able to explain the existing structure of prices completely (i.e., there was perfect correlation), we would have no basis at all for selecting underpriced securities. Nevertheless, in view of the positive results reported by Whitbeck and Kisor and Peck it would seem desirable to attempt to replicate their experiment with the expectations data employed in this study.

The results of some of the experiments for the years 1962–1965 are shown in Table 6. The results are based on regressions shown in Table 5. The degree of over- or underpricing was taken to be the residual from the prediction equation, i.e., $(P/\overline{NE} - \hat{P}/\overline{NE})$. If the model is useful in measuring underpricing, then underpriced securities, according to this criterion, ought to "outperform" overpriced securities over some subsequent period. One year was chosen as the appropriate horizon, and subsequent returns were measured in the normal manner:

$$R_{t+1} = \frac{P_{t+1} - P_t + D_{t+1}}{P_t}. \qquad (6)$$

If the empirical valuation model is successful in selecting securities for purchase, the residual (i.e., the difference between the actual and predicted multiples, or the degree of overpricing) from the valuation equation ought to be negatively related to these subsequent returns. As Table 6 indicates, the correlations are very low and are essentially

TABLE 6

USE OF MODEL AS STOCK SELECTOR

1962–1965*

$$R_{t+1} = b_0 + b_1 \left[P/NE - \widehat{P/NE}\right]$$

YEAR	$\hat{b}_1$	R^2	F
1962	0.50 (0.59) 0.84	0.02	0.71 (1,32)
1963	–0.10 (0.78) –0.13	0.00	0.02 (1,32)
1964	0.49 (0.78) 0.63	0.01	0.40 (1,32)
1965	1.01 (0.78) 1.30	0.05	1.68 (1,32)

*BASED ON REGRESSION RESULTS IN TABLE 5.

N.B. NUMBERS IN PARENTHESES BELOW COEFFICIENTS ARE STANDARD ERRORS; NUMBERS BELOW PARENTHESES ARE "t VALUES"; NUMBERS BELOW THE "F VALUES" ARE DEGREES OF FREEDOM.

zero. Similar results were obtained using the regression equations shown in Tables 2 and 3. The residuals from the equations employing historical data were no more successful in predicting subsequent performance. Moreover, other methods of measuring success in security selection such as examining the subsequent performance of, say, the five most overpriced and underpriced issues, were equally unsuccessful.

It is interesting to inquire why the model has been so unsuccessful in selecting securities with above-average subsequent returns. There appear to be three reasons for the lack of forecasting success.

One reason for the predictive failures has already been mentioned. The coefficients of the valuation relationship are sufficiently volatile that they cannot be used to establish valuation norms. By the next year (the end of the horizon period) the norms of valuation may be significantly altered. What was cheap on the basis of 1961's relationship (when growth was highly valued and dividend payout was almost ignored) may no longer represent good value on the basis of the relationship existing in 1962, as was indeed the case. This argument suggests that more success might have been achieved with a shorter horizon period. Nevertheless, tests employing a three-month horizon period proved just as unsuccessful.

Another reason for our lack of success in selecting securities with above-average subsequent returns was the generally poor quality of the earnings forecasts used as inputs to our study. Such a finding is really quite surprising. One would have believed that utility earnings are much more predictable than those of industrial companies. In a study by Cragg and Malkiel [5], however, it was shown that these growth rate forecasts proved little better than simple extrapolations of past growth rates in anticipating future earnings. While it is true that the mean squared errors for the utility forecasts tended to be lower than those of industrials, it turned out that security analysts' rankings of estimated growth within the utility industry were little more useful than random rankings. Rank correlations of predicted and realized growth rates within the utility industry were actually somewhat worse than those calculated for other industries. Needless to say, the availability of better forecasts would have improved the results substantially. This factor may be responsible for the differences in the predictive success of alternative empirical valuation models. The models themselves are probably much more similar than the inputs used to estimate them.

A final reason why the model may fail to predict performance may be specification error. Undoubtedly, there were special features applicable to many individual utilities that were not captured in our independent variables. That this conjecture has some validity is attested by an examination of the residuals from the equations in Table 4 for the years 1961-1964. A comparison of actual and predicted price-earnings multiples indicated that 14 stocks (well over one third of the sample) were consistently overpriced or underpriced in each of the four years. More than two thirds of the stocks in the sample were overpriced or underpriced in three of the four years. Consequently, it cannot be said that all deviations of actual from predicted price-earnings ratios are simply manifestations of temporary price anomalies.

One possible explanation for this result is the omission of variables. In the case of utilities, the most important missing factor in the valuation relationship may well be differences in the regulatory climate surrounding the various companies, which lead to differences in perceived risk. The fits might well be improved by adding dummy variables in the regression to capture regulatory differences, many of which can be categorized along geographical lines. Some preliminary experiments with this approach, however, do not indicate that such a procedure can improve the predictive ability of the regressions. Thus, despite the success in utilizing expectations data for estimating a valuation equation which has far more explanatory ability than one based on historical information, it is still quite clear that the present model does not offer a reliable guide for selecting securities.

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Expectations and the Structure of Share Prices

By Burton G. Malkiel and John G. Cragg*

This paper presents the results of an empirical study of year-end common-stock prices from 1961 through 1965. The ratios of market prices to earnings are related to such factors as earnings growth, dividend payout, and various proxy variables designed to measure the risk or quality of the returns stream.

Several previous empirical studies[1] have tried to explain share prices on the basis of such variables, but these investigations were forced to rely on published accounting data and untested hypotheses about the formation of expectations. V. Whitbeck and M. Kisor were able to increase the explanatory ability of their regression by substituting the estimates of security analysts of one firm for fabricated expectations variables based on simple extrapolations of past performance. Our study tries to determine whether the goodness of fit can be improved still further by substituting the estimates from several securities firms for the expectations of a single predictor and by using a wider variety of such expectational variables. The most important of the expectational variables employed are forecasts of short-term and long-term earnings growth, estimates of the "normal earning power" of each company, and estimates of the "instability" of the earnings stream. The data used are described in Section II.

It is found in Section III that an extermely close fit to the empirical structures of share prices is obtained with the use of such expectations data. These results are also contrasted with those obtained when only historic data are used. Section III then examines further the stability and predictive power of the model over time. Section IV discusses the usefulness of the model for security selection.

I. *Specification of a Valuation Model*

In the typical valuation model, the price of a share is taken to be the present value of the returns expected therefrom. In the simplest model, the price is the sum of the present values of a stream of dividends that is assumed to grow at a constant rate, g, over time. See, for example, J. B. Williams for one of the earliest statements of the problem and M. J. Gordon for a more recent treatment. Letting P stand for the (ex dividend) price of a share, D the (annual) dividend per share in the year just past, and r the appropriate rate of discount, we have

$$P = \sum_{i=1}^{\infty} D \frac{(1 + g)^i}{(1 + r)^i}, \tag{1}$$

provided $g<r$. Dividing both sides of (1) by earnings per share, E, and summing the

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[1] Cross-sectional empirical studies have been undertaken by F. D. Arditti, H. Benishay, R. S. Bower and D. H. Bower, G. R. Fisher, I. Friend and M. Puckett, M. J. Gordon, F. C. Jen, M. Kisor, Jr. and A. Feuerstein, Kisor and S. Levine, and R. Ortner.

progression we obtain an expression for the price-earnings multiple

$$\frac{P}{E} = \frac{D}{E}\,\frac{(1+g)}{(r-g)} \tag{2}$$

The price-earnings ratio is seen to depend on the dividend payout ratio and the expected long-term growth rate of the dividend stream.

The specific model of security price-earnings ratios presented in equations (1) and (2) has several drawbacks. It is inapplicable in cases where no dividends are currently paid, it leads to an infinite value for the shares when $g>r$, and it requires projecting growth rates from now till Kingdom come.[2] Such difficulties have led several writers to formulate a finite-horizon model of share prices. See, for example, Charles Holt and Malkiel. P. F. Wendt presents a useful survey of a number of alternative models. The basic idea of the finite-horizon approach is that both dividends and earnings are assumed to grow at some rate g for N periods,[3] and then grow at a normal rate such as the growth rate for economy as a whole. This approach can be illustrated by the following very simple model.[4]

$$\frac{P_0}{E_0} = \sum_{i=1}^{N} \frac{D_0}{E_0}\,\frac{(1+g)^i}{(1+r)^i} + (m_s)_0\,\frac{(1+g)^N}{(1+r)^N}, \tag{3}$$

where $(m_s)_0$ is the average current price-earnings ratio for the market as a whole. The model in (3) appears to be highly nonlinear in the growth rate and payout ratio. Fortunately, however, a linear approximation to the true expression seems to work reasonably well for N as small as five, the period for which we have growth-rate estimates.[5]

The preceding model has abstracted entirely from the existence of risk. There are several possible ways in which risk can be represented in a valuation model. The theoretical justification for the alternatives rests on the assumptions employed.

A common way in which risk is introduced into empirical valuation models is to incorporate a term representing the (expected) variance of the future returns stream from each security. Such a procedure has been justified in two ways. First, it has been argued (e.g., see L. G. Peck) that the horizon, N, over which extraordinary growth can be forecast is itself a function of the variance or "dependability" of the returns stream. By this reasoning, investors would project extraordinary earnings growth over only a very limited horizon for companies where the anticipated variance of the earnings stream is large. Since it can easily be shown that $\partial(P/E)/\partial N>0$ for a growth stock according to the finite-horizon model (see Malkiel, pp. 1028–29), it follows that price-earnings multiples should be negatively related to the variance term.

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[2] Moreover, since the growth rate estimates collected were specifically made for only the next five years, it would seem that this model is not consistent with the data.

[3] In some models, the growth rate is assumed to decline in stages to the final "mature" growth rate of the economy. In other models, the initial and terminal growth rates are estimated on the basis of such factors as the retention rate and the rate of return on equity.

[4] The rationale for this approach and the derivation of equation (3) is contained in Malkiel. It is assumed that after N periods, the price-earnings ratios for all stocks revert to the same average condition.

[5] The closeness of the proposed linear approximation was examined by fitting a regression of the form

$$\frac{D_{j0}}{E_{j0}} \sum_{i=1}^{5} \frac{(1+g_j)^i}{(1+r)^i} + (m_s)_0\,\frac{(1+g_j)^5}{(1+r)^5} = A + Bg_j + C\,\frac{D_0}{E_0} \tag{3'}$$

Values of the parameters $(m_s)_0$ and r were chosen to be consistent with experience during the 1961–65 period. The coefficient of determination, 0.97, was so high that it seemed safe to substitute the right-hand side of (3′) for the right-hand side of (3). It should be noted, however, that this argument assumed that the horizon N is the same for all companies.

A second justification for the inclusion of a variance term in the model rests on recent theoretical work by William Sharpe, John Lintner, and Jan Mossin, extending the Markowitz portfolio selection model. In these models the market establishes "prices" for the expected return and "risk" of each security, where risk consists of the sum of the variance of that security's return and its covariances with all other returns multiplied by the number of shares. If we assume that the returns from different securities are uncorrelated with each other, however, it turns out that the price of a security should simply be a linear function of the expected return and the variance associated with the security. This suggests not only that a variance term should be included in the model but also provides some justification for the linear specification employed in this study.

The second risk measure employed in this study, an index of the conformance between the returns of each individual security and that of a market index, rests on more realistic assumptions. In Sharpe's simplification of the Markowitz model, covariances are assumed to arise because all returns depend on one or a few common factors, such as a market or industry return. For example, the returns from each security, R_i, might first be related to the returns from some index of security prices

$$(4) \quad R_i = \alpha_i + \beta_i(\text{Return to Index}) + \mu_i$$

The total risk of an asset (i.e., the scatter of the R_i around their mean), can then be decomposed into a systematic component (due to underlying relationship between R_i and the return from the market index) and a nonsystematic component, μ_i, uncorrelated with the market index. We would expect investors to prefer those securities with low or negative β_i's. Other things being equal, a stock whose movements are not highly correlated with the market will tend to reduce the variability and thus, the risk of the stock portfolio. Of course, it should be emphasized that the covariances and variances that are being valued in the market are those perceived by investors and not some "true" set.

The final risk variable employed was a leverage variable measuring the "financial risk" of a company. As Franco Modigliani and Merton Miller have shown, leverage can be expected to decrease the price-earnings multiple by increasing the riskiness of the returns of common stock relative to their expected values. With a fully adequate measure for the risk associated with the stock, leverage should play no part. Otherwise, it may serve as a useful proxy for the expected variability of the returns stream. Indeed, if other risk measures apply to the instability of the operating earnings stream before fixed charges, and thus serve as estimates of the "business risk" of the firm, a leverage term may capture the additional financial risk of the firm.

Before ending this discussion of the general model underlying the study,[6] it is worth emphasizing that the model is cast entirely in terms of expectational variables. The critical dependence of share prices on expectational variables has proved to be a major obstacle for empirical investigators. Since only historical data have been available to most researchers, it has been difficult to isolate the true effect of the various variables influencing stock prices. A simple illustration should make this clear. The model described above indicates that we should expect that a *ceteris paribus* increase in the dividend-payout ratio should increase the price-earnings multiple of the shares.[7] Suppose, however, that the past

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[6] In a forthcoming publication, the authors will present a thorough and integrated model of share valuation.

[7] We must be careful, however, not to interpret a positive dividend coefficient as indicating that an individual firm can increase the price-earnings ratio of its shares by raising the dividend-payout ratio. A higher dividend (lower retention rate) may lower the future

growth rate of earnings is a very imperfect substitute for the relevant expected growth rate security purchasers anticipate.[8] The dividend payout could actually serve as an alternative proxy for expected growth.

For example, investors may take a low dividend payout ratio as a signal that the firm has many profitable investment opportunities available and that a high rate of earnings growth can be expected. In such a case, the coefficient of the payout ratio will be biased downward.[9] Without the proper expectational variables, it will be impossible to untangle the true influence of the many factors influencing the structure of price-earnings multiples. The following section will discuss the actual data employed in the study and indicate how they were collected.

II. *A Description of the Data Employed*

The principal data used in the study consist of a small number of forecasts of the long-term growth rates of earnings for 178 corporations, as of the five year-end periods from 1961 through 1965. In addition, data were collected on security analysts' estimates of "normal" earnings for the preceding year, their forecasts of next year's earnings, and their expectations about the future variability of the earnings stream. Certain historical financial data were also used to provide a contrast with the expectations data. These included past growth rates of various financial variables, past dividend-payout ratios, and a number of calculated risk proxies.[10]

The expectations data were collected from 17 investment firms, most of which were members of The Institute for Quantitative Research in Finance.[11] Of the participating firms, four were brokerage houses doing a considerable amount of investment advisory and institutional business, five were banks heavily engaged in trust management, five were mutual-fund management companies, two were pension-fund managers, and the remaining participant was an insurance company. The sample of 178 corporations was selected on the basis of data availability. Companies were included in the sample only when several investment firms made estimates of future earnings growth. Since there tended to be considerable overlap in the coverage of the security analysts for the leading industrial and utility companies, our sample tends to contain the "blue-chip" group of companies in which investment interest is centered. A detailed description of the data used in the study follows:

(a) *Normalized Earnings*

It is well known that the market does not necessarily capitalize the reported accounting earnings for a firm during the preceding year. If, for example, reported earnings are affected unfavorably by such

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growth rate per share by an amount sufficient to keep the price of the shares constant. Thus, the standard dividend model of share valuation is in no way inconsistent with the result of Miller and Modigliani that dividend policy cannot effect the value of the enterprise.

[8] It may be argued that one should not put so much reliance on either past or expected growth rates to explain security prices since there is considerable evidence that earnings growth is "higgledy piggledy." I. M. D. Little and Cragg and Malkiel have shown that both historic growth rates and even the forecasts of security analysts are little related to the growth that is actually achieved. This may be true and yet security analysts may continue to estimate the worth of shares and their anticipated future returns on the basis of the anticipated growth rate of the security's earnings. As is well known from work on the term structure of interest rates, expectations need not be correct to be an important determinant of the yield curve. Surely it is an empirical question whether or not the market actually does value shares consistently with the model presented here.

[9] For a full discussion of the pitfalls involved in isolating the effect of dividend policy on share prices, see Friend and Puckett.

[10] All historical data were taken from the *COMPUSTAT* tapes made available by Standard Statistics Corporation.

[11] The Institute is a consortium of 30 investment firms, organized to promote quantitative research in finance.

nonrecurring factors as strikes or flood damage, or by a cyclical contraction, it is likely that investors apply an appropriate price-earnings multiple to the amount they consider to represent the normal earning power of the company. Indeed, one of the first jobs of a security analyst is to adjust the firm's accounting earnings to arrive at an indication of true earning power (see B. Graham, D. L. Dodd, and S. Cottle ch. 34). Thus, the price-earnings ratios that are relevant for valuation may be the ratios of prices to normalized earnings rather than ratios of prices to reported earnings for the preceding accounting period. These normalized earnings are estimated to be the earnings that would obtain at a normal level of economic activity if the company were experiencing normal operations—that is, operations not affected by such nonrecurring items as strikes, natural disasters, and so forth. The normalized-earnings figures used in the present study were averages of estimates supplied by two of the participating firms.

(b) *Future Long-term and Short-term Growth Rates*

As was mentioned above, several theoretical models of stock valuation have all focused on the expected growth rates of earnings and dividends as a central explanatory variable. Most previous empirical studies, however, were forced to rely on past growth rates as a proxy for future growth rates. One of the major purposes of the present study was to ascertain whether the estimates of future growth rates from several securities firms can enable us to obtain a more satisfactory explanation for the structure of share prices.

In order to contrast the use of historical and expected growth rates, we first tried to find those historical growth rates that showed the closest correlation with market price-earnings multiples. Forty alternative growth rates were tried. These growth rates differed with respect to the period covered, the method of calculation, and the financial data upon which the growth rate was estimated. From the forty candidate growth rates, the following three were either clearly superior or, at least, no worse than any of the others. These were 1) the ten-year growth rate of earnings per share calculated as the geometric mean of first ratios, 2) the ten-year growth rate of cash earnings per share (i.e., earnings plus noncash charges) calculated as the geometric mean of first ratios, and 3) the ten-year growth rate of cash earnings plus taxes calculated from a regression of the logarithms of the earnings on time. The growth rate of cash earnings was slightly better than the other two in most of the five years studied, and was used in the regressions reported in this paper.

The expected growth rates were estimated by nine securities firms.[12] Each growth rate figure was reported as an average annual rate of growth of earnings per share expected to occur over the next five years. The figures used in the study were averages of the nine predictors.

In addition to these expectations of long-term growth rates, we also collected estimates of the following year's earnings from eleven securities firms.[13] We found, somewhat to our surprise, that the implicit forecasts of short-term (one-year) growth were not highly correlated with the long-term anticipations and we were able to use both sets of data in some of the empirical work presented later.

Obviously these expected growth rates are not the expectations of a wide cross-section of the buyers and sellers in the market. These expectations were formed,

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[12] It should be noted that not all firms provided growth-rate estimates for each of the companies used in the sample during each of the five years, 1961–65.

[13] Three of these eleven firms also supplied long-term forecasts.

however, by professional security analysts for securities firms or for large institutional investors who are important participants in the market. Moreover, in many cases, these expectations were made to be provided to other investors whose own expectations may be influenced by their advisors. Finally, we should note that these expectations are not limited to published information. The security analysts involved frequently visit the companies they follow and discuss the company's prospects with its executives. Insofar as other security analysts follow the same sort of procedures as our participating firms, the growth-rate estimates of other institutional investors and securities firms may resemble those we have collected. Consequently, these predictions may well serve as acceptable proxies for market expectations and they surely seem worthy of detailed analysis.

(c) *Dividend Payout*

The measurement of the dividend-payout ratio also presents problems. If we simply take the ratio of dividends to earnings, short-run disturbances to reported earnings that do not produce equiproportional changes in dividends can make calculated payouts differ considerably from target or normal payout ratios. For this reason we chose two alternative methods of calculating the dividend payout. The first method was simply to divide the dividend by normalized rather than reported earnings. The second method, used in the regressions where only historic data were employed, was to average the actual payout ratios over the preceding seven years.

(d) *Risk Variables*

Several types of expectational risk variables were introduced to serve as proxies for the anticipated variance of individual security returns. We included such variables as the standard deviation of the forecasts of security firms, various types of subjective quality ratings, and an index of the expected instability of future earnings. These risk proxies all turned out to be highly correlated with each other and only the one most useful in explaining earnings multiples, the instability index, has been included in the regressions reported in this paper. This variable was collected from one of our participating firms and represented a measure of the past variability of earnings (around trend) adjusted by the security analyst to indicate anticipated future variability.

In order to contrast the use of expectations data with historical data, a number of risk proxies were calculated on the basis of the financial records of each company. These included statistics measuring the variance of past earnings and of other financial data, a leverage variable, and the conformance between returns of each individual security and that of a market index. The index of market conformance was obtained by estimating the slope, β_i, of a regression of the annual returns of each security on the annual returns from the Standard and Poor's Composite Index. Ten years of data were employed in obtaining the estimate. The most useful historic risk proxies for our present purposes were the semideviation of earnings around trend, the index of market conformance, and the leverage variable. In Table 1 we summarize the variables employed in the regressions.

Before turning to the regression results, a problem concerning the timing of the availability of the expectations and hisrorical data should be mentioned. Our study tries to explain differences among price-earnings multiples for a cross-section of securities as of December 31 in each of five years. While normal earnings per share (and expected growth rates) were estimated and, therefore, available at the end of each year, actual earnings per share for the 12 months to December 31 are not generally known until some time after the close of the year. Thus, the actual P/E ratios and the historic growth rates calculated to the end of the year, which we employed in the regressions estimated from historic data, were not available to investors on the dates for which equations were estimated, although rather close estimates of the earnings necessary for the calculations are usually well known by that time. In order to test whether our results might be strongly influenced by, in effect, assuming perfect foresight by the market regarding current-year's earnings, we performed an alternative set of runs using the most recent publicly available 12-months' earnings to calculate P/E ratios and historic growth rates. Since the regression results from the alternative set of runs were almost identical to those reported here, it seems safe to conclude that our assumptions regarding the timing of the availability of historic data had little influence on the results.

TABLE 1—VARIABLES USED IN VALUATION STUDY

P	End-of-year market price per share
D	Total dividends paid per share (adjusted to number of shares outstanding at year end)
E	Reported earnings per share (adjusted to exclude nonrecurring items)
$\overline{D/E}$	Average dividend-payout ratio over past 7 years
$\overline{NE}$	Average "normalized" earnings estimates of security analysts
$\bar{g}_p$	Average predicted future long-term growth rate of earnings per share, measured as an annual percentage rate of growth
g_H	Historic (10-year) growth rate of (cash) earnings per share measured as an annual percentage rate of growth
I_p	Predicted instability index of the future earnings stream
β	The slope of a regression of the annual returns from a company's shares on the annual returns from the market index
$I_{H,1}$	Calculated instability index of the historic earnings stream (semideviation of earnings around trend)
$I_{H,2}$	Calculated instability index of the historic operating earnings streams (semideviation of earnings plus financial fixed charges around trend)
$\bar{E}_{t+1}$	Average predicted earnings per share for the next year
$\frac{F}{E+F}$	Leverage variable (the ratio of fixed charges to earnings plus fixed charges)

III. *Regression Results*

In this section we first present a comparison of the regression results for equations including comparable historic and expectational variables. Then, the results for the most satisfactory expectational equations are shown and the stability of the coefficients over time is examined.

(a) *Comparison of Regressions Using Historical and Expectational Variables*

In Table 2 the results of regressions using only three variables calculated from readily available historical data are compared with regressions employing comparable expectations data.[14] In panel A of Table 2, the price-earnings multiple is regressed on the historic ten-year growth rate of cash earnings (calculated as the geometric mean of first ratios), the dividend-payout ratio (averaged over the preceding seven years), and an instability index of earnings (calculated as the semideviation from a regression of earnings over the past ten years). It will be noted that generally about half of the variance in price-earnings multiples is explained by the regressions. The growth-rate variable is highly significant in each of the years covered. The calculated payout and risk

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[14] It will be noted that the sample size for each regression was usually less than the total sample of 178 companies. Companies had to be dropped from the sample whenever historic or expectational data were unavailable or could not be computed. In addition whenever a company's calculated historic growth rate was negative, the firm was dropped from the sample. This was done to make the regressions based on historic data as comparable as possible to those based on expectations data, where no negative growth rates were projected.

TABLE 2—COMPARISON OF REGRESSIONS USING HISTORICAL AND EXPECTATIONAL VARIABLES

A. REGRESSION RESULTS: HISTORIC VARIABLES

$P/E = a_0 + a_1 g_H + a_2 \overline{D}/\overline{E} + a_3 I_{H,1}$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
1961	13.65	+1.87	−.26	−.65	.50	51.27
		(.17)	(6.14)	(1.37)		(3; 156)
		10.72	−.04	−.47		
1962	8.92	+1.06	+6.90	−.77	.45	44.78
		(.10)	(3.28)	(.68)		(3; 163)
		10.90	2.10	−1.14		
1963	9.39	+1.33	+5.22	−.96	.49	51.31
		(.12)	(3.73)	(.81)		(3; 161)
		11.29	1.40	−1.19		
1964	10.88	+.95	+4.85	−.69	.36	32.16
		(.11)	(3.52)	(.71)		(3; 170)
		8.65	1.38	−.96		
1965	5.74	+1.52	+6.64	+.35	.65	98.65
		(.10)	(3.55)	(.77)		(3; 162)
		15.23	1.87	.46		

B. REGRESSION RESULTS: COMPARABLE EXPECTATIONS VARIABLES

$P/E = a_0 + a_1 \bar{g}_p + a_2 D/\overline{NE} + a_3 I_p$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
1961	4.73	+3.28	+2.05	−.82	.70	89.34
		(.23)	(4.33)	(.75)		(3; 115)
		14.47	.47	−1.09		
1962	11.06	+1.75	+.78	−1.61	.70	133.33
		(.13)	(2.47)	(.39)		(3; 174)
		13.99	.31	−4.11		
1963	2.94	+2.55	7.62	−.27	.75	174.51
		(.13)	(2.58)	(.39)		(3; 174)
		19.67	2.95	−.69		
1964	6.71	+2.05	+5.33	−.89	.75	168.46
		(.11)	(2.17)	(.36)		(3; 170)
		18.24	2.44	−2.48		
1965	.96	+2.74	+5.01	−.35	.85	317.52
		(.10)	(2.05)	(.30)		(3; 171)
		26.50	2.44	−1.14		

Note: Numbers in parentheses below coefficients are standard errors and numbers below parentheses are t-values. Numbers below the F-values are degrees of freedom.

measures usually have their expected signs but are not significant.[15]

In panel B of Table 2, the average growth rates and other expectational variables collected from the participating firms are used to explain price-earnings multiples. All coefficients have their expected signs. Moreover, the fits are very close for cross-sectional empirical work and are much better than those obtained with the historical data. About three quarters of the variability of price-earnings ratios is explained by the regressions. We should also mention that better fits were obtained by using the average growth rates of all predictors than by employing forecasts of a single analyst. This suggests that our survey was useful in getting closer to what might be considered the expectations of a "representative" investor.

(b) *Regression Results Employing a Covariance Risk Measure*

In Table 3 we present regression results employing a covariance risk measure. It will be noted that β, the index of market conformance, has the right sign in all cases except for the 1961 regression employing expectations data. Although it is significant in only two of the five years, the general consistency of the signs would suggest that market values do tend to reflect measures of past covariance with the market. It is also interesting that β had a particularly strong influence on price-earnings ratios at the end of 1962, following a large decline in stock prices. It would appear that investors particularly favor securities that tend to move relatively independently of the market during periods when the memory of sharply falling stock prices is clearly in mind.

Comparing Tables 2 and 3, the *t*-values associated with β tend to be slightly higher than those associated with either of the two previous risk variables.[16] When a variable measuring expected short-term growth is introduced, however, the predicted instability index tends to be somewhat superior, being "significant" in four out of the five years (see Table 5). The variables β and I_p cannot be used together in the same regression, because the two variables are highly correlated, and both become insignificant.[17]

(c) *Regression Results Employing a Combination of Expectations and Historic Data*

In Table 4, we present regression results involving a combination of expectations and historic data. The price-normalized earnings ratio is employed as the dependent variable. Independent expectational variables include anticipations of short- and long-term growth, and the dividend payout expressed as a percent of normalized earnings. Historic variables were an instability index and a leverage variable. In these regressions, the instability index was calculated from a time-series of earnings plus fixed charges. This measure should represent the instability of operating earnings and may serve as an acceptable proxy for business risk. We also included a leverage variable, which should indicate the additional financial risk borne

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[15] As noted above, the positive sign on the dividend coefficient should not be interpreted as evidence that dividend policy can affect the value of the shares. This coefficient indicates only that a *ceteris paribus* change in dividend payout will increase the price of the shares. What the famous "dividend-irrelevancy" theorem of Modigliani and Miller says is that an increase in dividend payout (holding the firm's investment constant) will tend to reduce the growth rate of earnings per share since new shares will now have to be sold to make up for the extra funds paid out in dividends. A positive dividend coefficient is thus in no way inconsistent with the dividend-irrelevancy theorem.

[16] While it should be noted that these comparisons are based on regressions using somewhat different numbers of observations, the conclusions presented hold also for comparisons based on the smaller sample of companies for which all data were available.

[17] Correlation coefficients between β and I_p during the period studied are approximately 0.60.

TABLE 3—REGRESSION RESULTS EMPLOYING A COVARIANCE RISK MEASURE

A. HISTORIC VARIABLES AND COVARIANCE MEASURE

$P/E=a_0+a_1g_H+a_2\overline{D}/\overline{E}+a_3\beta$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
1961	15.52	1.82	−1.75	−1.53	.49	52.60
		(0.17)	(6.14)	(1.34)		(3; 161)
		10.54	−0.29	−1.15		
1962	12.42	1.02	4.28	−2.87	.54	65.86
		(0.09)	(2.94)	(0.60)		(3; 169)
		11.38	1.46	−4.76		
1963	9.20	1.28	6.84	−1.21	.48	51.69
		(0.11)	(3.67)	(0.88)		(3; 168)
		11.19	1.87	−1.38		
1964	14.37	0.96	3.29	−3.54	.44	44.76
		(0.10)	(3.18)	(0.72)		(3; 173)
		9.36	1.03	−4.92		
1965	7.47	1.52	5.58	−0.95	.64	99.49
		(0.10)	(3.34)	(0.79)		(3; 165)
		15.30	1.67	−1.20		

B. COMPARABLE EXPECTATIONS VARIABLES AND COVARIANCE MEASURE

$P/E=a_0+a_1\bar{g}_p+a_2D/\overline{NE}+a_3\beta$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
1961	3.63	3.29	3.24	0.97	.74	132.82
		(0.19)	(4.47)	(1.09)		(3; 140)
		17.20	0.73	0.89		
1962	9.79	1.87	2.25	−2.65	.72	148.29
		(0.11)	(2.23)	(0.47)		(3; 173)
		16.88	1.01	−5.69		
1963	3.47	2.57	7.17	−0.84	.75	176.82
		(0.12)	(2.47)	(0.61)		(3; 174)
		21.38	2.90	−1.37		
1964	6.16	2.10	5.87	−1.41	.76	184.63
		(0.10)	(2.04)	(0.53)		(3; 173)
		21.40	2.88	−2.67		
1965	0.25	2.86	5.01	−0.47	.86	352.19
		(0.10)	(2.00)	(0.49)		(3; 172)
		29.14	2.50	−0.96		

Note: Numbers in parentheses below coefficients are standard errors and numbers below parentheses are t-values. Numbers below the F-values are degrees of freedom.

by the shareholders. The specific measure employed was the ratio of fixed charges per share to earnings plus fixed charges per share.[18] In addition, a dummy variable was included that took the value unity for utility companies and zero for industrials. This variable was introduced to account

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[18] For a discussion of the problems involved in using the debt-equity ratio itself, see A. Barges and R. Wippern.

TABLE 4—REGRESSION RESULTS EMPLOYING A COMBINATION OF EXPECTATIONS AND HISTORIC DATA

$$P/\overline{NE}=a_0+a_1\bar{g}_p+a_2\tilde{E}_{t+1}/\overline{NE}+a_3D/\overline{NE}+a_4F/(E+F)+a_5Dum+a_6I_{H,2}$$

Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	$\hat{a}_5$	$\hat{a}_6$	R^2	F
1961	−41.19	+2.88	+44.88	+5.53	−12.34	+1.79	−4.93	.85	102.98
		(.20)	(5.24)	(4.53)	(4.06)	(1.69)	(9.21)		(6;106)
		14.07	8.57	1.22	−3.04	1.05	− .54		
1962	−1.41	+1.68	+9.89	+2.60	−7.53	+4.46	−7.69	.78	74.04
		(.13)	(2.72)	(2.50)	(2.07)	(.92)	(4.75)		(6;129)
		13.16	3.63	1.04	−3.65	4.87	−1.62		
1963	−12.94	+2.41	+15.29	+8.96	−6.20	+.71	−5.70	.81	90.72
		(.14)	(2.99)	(2.79)	(2.33)	(1.04)	(5.33)		(6;129)
		17.12	5.11	3.21	−2.66	.69	−1.07		
1964	−10.91	+1.89	+14.31	+7.70	−3.39	+3.62	+4.59	.80	83.42
		(.12)	(2.02)	(2.45)	(2.21)	(.94)	(5.28)		(6;128)
		15.65	7.09	3.14	−1.53	3.86	(.87)		
1965	−15.55	+2.64	+20.05	−2.04	−7.81	+2.64	−17.59	.84	118.41
		(.14)	(1.99)	(3.01)	(2.61)	(1.12)	(6.33)		(6;128)
		18.69	10.09	−.68	−2.99	2.37	−2.78		

Note: Numbers in parentheses below coefficients are standard errors and numbers below parentheses are *t*-values. Numbers below the *F*-values are degrees of freedom.

for differences in risk between the two classes of companies not captured by our other risk variables.

As can be seen from the table, the combination of historical and expectational variables works remarkably well in accounting for the structure of share prices. Most significant were the coefficients of the short- and long-term growth rates. It should be noted that while the coefficient of the "operating-risk" variable (the semi-deviation of earnings plus fixed charges around trend) usually was not statistically significant and had the "wrong" sign in 1964, the coefficient of the financial-risk variable (our measure of leverage) always had the "correct" sign and was significant in all but one year. This provides support for the Modigliani-Miller proposition that the required rate of return on equity should be an increasing function of leverage.

(d) *Regression Results Employing Expectations Data Alone*

In Table 5 we present additional regression results for the equations employing only expectations variables. The price-normalized earnings ratio is the dependent variable. Independent variables include expectations of short- and long-term growth, the dividend-payout ratio, and the expected instability index.[19]

We find that the long-term growth variable contributes most to an explanation of the structure of earnings multiples. The growth coefficient has a *t*-value over 13 in every year. The coefficient of short-term growth ($\tilde{E}_{t+1}/\overline{NE}$) is also positive and highly significant. The coefficients of the payout ratio and the risk proxy are positive and negative, respectively, as ex-

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[19] Fortunately, the correlations between the independent variables tended to be relatively low in all years. A sample correlation matrix (for the 1964 data) is presented below

	$\bar{g}_p$	$\tilde{E}_{t+1}/\overline{NE}$	I_p	$D/\overline{NE}$
$\bar{g}_p$	1.00			
$\tilde{E}_{t+1}/\overline{NE}$	.28	1.00		
I_p	− .32	.09	1.00	
$D/\overline{NE}$	− .34	− .07	− .37	1.00

TABLE 5—REGRESSION RESULTS: EMPLOYING EXPECTATIONS DATA

	$P/\overline{NE}=a_0+a_1\bar{g}_p+a_2\bar{E}_{t+1}/\overline{NE}+a_3D/\overline{NE}+a_4I_p$							$R_{t+1}=a+b\left[\frac{P/\overline{NE}-\hat{P}/\overline{NE}}{\hat{P}/\overline{NE}}\right]$		
Year	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{a}_4$	R^2	F	$\hat{b}$	R^2	F
1961	−27.96	+2.91	+31.78	+4.57	−.58	.77	80.39	−.25	.09	9.47
		(.21)	(5.76)	(3.96)	(.70)		(4,96)	(.08)		(1;99)
		13.56	5.51	1.15	−.83			−3.08		
1962	+3.42	+1.61	+6.88	+3.21	−2.20	.79	129.14	.21	.03	3.73
		(.12)	(2.87)	(2.32)	(.41)		(4,138)	(.11)		(1;141)
		13.05	2.40	1.39	−5.44			1.93		
1963	−11.33	+2.29	+15.11	+8.11	−1.14	.80	139.82	−.20	.04	6.48
		(.14)	(2.82)	(2.70)	(.39)		(4,137)	(.08)		(1;140)
		16.30	5.35	3.01	−2.88			−2.55		
1964	−9.29	+1.87	+15.20	+7.03	−1.13	.78	120.00	−.00	.00	.00
		(.14)	(1.94)	(2.40)	(.41)		(4,134)	(.15)		(1;137)
		13.05	7.83	2.92	−2.75			−.00		
1965	−11.15	+2.42	+13.78	+4.22)	−.81	.83	162.21	—.01	.00	.01
		(.12)	(1.85)	(2.34)	(.38)		(4,136)	(.10)		(1;139)
		19.59	7.46	1.81	−2.14			−.11		

Note: Numbers in parentheses below coefficients are standard errors and numbers below parentheses are t-values. Numbers below the F-values are degrees of freedom.

pected, and are usually significant. While Tables 4 and 5 are not comparable because of different degrees of freedom, the regressions in Table 5 tend to produce slightly better fits adjusted for degrees of freedom.

It might be argued that the expectations data used as independent variables in the valuation equation may strongly reflect the $P/\overline{NE}$ ratio and, thus, we are in effect including the same variable on both sides of the valuation equation. The growth rates that we have collected are "supposedly" independent of market prices. The security analysts who have furnished the data claim that these estimates are ones that they use to calculate an "intrinsic" value of the shares, which is then compared with actual market prices in arriving at purchase or sale recommendations. In point of fact, however, the forecasted growth rates may still be strongly influenced by the market earnings multiples themselves.

Even if the anticipations data are strongly influenced by current market prices, however, this should not interfere with the basic purpose of this paper, which is to gain an understanding of the structure of share prices. The point is that the anticipations we have collected may simply be the security analysts' estimates of what the "average opinion" will continue to believe the reasonable expectations will be. The point is, of course, the familiar one about the Keynes beauty contest where the rational contestant would not pick those girls that he himself found prettiest, nor even those he deemed most likely to catch the fancy of the other contestants, but rather those that he anticipated the other contestants would believe the average opinion would consider prettiest.

Thus, if the $P/\overline{NE}$ ratio rises, and the security analyst believes that such a rise will continue to be justified by the average opinion, he may simply adjust his anticipated growth rate to a level that would justify the earnings multiple. In any case, what our valuation equation will measure is the relationship between growth rates and price-earnings multiples that security analysts believe the average opinion will continue to justify. Even in this event, our empirical results should still be useful in explaining and describing the structure of share prices at any given time.

(e) *Changes in the Valuation Relationship Over Time*

It is of some interest to examine whether the coefficients of the valuation equations are the same in each year or whether they change. This is of considerable importance to those who wish to use valuation equations in connection with assigned values of the independent variables to estimate the intrinsic worth of a security. Constancy of the relationship is also important if a firm is to seek to follow policies that will maximize the value of its shares. On the other hand, there is nothing in the theory of valuation to indicate that the equation need be constant over time.

An inspection of Table 5 indicates that the coefficients of our equation change considerably from year to year and in a manner that is consistent with the changing standards of value in vogue at the time. At the end of 1961 "growth stocks" were in high favor, and it is not surprising to find that the coefficient of the growth rate (2.91) is highest in this year. During 1962, however, there was a conspicuous change in the structure of share prices that was popularly called "the revaluation of growth stocks." This revaluation is reflected in the decline of the growth-rate coefficient for 1962 to 1.61, its lowest value for any of the five years. A similar set of observations can be made for the coefficient of the short-term growth rate ($\tilde{E}_{t+1}/\overline{NE}$). On the other hand, the risk index has its most negative influence on earnings multiples in 1962, whereas the coefficient was smallest in 1961, and, while negative, it was not significantly different from zero.

In actually testing whether the coefficients of the valuation equation were the same over time, it had to be recognized that the residuals in different years might not be independent. Indeed, it is shown in the bottom panel of Table 6, which we will discuss below, that the residuals are fairly highly correlated. As a result, Arnold Zellner's seemingly unrelated regression version of Aitken's generalized least-squares model is appropriate, although it had to be modified to take account of the fact that we did not have observations for all corporations in all years.[20] Using this procedure, the hypothesis that the coefficients are the same in each year was rejected beyond the .0001 level.

IV. *Use of the Valuation Model for Security Selection*

One of the most intriguing questions concerning empirical valuation models is whether they can be used to aid investors in security selection. The empirical valuation equation shows us, at a moment in time, the average way in which variables such as growth, payout, and risk influence market price-earnings multiples. Given the values of these variables applicable to any specific company, we can compute an estimated normal price-earnings ratio based on the empirical valuation equation. It has been suggested that securities may be selected by comparing the actual market price-earnings ratio with the normal

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[20] In using this procedure, the covariance matrix of the disturbances was estimated from the single-equation regression residuals. This procedure also produced more efficient estimates of the coefficients of the individual equations. Since these differed but little from those shown in Table 5, and had the same implications, we shall not present them here. The test reported is an *F*-test (asymptotically), which uses the vectors of independent and dependent variables, following transformation, in the usual way.

TABLE 6—ANALYSIS OF LACK OF FORECASTING SUCCESS

Description	Coefficient of Determination Residuals against 1964 Return	F-Value (and Degrees) of Freedom)
1963 Valuation equation with 1963 predictions	.04	6.48 (1;140)
1964 Valuation equation with 1963 data. (Assume that next year's valuation relationship is known.)	.08	12.15 (1;140)
1963 Valuation equation with realized growth rates. (Assumes perfect foresight regarding future long-term growth and next year's earnings.)	.12	18.140) (1;14
1963 Valuation equation with 1964 predictions. (Assumes perfect foresight regarding market expectations next year.)	.24	41.75 (1;140)

Correlations of Residuals over Years

Description	Coefficient of Determination
1962 vs. 1961	.46
1963 vs. 1962	.24
1964 vs. 1963	.13
1965 vs. 1964	.35

multiple predicted by the valuation equation. If the actual earnings multiple is greater (less) than the normal earnings multiple, we designate the security as "overpriced" ("underpriced") and recommend sale (purchase). Such a procedure was employed by Whitbeck and Kisor, who claimed that an underpriced group of securities selected by the above procedure consistently outperformed an overpriced group during the early 1960's.

Of course, even on a priori grounds, it is possible to think of many reasons why such a procedure would prove fruitless. For example, if high P/E (high growth rate) stocks tended to be overpriced during one particular period, the estimated growth-rate coefficient will be larger (by assumption) than that which is warranted. However, the recommended procedure will not indicate that high P/E stocks are overpriced because normal market-determined earnings multiples for these securities will themselves be higher than is warranted. Nevertheless, in view of the positive results reported by Whitbeck and Kisor, it would seem desirable to attempt to replicate their experiment with our data.

The results of some of our experiments are shown in the right-hand columns of Table 5. We measured the degree of over- or underpricing as the ratio of the residual from the prediction equation to the predicted earnings multiple, i.e., $[(P/\overline{NE}-\hat{P}/\overline{NE})/(\hat{P}/\overline{NE})]$. A percentage measure was chosen in view of the considerable variance in actual earnings multiples. If the model is useful in measuring underpricing, then underpriced securities, according to this criterion, ought to "outperform" overpriced issues over some subsequent period. We picked one year as the appropriate horizon and measured subsequent returns, in the normal manner, as

$$(5) \qquad R_{t+1} = \frac{P_{t+1} - P_t + D_{t+1}}{P_t}$$

If the empirical valuation model is successful in selecting securities for purchase, the percentage residual (degree of overvaluation) from the valuation equation ought to be negatively related to these subsequent returns. As the table indicates, in only three of the five years for which this experiment was performed was the relationship negative, and the degree of association was extremely low. In the other two years, there was either a positive or zero relationship. Supplementary tests conducted by industry and other groupings produced similar results. It should also be noted that the residuals from the equations employing historical data and from equations combining historical and expectational data were no more successful in predicting subsequent performance. Moreover, these results were unaltered when the subsequent returns were measured over alternative time periods such as one quarter ahead or two or more years ahead.

In Table 6 some statistics are presented which may be helpful in interpreting the reason for our predictive failures. We note that using the 1963 valuation equation as an example, the percentage degree of under- or overpricing is not highly correlated with subsequent returns. The coefficient of determination is only .04. It is possible, however, to isolate four reasons for our lack of forecasting success.

1) The first reason is that the valuation relationship changes over time. We might be unable to select truly underpriced securities because by the next year (the end of the horizon period) the norms of valuation have been significantly altered. Thus, what was cheap on the basis of 1963's relationship may no longer represent good value on the basis of the 1964 relationship. To test how important this factor might be, we performed the following experiment: We assumed that investors knew at the end of 1963 exactly what the market valuation relationship would be in 1964, i.e., we assumed perfect foresight regarding next year's valuation equation. Then, on the basis of the 1964 valuation equation, we utilized the 1963 data to calculate warranted $P/\overline{NE}$ multiples, which could then be compared with actual multiples to determine whether each security was appropriately priced. Correlating the percentage residuals with subsequent returns, we found that the coefficient of determination doubled, 8 percent of the variance in subsequent returns was explained.

2) A second reason for lack of success might be the quality of the expectations data employed. As was indicated in our 1968 article several of the growth-rate forecasts used in the present study were in fact shown to be rather poor predictors of realized earnings growth. To determine how much better off we would be with more accurate forecasts, we assumed perfect foresight regarding the future long-term growth rate of the company and regarding the next year's anticipated earnings. Thus, the 1963 empirical valuation equation was used to determine normal value, but in place of the variable $\tilde{E}_{64}/\overline{NE}_{63}$ we substituted the variable $E_{\text{actual } 64}/\overline{NE}_{63}$, and in place of $\bar{g}_p$ we substituted the realized long-term growth rate through the end of 1966. Using these realized data to determine warranted price-earnings multiples, the percentage residuals therefrom were correlated with future returns. As expected, an even greater improvement in forecasting future returns was found. The R^2 rises to .12.

3) As a further experiment, perfect foresight was assumed not regarding the

actual rate of growth of earnings but rather regarding what the market expectations of growth would be next year. Calculating the degree of overpricing as before, we find a much greater improvement in prediction of future returns, 24 percent of the variability of future returns is explained, compared with 4 percent in the original experiment. We conclude that if one wants to explain returns over a one-year horizon it is far more important to know what the market will think the growth rate of earnings will be next year rather than to know the realized long-term growth rate. Of course this observation brings us back to Keynes' newspaper contest again. What matters is not one's personal criteria of beauty but what the average opinion will expect the average opinion to think is beautiful at the close of the contest.

4) A final source of error is that the valuation model does not capture all the significant determinants of value for each individual company. Despite our success in accounting for approximately 80 percent of the variance in market price-earnings multiples, there are likely to be special features applicable to many individual companies that cannot be captured quantitatively. For example, it turned out that the stock of Reynolds Tobacco always appeared to be underpriced. The reason for this is, of course, not difficult to conjecture. There is a risk of government sanctions against the tobacco industry, which weighs heavily in the minds of investors, but which is not related to the instability measure of Reynolds' earnings we have employed.

To indicate how important this problem of omitted variables might be, the residuals from our valuation equations from year to year were correlated. If certain factors specific to individual companies are consistently missing, the residuals from the valuation equations can be expected to be positively correlated over time. As the bottom half of Table 6 indicates, the residuals are significantly correlated over time. Thus, despite our success with expectations data in estimating a valuation equation which has far more explanatory ability than those based on historic information, it is clear that certain systematic valuation factors are still missing from the analysis.[21] Consequently, it cannot be said that all deviations of actual from predicted price-earnings ratios are simply manifestations of temporary over- or underpricing.

V. *Concluding Comments*

We have demonstrated that it is possible to explain, for several successive years, a large percentage of the variability in market price-earnings ratios with the variables included in this study and the specification suggested by the very simple model in Section I. The analysis was not successful, however, in isolating underpriced securities that might be expected to have above-average future returns. Needless to say, there are many additional factors that should be considered in a full valuation study. While it does not seem likely that this further work will provide direct answers to the problem of security selection, it may well shed further light on the logic of market valuations.

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[21] It would be possible, of course, to incorporate some sort of firm-effect variable to capture the systematic portion of the under- or overpricing. Such a procedure was attempted. As a firm effect we utilized the difference between the last year's actual $P/\overline{NE}$ multiple and and $\hat{P}/\overline{NE}$, the predicted earnings multiple. As might be expected, this procedure served to improve the goodness of fit substantially, but it did not affect the magnitude of the other regression coefficients. Unfortunately, however, it was not successful in improving the forecasts of future returns.

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On The Use Of Consensus Forecasts Of Growth In The Constant
Timme, Stephen G.; Eisemann, Peter C.
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On the Use of Consensus Forecasts of Growth in the Constant Growth Model: The Case of Electric Utilities

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■ The constant growth model is often used for estimating the cost of equity capital in utility rate setting proceedings. A major source of controversy over the cost of equity is the method used to estimate the model's projected growth variable. (See, for example, [23, 24, 36] for a discussion of several technical aspects related to the estimation of the dividend yield component in the constant growth model.) The best estimate of projected growth is assumed to be one that incorporates all information regarding future growth contained in alternative growth proxies. In recent years, utility commissions and researchers have been more receptive to consensus financial analyst's forecasts (FAF's) of growth as opposed to historical growth rates as the basis for the growth variable estimate (e.g., [5], [10], [12], and [21]).[1] A consensus forecast should incorporate the information contained in alternative forecasts and therefore provide the most appropriate estimate for rate of return regulation and research. (Motivation for the use of a consensus growth estimate is provided by the forecasting literature that examines the benefits of combined forecasts, e.g., [18, 19, 26].)

Here the informational content of the increasingly popular consensus forecast provided by Lynch, Jones, and Ryan's *Institutional Brokers Estimate System* (I/B/E/S)

Our thanks to Louis Ederington and two anonymous referees for their valuable comments. All remaining errors are the responsibility of the authors. We wish to also thank the Center for the Study of Regulated Industry at Georgia State University for financial support; to Lynch, Jones, and Ryan for providing the I/B/E/S data through an academic research grant; and to Salomon Brothers, Inc. for also providing data.

[1] There is a growing body of literature demonstrating the superiority of FAF's relative to naive forecasts (e.g. [6, 7, 14]) and that the revision of FAF's conveys information to investors (e.g. [1, 11, 15, 16]). See [17] for an in-depth review of this literature.

is examined relative to the frequently used alternative forecasts by Salomon Brothers, Inc. and Value Line. In comparing the relative informational content of FAF's, this adds to previous research (e.g., [8, 30, 37, 38]) that has to date only examined the use of FAF's versus historical growth rates as estimates of the growth rate in the constant growth model. For completeness, historical growth estimates are also examined. The analysis is performed for a group of electric utilities over 1982–1986. Electric utilities are commonly the focus of applied academic research (e.g., [4, 5, 21, 28, 29, 30, 37, 38]), and the constant growth model is frequently used in electric utilities' rate setting proceedings.

The results of the analyses for the sample utilities show the following:

(i) There generally are large size differences between both the various FAF's and between the FAF's and historical growth rates;

(ii) Neither the consensus I/B/E/S forecast nor the FAF forecasts by Salomon Brothers and Value Line contain by itself all the information included in the other FAF forecasts; and

*(iii)*FAF-based growth rates contain all the information found in historical growth rates.

The study's primary conclusion is that although a consensus FAF can be formed to contain all the information incorporated in alternative analysts', forecasts, and historical growth rates, the construction of the consensus forecast requires the judicious choice of the weight to be assigned to each forecast. More generally, the results suggest that the informational content of forecasts used as proxies for investor expectations should be compared using a methodology similar to this study's before being accepted in research and regulatory proceedings.

I. Hypothesis, Model, and Methodology

A. The Hypothesis

The standard constant growth model states,

$$k = \frac{D_0(1+g)}{P_0} + g, \qquad (1)$$

where,

P_0 = current stock price,
D_0 = current dividend per share,
g = expected constant growth rate of dividends, and
k = required rate of return on equity.

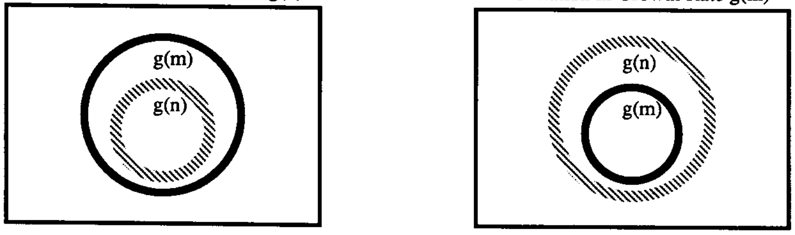
The estimate of the constant growth rate chosen for Equation (1) ideally contains all the information regarding the valuation of equity capital included in all other alternative growth estimates. This concept is depicted graphically in Exhibit 1, which compares the relative informational content of two growth estimates, *g(m)* and *g(n)*. For exposition purposes, it is assumed that *g(m)* and *g(n)* are the only two growth estimates available to investors. However, the analysis can be easily extended to the joint comparison of more than two growth estimates.

In Exhibit 1, the solid-lined circle encompasses all the information included in *g(m)* and the broken-lined circle all the information in *g(n)*, which investors incorporate into stock prices. Panel A depicts a scenario in which *g(m)* contains all the information incorporated in *g(n)*, and *g(n)* does not contain all the information in *g(m)*. As a result, *g(m)* should be wholly used to estimate the growth component in Equation (1). Panel B depicts an opposite scenario in which *g(n)* should be used instead of *g(m)* as a proxy. In Panel C neither growth estimate contains all the information found in the other, although there is some overlap of information as shown by the shaded area of intersection. In Panel D, both estimates contain unique information; there is no common information. Because neither forecast in Panels C and D contains all the information included in the other, some type of average of *g(m)* and *g(n)* should be used as the growth estimate. Finally, in Panel E both *g(m)* and *g(n)* contain exactly the same information found in the other. In this case, *g(m)* and *g(n)* should be equal and either could be used as an estimate of growth.

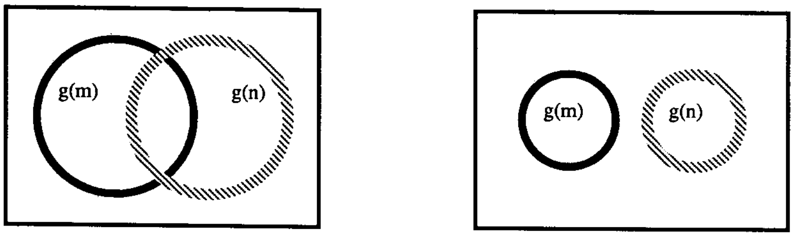
B. The Model

The growth estimate's relative informational content is tested using the model developed in the works by Malkiel [27] and Cragg and Malkiel [8]. In their research on expectations and valuation, Cragg and Malkiel constructed a linear price-earnings model that approximates a dividend growth model, such as Equation (1) (see their equations 3.3-13 and 3.3-14, 3.3-18, and 4.4-1). The linear price-earnings model is stated as follows:

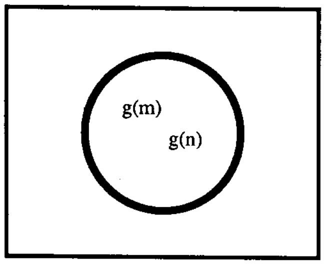
Exhibit 1. Graphical Depiction of Growth Estimates' Relative Informational Content


Panel A
Growth Rate g(m) Contains All Information in Growth Rate g(n)

Panel B
Growth Rate g(n) Contains All Information in Growth Rate g(m)


Panel C
Growth Rates g(m) and g(n) Contain Unique and Overlapping Information

Panel D
Growth Rates g(m) and g(n) Contain Only Unique Information


Panel E
Growth Rates g(m) and g(n) Contains the Same Information

$$\frac{P_0}{E_0} = \varphi + \beta_1 \frac{D_0}{E_0} + \beta_2 g + \Sigma\, \alpha_i RISK_i + \epsilon\,. \qquad (2)$$

That is, the price-earnings is a linear function of a constant, plus the dividend payout ratio factor, expected future growth factor, and a series of risk factors. In Equation (2), $RISK_i$ is the ith measure of risk associated with the cost of equity k, and ϵ is an error term. Malkiel [27] and more recently Vander Weide and Carleton [37, 38] found that the linear specification in Equation (2) is a fairly robust approximation of the true nonlinear price-earning ratio model which can be derived from Equation (1) and, therefore, is useful for examining alternative proxies for growth. The specific measures of risk used in Equation (2) are discussed in Section II. However, to facilitate the presentation of the paper's methodology, the sources of the growth estimates are discussed first.

C. The Growth Estimates

Five end-of-the-year growth estimates were collected for a group of 62 electric utilities for December 1982 through December 1986. The selection criteria are discussed in Section II. The growth rates are:

GIBES = mean 5-year financial analysts' consensus earnings growth forecast available through Lynch, Jones, and Ryan's *Institutional Brokers Estimate System* (I/B/E/S);[2]

GSB = The projected 5-year normalized growth rate forecasted by Salomon Brothers, Inc. in their publication *Electric Utility Monthly;*

GVLD = The 3 to 5-year forecasted growth in dividends per share as reported in the *Value Line Investment Survey;*

GVLE = The 3 to 5-year forecasted growth in earnings per share as reported in the *Value Line Investment Survey;* and

GHD5 = The 5-year log-linear historical growth in dividends paid per share.[3]

The financial analysts' forecasts GIBES, GSB, GVLD, and GVLE are included in the study for several reasons. First, these growth estimates have been used in previous research to examine electric utilities' cost of equity (e.g., [5, 21]) and are frequently used in rate setting proceedings. Second, for the five years examined in this study, this set of growth estimates permits an appreciably larger sample of utilities than do sets of these estimates combined with other growth estimates (e.g., Merrill Lynch) also available to the authors. Third, although the model in Equation (2) specifies dividend growth, this study uses both dividend and earnings estimates. Theoretically, dividends and earnings per share growth are identical in the constant growth model, and from a practical viewpoint, financial analysts focus on earnings and, therefore, earnings per share data are more readily available. Finally, the historical growth rate GHD5 is included to provide additional insights into the use of analysts' versus historical growth rates. See also [8, 29, 30, 37, 38] for an examination of the use of historical growth rates to estimate the cost of equity.

D. Methodology

The model in Equation (2) is initially estimated using each growth forecast to test hypotheses that each forecast contains all the information contained in all other forecasts. Later, the model in Equation (2) is used to examine the relative informational content of various combinations of forecasts. Similar to all empirical valuation models, a caveat of these tests is that they are really joint tests of each growth rate's informational content and that investors price equity securities in a manner consistent with Equation (2). Maintaining that investors follow Equation (2) in setting security prices, the hypotheses regarding the alternative growth forecasts' informational content are tested using the following variation of Equation (2):

$$\frac{P_0}{E_0} = \varphi + \beta_1 \frac{D_0}{E_0} + \beta_2^{*} g(m) + \beta_2^{**} g(n) + \Sigma\, \alpha_i RISK_i + \epsilon\,, \qquad (3)$$

for

m and n = GIBES, GSB, GVLD, GVLE, and GHD5, but $m \neq n$.

The informational content of each growth estimate, as depicted in Exhibit 1, is tested by performing pairwise likelihood ratio tests using Equations (2) and (3). See Maddala [25] for details on tests using likelihood ratios. In performing the tests, the basic approach is to compare *g(m)* and *g(n)* via two tests. In the first test, Equation (2) is estimated using *g(m)* and Equation (3) is estimated using *g(m)* and *g(n)*. The overall fit of Equation (2), as measured by the log of the likelihood function, is then tested against the overall fit of Equation (3). As an example, suppose the test statistic is significant. This indicates that *g(n)* contains some information not found in *g(m)*. The second test involves estimating Equation (2) using *g(n)* and comparing its overall fit to Equation (3), again estimated using *g(m)* and *g(n)*. If the test statistic from the second test is insignificant, then *g(m)* does not contain any information not already incorporated in *g(n)*. In this case, these results would suggest that *g(n)* is a better proxy for investor expectations than *g(m)*, again maintaining that

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[2] Use of the I/B/E/S median as opposed to the mean growth forecasts does not alter the study's findings. These results are available from the authors.

[3] Five-year historical growth in earnings per share was also examined. The results for the 5-year historical earnings growth rate show it never contains information not already incorporated in the FAF growth estimates, and that the FAF growth estimates always contain significantly more information than the 5-year historical earnings growth rates. In the interest of space these results are not presented but are available from the authors.

Exhibit 2. Possible Outcomes of Pairwise Likelihood Ratio Tests of the Informational Content of Two Alternative Constant Growth Estimates, $g(m)$ and $g(n)$

Test No.[1]	Significant	Relative Importance
1	Yes	Growth rate $g(m)$ contains all the information in $g(n)$ plus some additional information. See Panel A, Exhibit 1. Growth rate $g(m)$ should be used as an estimate of the constant growth rate.
2	No	
1	No	Growth rate $g(n)$ contains all the information in $g(m)$ plus some additional information. See Panel B, Exhibit 1. Growth rate $g(n)$ should be used as an estimate of the constant growth rate.
2	Yes	
1	Yes	The growth rates $g(m)$ and $g(n)$ contain both unique and overlapping information, or only unique information. See Panels C and D, Exhibit 1. A combination of $g(m)$ and $g(n)$ should be used as an estimate of the constant growth rate.
2	Yes	
1	No	The growth rates $g(m)$ and $g(n)$ contain the same information. See Panel E, Exhibit 1. Either growth rate can be used as an estimate of the constant growth rate.
2	No	

[1] Using Equations (2) and (3), Test No. 1 tests the informational content of $g(m)$ relative to $g(n)$. Test No. 2 tests the informational content of $g(n)$ relative to $g(m)$.

Exhibit 3. Listing of Electric Utility Companies in Sample

Allegheny Power
American Elec. Pwr.
Atlantic City Elec.
Baltimore Gas & Elec.
Boston Edison
Carolina Pwr. & Lt.
Central & South West
Central Ill. Pub. Svc.
Cilcorp
Commonwealth Edison
Commonwealth Energy
Consolidated Edison
Dayton Pwr. & Lt.
Delmarva Pwr. & Lt.
Detroit Edison
Duke Power Co.
Eastern Utilities
El Paso Electric
Empire District Electric
FPL Group
Hawaiian Electric
Houston Industries
Idaho Power Co.
Illinois Power Co.
Interstate Power
Iowa Electric Lt. & Pwr.
Iowa Resources Inc.
Iowa Southern Utilities
Ipalco Enterprises
Kansas Pwr. & Lt.
Kentucky Utilities
Louisville Gas & Elec.
MDU Resource Group
Minnesota Pwr. & Lt.
Nevada Power Co.
New England Electric
Northeast Utilities
Northern States Power
Ohio Edison
Oklahoma Gas & Electric
Orange & Rockland Util.
Otter Tail Power
PacifiCorp
Pacific Gas & Elec.
Penn. Pwr. & Lt.
Portland General Corp.
Potomac Electric Pwr.
Public Service Ent. Group
Public Service New Mexico
Puget Sound Pwr. & Lt.
San Diego Gas & Elec.
Savannah Electric
Southern Calf. Edison
Southern Ind. Gas & Elec.
Southern Company
TECO Energy
Texas Utilities
Tucson Electric Pwr.
Union Electric
Utah Pwr & Lt.
Wisconsin Pwr. & Lt.
Wisconsin Public Service

investors follow Equation (2) in setting stock prices. Four outcomes are possible when performing the pairwise likelihood ratio tests using Equations (2) and (3). These outcomes and their interpretation as they relate to the growth estimates' relative informational content are summarized in Exhibit 2.

II. The Data

A. The Companies

End-of-the year data were collected for 1982–1986 for a sample of investor-owned electric utilities operating in the United States. Several different criteria are imposed in the selection of the sample companies. First, the sample comprises companies for which data are available through I/B/E/S, Salomon Brothers, Inc.'s *Electric Utility Monthly*, and the *Value Line Investment Survey* for each of the five years in the study, and each year's forecasted growth rates are positive for each source. Second, companies were excluded which experienced negative historical dividend growth over 1982–1986 except through stock splits and stock dividends. These criteria exclude companies for which it is believed the constant growth model is not appropriate, since in practice the model is not used to estimate the cost of equity for companies with negative growth rates. Excluded companies are primarily those which have exhibited considerable financial burdens due to nuclear construction programs (e.g., Long Island Lighting, Public Service Indiana, and Public Service New Hampshire). Third, to avoid possible distortions, sample companies are required to have a fiscal year ending December 31. Imposing these criteria results in the sample of 62 utilities listed in Exhibit 3.

B. The Risk Variables

A large number of variables have been used in research and regulatory proceedings to characterize electric utilities' equity risk. (Cragg and Malkiel [8] used risk measures such as equity beta and the variance of the long-term growth forecast [chapter 4], and Vander Weide and Carleton [37, 38] used the firm's pre-tax interest coverage ratio and the stability of the firm's five-year historical earnings per share among others.) The risk measures, $RISK_i$ in Equations (2) and (3), used in this study are defined below.

BETA = The company's equity beta.

BOND1, BOND2, and *BOND3* = A dummy variable for the Moody's bond rating. If a company has either an "Aaa" or "Aa" rating, *BOND1* is assigned a value of 1 and *BOND2* and *BOND3* values of 0. For an "A" rating, *BOND2* is assigned a value of 1 and *BOND1* and *BOND3* values of 0. Finally, for a company with a "Baa" rating, *BOND3* is assigned a value of 1 and *BOND1* and *BOND2* values of 0.

NUKE = A dummy variable for the company's nuclear status. *NUKE* is assigned a value of 0 if the company did not exhibit significant nuclear construction/regulatory risk during the 1982–1986 sample period. *NUKE* is assigned a value of 1 if the company did exhibit significant nuclear related construction/regulatory risk during the sample period. The source of data for *NUKE* is discussed below.

A primary consideration in the choice of these risk variables is that they have all been used in academic studies to characterize equity risk.[4] Beta is widely used as a measure of systematic risk, and its theoretical underpinnings are well-known.[5] Studies have shown that bond ratings incorporate numerous measures of risk (e.g., [9, 31, 32]) and that bond ratings are significantly correlated with equity returns (e.g. [20, 33, 39]). The importance of nuclear risk for capital costs became apparent with the Three Mile Island accident on March 28, 1979. Studies have shown that as a result of the accident, both bond risk premiums [2] and stock prices ([3, 22]) for the entire electric utility industry reflected an increased perception of risk, with the risk effect being the greatest for firms with significant nuclear exposure.

C. Data Sources

The sources of data for the growth estimates were described in Section I. The dependent variable P_0/E_0 in Equations (2) and (3) is the end-of-year price-earnings ratio. It equals the closing price on the last trading day of each year divided by earnings per share normalized for the effects of extraordinary items and discontinued operations.[6] Three proxies were used for normalized earnings. They are the estimates for the forthcoming year of primary earning per share before extraordinary items and discontinued operations provided by I/B/E/S, Salomon Brothers, and Value Line.[7] The dividend payout ratio D_0/E_0 equals the end-of-year indicated dividend per share, divided by the proxy for normalized earnings per share. Dividends also exclude the payment of special dividends. The source of data for dividends is *Electric Utility Monthly.* The source of data for BETA is the *Value Line Investment Survey* and bond rating data are obtained from *Moody's Bond Record.* Finally the data for the risk variable NUKE are from various Salomon Brothers publications (e.g., [34]). In these

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[4] In an earlier version of this paper, various accounting measures (e.g., debt-to-equity and times-interest-earned) were used, as well as the dispersion of the analysts' forecasts, as measures of equity risk. The results using these measures are consistent with the conclusions associated with the results reported in this paper, that the consensus I/B/E/S consensus forecast does not contain all relevant information and the construction of a consensus forecast requires the judicious choice of the weight to be assigned each analyst's forecast. The authors prefer usage of BETA, BOND, and NUKE because of their intuitive appeal and their apparent ability to parsimoniously represent the information contained in the other risk measurers.

[5] The authors acknowledge that the use of beta to estimate utilities' cost of equity capital continues to be debated in the literature (e.g., [4] and the comments and replies in earlier issues of this journal).

[6] As pointed out by a referee, a caveat to this paper's analyses relates to the comparability of utilities' earnings per share both across companies and through time. The level and quality of earnings may vary across companies due to, for example, differing treatment of allowances for funds used during construction (AFUDC) and the tax effects of normalization versus flow-through accounting (e.g., the treatment of depreciation, tax deferrals, and investment tax credits). Earnings per share may not be directly comparable across time due to changes in accounting conventions. In SFAS 90, for example, it was decided during this study's sample period that plant abandonment and disallowances were no longer extraordinary items for regulated utilities.

Exhibit 4. Mean Values and Standard Deviations (in parentheses) for Sample Utilities[1]

	1982		1983		1984		1985		1986	
	Non-Nuclear Group	Nuclear Group	Non-Nuclear Group	Nuclear Group	Non-Nuclear Group	Nuclear Group	Non-Nuclear Group	Nuclear Group	Non-Nuclear Group	Nuclear Group
P/E[2]	6.98 (0.82)	6.78 (1.45)	7.09 (1.06)	6.02 (0.93)	7.41 (1.07)	6.42 (0.70)	9.19 (1.03)	7.42 (0.90)	11.45 (1.10)	9.11 (1.31)
GIBES	5.23% (1.15%)	5.17% (1.33%)	5.14% (1.29%)	4.99% (0.95%)	4.90% (1.22%)	4.40% (1.23%)	4.67% (1.15%)	4.38% (1.11%)	4.64% (1.05%)	3.94% (1.18%)
GVLD	5.89 (2.62)	6.16 (2.33)	5.69 (2.50)	5.09 (1.78)	5.66 (2.62)	4.91 (1.49)	5.53 (2.23)	4.96 (1.58)	4.99 (2.05)	4.30 (1.72)
GVLE	6.30 (2.19)	6.50 (1.44)	5.65 (2.12)	5.64 (1.91)	5.54 (2.72)	4.75 (1.67)	4.93 (1.95)	4.43 (1.90)	4.44 (1.55)	3.45 (1.90)
GSB	6.35 (1.34)	6.05 (1.25)	6.31 (1.25)	5.81 (1.25)	6.33 (1.44)	5.50 (1.23)	5.93 (1.28)	5.05 (1.13)	5.61 (1.23)	4.71 (1.17)
GH5D	6.18 (3.79)	5.70 (3.38)	6.07 (2.86)	5.69 (3.05)	6.03 (2.77)	5.51 (2.56)	5.94 (2.91)	5.22 (2.27)	5.68 (3.03)	4.68 (2.38)

[1] The growth rates are defined as follows: GIBES, the mean I/B/E/S consensus five-year earnings forecast; GSB, the Salomon Brothers' projected 5-year normalized growth; GVLD, the Value Line 3 to 5-year forecasted growth in dividends; GVLE, the Value Line 3 to 5-year forecasted growth in earnings; and GHD5, 5-year historical growth in dividends.

[2] The price-earnings ratio is calculated for each company using the year-ending closing price divided by the I/B/E/S consensus estimate of primary earnings per share before extraordinary items and discontinued operations for the forthcoming year.

publications, Salomon Brothers categorizes electric utilities into two groups—those with (NUKE = 1) and those without (NUKE = 0) significant nuclear risk based upon the utilities' investment in nuclear construction relative to the value of equity and other factors.

III. Empirical Results

A. Summary Statistics

Exhibit 4 reports the means and standard deviations of the price-earnings ratios and all growth estimates for each year in the study. For comparative purposes the data are reported by nuclear risk classification, i.e., for the Nonnuclear Group the risk variable NUKE = 0 and for the Nuclear Group NUKE = 1. Of particular interest is the appreciable difference between the various FAF's for each group. For example, GSB generally exceeds GIBES for both groups. The difference, approximately 100 basis points, is statistically and potentially economically significant in all years.[8] For example,

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[7] Fortunately, the various sources of projected earnings per share and forecasted growth rates exhibited only slight correlation. Regressing the projected earnings per share on forecasted growth resulted in an average adjusted *R*-square of approximately 0.15. Thus, the effects of spurious correlation in the regression analysis presented in this paper should be minimal.

The tests were also conducted using several other definitions of earnings per share, including the most recent reported twelve-month earnings per share, which, as of the end of December was for the period from October of the previous year through September of the current year. Assuming perfect foresight, normalized earnings were also defined in an earlier version of this paper as the annual primary earning per share actually reported for the current year. These earnings are generally not available until February or March of the following year. The conclusions drawn from the use of all of these alternative definitions of earnings per share are the same as those reported in this paper. The empirical results using these alternative definitions are available from the authors upon request.

[8] For each year statistical tests were conducted to test whether each pair of forecasts was significantly different. These results are available upon request.

Exhibit 5. Estimates of Regression Coefficients for the Price-Earnings Model Using Equation (4)[a]

Variable	Regression Coefficient	Growth Estimate Used in Regression GIBES	GSB	GVLD	GVLE	GHD5
Constant	φ_1	3.09*	-0.99	1.47	3.29*	3.49*
		(0.92)	(0.99)	(0.87)	(0.85)	(0.80)
YR83	φ_2	-0.17	-0.13	-0.09	-0.10	-0.19
		(0.16)	(0.14)	(0.15)	(0.16)	(0.15)
YR84	φ_3	0.38#	0.47*	0.43*	0.41*	0.28
		(0.16)	(0.15)	(0.17)	(0.16)	(0.15)
YR85	φ_4	1.74*	1.97*	1.72*	1.80*	1.62*
		(0.17)	(0.15)	(0.15)	(0.16)	(0.16)
YR86	φ_5	3.68*	3.98*	3.70*	3.80*	3.56*
		(0.17)	(0.16)	(0.15)	(0.17)	(0.16)
D_0/E_0	β_1	6.99*	9.51*	8.84*	6.99*	6.95*
		(0.63)	(0.66)	(0.66)	(0.59)	(0.57)
g	β_2	24.01*	51.37*	22.80*	15.11*	11.70*
		(5.46)	(5.71)	(2.93)	(2.84)	(1.92)
BETA	α_1	-2.40#	-2.23#	-2.06#	-2.14#	-2.19#
		(1.03)	(0.94)	(0.97)	(1.02)	(1.00)
NUKE	α_2	-0.84*	-0.63*	-0.79*	-0.83*	-0.87*
		(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
BOND2	α_3	-0.49*	-0.28*	-0.50*	-0.61*	-0.41*
		(0.11)	(0.10)	(0.10)	(0.11)	(0.11)
BOND3	α_4	-1.12*	-0.62*	-1.19*	-1.32*	-1.04*
		(0.17)	(0.17)	(0.16)	(0.17)	(0.17)
Logged Likelihood Function		-388.79	-361.35	-369.86	-384.57	-380.45
Adjusted R^2		0.80	0.83	0.82	0.80	0.80

[a]Standard errors in parentheses.

*Significant at the 0.01 level.

#Significant at the 0.05 level.

a 100 basis point difference in the recommended cost of equity translates into a change in revenue requirements in excess of $2.0 billion per year for the electric utility industry.[9]

B. Estimation

The models in Equations (2) and (3) are estimated by pooling the data across companies and time periods. As is common when pooling cross-section and time-series data, dummy variables are also added to allow the intercept term to vary for each year (e.g., see Maddala [25, Chapter 14]). The dummy variables are included to allow for yearly changes in variables, such as general capital market conditions and investor behavior, which are not explicitly included in Equations (2) and (3), and are maintained to result in an additive shift in the overall level of all firms' price-earnings ratios. With the inclusion of the time dummy variables and the risk variables discussed in Section II, the final formulation of Equation (2) is

$$\frac{P_0}{E_0} = \varphi_1 + \varphi_2 YR83 + \varphi_3 YR84 + \varphi_4 YR85 + \varphi_5 YR86 + \beta_1 \frac{D_0}{E_0} + \beta_2 g + \alpha_1 BETA + \alpha_2 NUKE + \alpha_3 BOND2 + \alpha_4 BOND3 + \epsilon, \tag{4}$$

where,

$YR83$ = 1 if 1983, 0 otherwise;
$YR84$ = 1 if 1984, 0 otherwise;
$YR85$ = 1 if 1985, 0 otherwise;
$YR86$ = 1 if 1986, 0 otherwise; and

all other variables are as previously defined.

A reformulation similar to Equation (4) is also applied to Equation (3).

The regression model in Equation (4) is structured such that the intercept term, φ_1, captures the combined effects of a utility with either a "Aaa" or "Aa" bond rating, BOND1 = 1, and a company with no nuclear risk, NUKE = 0. Therefore, the bond rating regression parameters α_3 and α_4 measure, respectively, the mean differences between the price-earnings ratio P_0/E_0 of utilities with "A" and "Baa" rated bonds relative to those with "Aaa" or "Aa" rated bonds holding all else constant. Likewise, the regression parameter α_2 measures the differences between the mean price-earnings ratios of utilities with nuclear risk relative to companies without such risk, again holding all other factors constant.

C. The Results

Exhibit 5 reports selected statistics from estimation of Equation (4) using each of the growth estimates and the I/B/E/S proxy for normalized earnings per share.[10] Only the results using the I/B/E/S proxy for normalized earnings are reported since the conclusions drawn from the empirical findings are the same regardless of the proxy for normalized earnings.[11] The results in Exhibit 5 indicate that Equation (4) is a reasonable model of the electric utilities' price-earning ratios with the signs of all the estimated regression coefficients as expected. For example, β_2 shows that utilities with higher expected growth rates, holding all else constant, have higher price-earnings ratios. Also, the negative coefficient for α_2 indicates that utilities with significant nuclear risk have, on average, price-earnings ratios approximately 0.90 lower than utilities without such risk. The negative coefficients for α_3 and α_4, for "A" and "Baa" rated bonds, respectively, indicate that utilities with lower bond ratings exhibit lower price-earnings ratios (approximately 0.5 lower for "A" and 1.0 lower for "Baa" rated bonds). The results also show that the regression coefficient α_1 for BETA is, as expected, negatively related to the price-earnings ratio. Finally, the coefficients for the yearly dummy variables are consistent with the significantly upward trend in the sample companies' price-earnings ratios over the sample period (see summary statistics for *P/E* ratio in Exhibit 4).

Exhibit 6 reports the calculated pairwise likelihood ratio tests and is arranged such that the calculated likelihood ratios correspond to tests of the informational content of the growth estimates in Column 1 relative to the growth estimates in Columns 2 through 6. The results in Exhibit 6 show that when the informational content of GIBES is tested relative to all other growth estimates, all calculated likelihood ratios are significant at the 0.01 level (see Row 1). (Because of the serious economic consequences which could result from the incorrect rejection of the null hypotheses and the large number of pairwise tests, the probability of Type I error is set at 0.01.) For example, when the

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[9] Salomon Brothers [35] reports $133 billion of common equity outstanding as of June 30, 1986 for their 100 Electric Utilities. Using a marginal tax rate of 40% (federal and state), a 100 basis point difference in the recommended cost of equity would translate into a $2.22 billion [($133 billion × 1%)/ (1 - 40%)] difference in annual revenue requirements.

[10] The regression estimates for the reformulated version of Equation (4) are available upon request.

[11] The results using the Salomon Brothers and Value Line proxy for normalized earnings are available upon request.

Exhibit 6. Pairwise Likelihood Ratio Tests of the Informational Content of Alternative Proxies for Growth Rate in the Constant Growth Model[1]

	Calculated Likelihood Ratio Tests[2]				
	GIBES	GSB	GVLD	GVLE	GHD5
(1)	(2)	(3)	(4)	(5)	(6)
(1) GIBES	N/A	56.32*	40.20*	11.72*	17.80*
(2) GSB	1.44	N/A	8.12*	10.48*	1.42
(3) GVLD	2.34	25.14*	N/A	3.78	2.18
(4) GVLE	3.28	56.92*	33.20*	N/A	25.44*
(5) GHD5	7.12*	39.62*	23.36*	17.20*	N/A

*Significant at the 0.01 level.

[1] The growth rates are defined as follows: GIBES, the mean I/B/E/S consensus 5-year earnings forecast; GSB, the Salomon Brothers' projected 5-year normalized growth; GVLD, the Value Line 3 to 5-year forecasted growth in dividends; GVLE, the Value Line 3 to 5-year forecasted growth in earnings; and GHD5, 5-year historical growth in dividends.

[2] Significant likelihood ratio tests indicate that the growth rate in Columns (2)–(6) contains information not incorporated in the growth rate in Column (1). The ratio tests are chi-squared distributed with 1 degree of freedom. The critical test values are 3.84 at the 0.05 level of significance, and 6.63 at the 0.01 level.

informational content of GIBES is compared to the Salomon Brothers growth rate, GSB, the calculated likelihood ratio equals 56.32 (see Row 1, Column 3) which is highly significant, indicating that GSB contains information not incorporated in GIBES. Conversely, when the informational content of all the other growth estimates is tested relative to GIBES (see Column 2), only GHD5 is significant. For example, when testing the hypothesis that GIBES contains information not found in GSB, the calculated likelihood ratio equals 1.44 (see Row 2, Column 2), which is insignificant. This suggests that the I/B/E/S growth estimate does not contain any information not already found in GSB. The overall results indicate that all alternative growth estimates contained information not incorporated in GIBES (Row 1), whereas GIBES only contained some information not in GHD5 (Column 2). Consequently, maintaining that Equation (2) represents investors' pricing behavior for the sample utilities, the results suggest that GIBES was not the best proxy.

If the set of all possible growth estimates is restricted to only those analyzed in this study, the results suggest that for the sample utilities, investor expectations are best proxied from some combination of GSB and GVLD. The hypothesis that GSB contained all information included in other growth rates is rejected when tested relative to GVLE and GVLD, whereas the hypotheses for all growth rates are rejected when tested relative to GSB. In addition, the hypothesis that GVLE includes all information is rejected when tested against all other growth estimates including GVLD, whereas the hypothesis the GVLD contains all information is not rejected when tested against GVLE. This finding provides supports, therefore, for the use of some type of combined financial analyst forecast for estimating the constant growth term.[12]

Additional analyses were performed comparing the combined informational content of GSB and GVLD relative to the information contained in various combinations of GIBES, GVLE, and GHD5. When testing the hypothesis that the combination of GSB and GVLD contains more information than the combinations of *(i)* GIBES and GVLE, *(ii)* GIBES and GHD5, and *(iii)* GVLE and GHD5, the calculated likelihood ratios are 56.66, 39.56, and 34.28, respectively, which are all highly significant. In testing the hypotheses that these three combined forecasts contain information not already incorporated in GSB and GVLD, all likelihood ratio tests were insignificant. As an additional test, the hypothesis that the combination of GSB and GVLD contains more information than the combination of GIBES, GVLE, and GHD5 was also tested resulting in a likelihood ratio of 34.10, which is again highly significant. Finally, the combination of GIBES, GVLE, and GHD5 was found not to contain any information in addition to that incorporated in GSB and GVLD.

D. Performance of the I/B/E/S Consensus Forecast

The performance of the consensus forecast, GIBES, is possibly explained by several factors. First, GIBES

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[12] Insights into the weights to assign to GSB and GVLD to derive the optimal growth estimate, g^*, are provided from the estimated regression coefficients, β_2^* for GSB and β_2^{**} for GVLD, from the reformulated version of Equation (4) by letting $g^* = wGSB + (1 - w)GVLD$, and maintaining the hypothesis that $\beta_2^* = w\beta_2$ and $\beta_2^{**} = (1 - w)\beta_2$. The estimate for w is $(\beta_2^*/\beta_2^{**})/(1 + \beta_2^*/\beta_2^{**})$. The estimated coefficients for β_2^* and β_2^{**} equal 37.54 and 10.50, respectively, resulting in an estimate of w of approximately 80% for GSB and 20% $(1 - w)$ for GVLD.

equally weights each individual analyst's forecast to obtain the consensus forecast. However, studies (e.g., [13, 19]) of other economic variables indicate that in an optimal forecast the weights assigned to individual forecasts are usually unequal. Since GSB and GVLE are often included in the derivation of GIBES, the results suggest that it may be that the equal weighting scheme is suboptimal. Furthermore, the finding that an individual forecast such as GSB comes close to including all information found in the other forecasts is consistent with the findings in the other studies (e.g., [16, 26]) that have examined forecasts of macroeconomic variables. These studies show that in cases where the combined forecast is derived using incorrect weights, it is possible for a good individual forecast to actually outperform the combined forecast.

Another possible limitation of the I/B/E/S consensus data which has been noted in the literature (e.g., [17, 21]) is that the forecasts contained in the I/B/E/S consensus forecast may not represent each source's most recent forecast. To the extent that there is a lag in collecting the most recent forecasts, GIBES may not incorporate all relevant current information.

The I/B/E/S data used in this study were usually made publicly available the Thursday of the third week of December. The Salomon Brothers forecast, GSB, was prepared at the end of each November and was published in the *Electric Utility Monthly* usually within the first week of December. Since this study uses end-of-month December price and earnings data, the published GSB was approximately one month old and may not have represented Salomon Brothers most recent unpublished forecast. (See [1] for an examination of the impact on stock prices from releasing revisions of analysts' forecasts to select clients before making them available to the general public.) Also, for some of the utilities in the sample the Value Line forecasts were approximately two months old. Hence, considering the timing of the release of the Salomon Brothers and Value Line data, the performance of GIBES relative to GSB and GVLE cannot be fully explained by the possibility that the I/B/E/S consensus data did not contain all the most recent forecasts.[13]

E. Financial Analysts' Forecast vs. Historical Growth

The results in Exhibit 6 also provide additional evidence of the superiority of FAF's over historical growth based forecasts. The results show that all financial analysts' forecasts contain a significant amount of information used by investors in the determination of share prices not found in the historical growth rate GHD5. However, the historical growth rate, GHD5, also contains information not incorporated in GIBES and GVLE.

It seems somewhat paradoxical that the financial analysts' forecasts GIBES and GVLE would not contain all the information found in the readily available historical growth rate GHD5. However both GIBES and GVLE are forecasts of growth in earnings, not dividends. The information incorporated in a rational earnings forecast need not include information found in historical dividend growth, even if such information is incorporated in stock prices, unless historical dividend growth also contains information pertaining to future growth in earnings. However, it would be expected that a rational forecast of future growth in dividends would at least incorporate any information found in historical dividend growth rates. Exhibit 6 shows that the Value Line's forecasted dividend growth rate, GVLD, contains all the information in the historical growth rate, GHD5, and more.

Finally, GSB always contains information not found in GHD5 and GHD5 does not contain information not already incorporated in GSB. Since GSB is, for the sample companies, a part of the appropriate proxy for g, the results indicate that an estimate comprised wholly of FAF's is preferable to one based solely on historical growth rates, or a combination of historical growth rates and FAF's. These findings are consistent with those in [8, 37]. However Newbold, Zumwalt, and Kannan [30] compared ARIMA model forecasts to Value Line's, and found that combining forecasts increased forecasting ability.

IV. Summary and Conclusion

Consensus analysts' forecasts are being increasingly used as proxies for investor expectations. Exclusive use of a consensus forecast assumes that it incorporates all information relating to equity valuation contained in alternative proxies. This assumption is of critical im-

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[13] As pointed out by a referee, the I/B/E/S consensus growth forecasts are a mixture of both arithmetic and geometric growth rates and, therefore, it may be argued that their comparison to individual analyst's forecasts is unfair. However, as also noted by the referee, such criticism is moot since I/B/E/S forecasts are purchased by analysts, regulators, and companies who use I/B/E/S as an alternative to other forecasts.

portance both in investor research and in regulatory rate setting proceedings where consensus forecasts are often used to establish cost of equity recommendations. Using an approximation to a constant growth valuation model, this study examined the informational content of the commonly used I/B/E/S consensus growth forecast relative to selected individual analyst's forecasts provided by Salomon Brothers and Value Line. Historical growth rates were also examined. The analyses were performed for a group of electric utilities.

Within the limitations of the empirical pricing model used in the study the results indicate, for the sample of utilities examined, that the I/B/E/S consensus forecast did not contain all relevant information. Instead, the selected individual analysts' forecasts consistently contained significant amounts of information not reflected in the consensus data. The results demonstrate that in research and regulatory proceedings, analyses similar to that performed in this study should be conducted to establish the adequacy of forecasts used as proxies for growth. Finally, the results provide additional evidence that historical growth rates are poor proxies for investor expectations; hence, they should not be used to estimate utilities' cost of equity capital.

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