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Evidence on Surrogates for Annual Earnings
Expectations Within a Capital Market Context

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ABSTRACT

This study compared the abilities of statistical model forecasts versus financial analyst forecasts to serve as surrogates for market expectations of quarterly and annual earnings per share. We extended previous research in terms of our sample, the statistical models considered, by introduciing methodological refinements, and by controlling for timing advantages favoring financial analysts.

The market association tests indicate that for annual earnings expectations the financial analysts forecasts more closely surrogate the capital markets' expectation than do the statistical models. On the other hand, similar tests indicated that neither of these two sources of forecasts is dominant with respect to interim earnings.

Additional tests were performed on the null hypothesis that the financial analysts exploit all information used by the time-series models. The data indicate rejection of this hypothesis for both annual and interim forecasts. Finally, forecast error analysis supports previous research in finding that analysts' forecasts are more accurate than those of statistical models. However, this superiority disappears after controlling for hypothesized timing advantages favoring the analysts.

EVIDENCE ON SURROGATES FOR ANNUAL EARNINGS EXPECTATIONS WITHIN A CAPITAL MARKET CONTEXT

A substantial body of accounting research has relied on expectations or forecasts of earnings or earnings per share. This is expecially true in the capital market/informational content area. Examples of such studies are those of Ball and Brown [1968], Beaver [1968], Beaver and Dukes [1972], Brown and Kennelly [1972], Joy et al. [1977] and Kiger [1972].

The importance of the choice of the forecast used in capital market research designs has been widely recognized. For example, Foster [1977, p. 2] wrote "choice of an inappropriate [forecast] model (one inconsistent with the time series) may lead to erroneous inferences about the information content of accounting data." This fact has contributed to motivating a large number of studies comparing accuracy of competing sources of earnings forecasts. Some have focused on the relative forecast accuracy of statistical models (e.g., Brown and Rozeff [1979], Griffin [1977], Lorek [1979] and Watts [1975]). Others have focused on forecast accuracy of financial analysts versus statistical models (e.g., Brown and Rozeff [1978] and Collins and Hopwood [1980]). These and other studies have provided evidence that the financial analysts provide expectations of earnings which are substantially more accurate than those generated by the statistical models examined thus far.

While information on forecast accuracy has, to a degree, served as a measure of the usefulness of a given source of forecasts, a number of researchers (e.g., Brown and Kennelly [1972], Foster [1977], Watts [1978] and Fried and Givoly [1982] have noted that a more direct approach to evaluating a forecast source is to examine the association between its forecast error and abnormal security returns. For example, Brown and Kennelly [1972, p. 104] write:

> This experimental design permits a direct comparison between alternative forecasting rules . . . The . . . contention is based on the hypothesis (and evidence) that the stock market is "both efficient and unbiased in that, if information is useful in forming capital asset prices, then the market will adjust asset prices to the information quickly and without leaving any opportunity for further abnormal gain" (Ball and Brown [1968]. There is, then a presumption that the consensus of the market reflects, at any point, an estimate of future EPS which is the best possible from generally available data. Since the abnormal rate of return measures the extent to which the market has reacted to errors in its previous expectations, <u>the abnormal rate of return can be used to assess the predictive accuracy of any device which attempts to forecast a number that is relevant to investors</u>. [Emphasis added]

Along these lines, Foster [1977] investigated several models for quarterly earnings and found that a model with both seasonal and non-seasonal components best represented the market expectation for earnings, where the "best expectation" was measured in terms of association between model error and risk adjusted returns. Using similar methods, Brown and Kennelly [1972] found that certain quarterly models generated better surrogates of capital market expectations than those generated from annual models.

The purpose of the present study is therefore to further investigate the issue of financial analysts versus statistical model expectations within a capital market context. <u>The most significant aspect of our research is that is considers interim earnings on a quarter-by-quarter basis using daily security returns</u>. To our knowledge, there has been little or no previous research comparing, within a capital market context, single financial analyst forecasts to those generated from statistical models within an interim context. However, there are a number of other major contributions involved in the present study. In a general sense, relative to previous research, we consider a broader set of (18) statistical models. We also provide certain critical improvements in the areas of sampling restrictions and design methodology. Finally, we investigate the possibility that at least some of the previously reported advantage of Analysts' forecasts over statistical models might be attributed to a timing advantage.[1]

The remainder of this paper consists of five sections. The first sets forth in detail the contribution of our study relative to previous research. Section two summarizes the eighteen statistical expectation models. Sections three and four give annual and quarterly forecast results, respectively. The last section includes a summary and conclusions.

THE CONTRIBUTION OF THE PRESENT STUDY RELATIVE TO PREVIOUS RESEARCH

The present study improves on previous research by providing contributions in four broad areas. These are: 1) Financial analyst forecasts are incorporated into the design, and we present capital market results for forecast comparisons between analyst and statistical models for both interim and annual earnings forecasts, 2) A number of specific methodological refinements (some of which we view as critical) are made, 3) We considerably broaden the set of statistical models used. Our broader set includes multivariate time-series models and those that exploit interim data, and, 4) We extend previous research by investigating the hypothesis that financial analyst forecast superiority over statistical models can be accounted for by a timing advantage. Each of these areas is discussed individually.

Financial Analysts Forecasts and Interim Earnings

Previous studies comparing various forecasts in a capital market context have typically either: 1) not incorporated financial analyst forecasts, or 2) not incorporated abnormal returns for interim periods. The present study therefore incorporates a very broad set of statistical model forecasts, financial analyst forecasts and capital market results for interim earnings. As stated above this is a major contribution of the present research. The present section reviews the relevant aspects of several major publications in this area of research.

The studies of Bathke and Lorek [1984], Brown and Kennelly [1972] and Foster [1977] showed, among other things, that different expectation models provide forecast errors with varying degrees of association with risk adjusted returns. However, none of these studies included forecasts of financial analysts which, as cited above, have been shown to produce the most accurate forecasts. The present study includes this source of forecasts.

Also of importance is the Fried and Givoly [1982] study which compared association between abnormal returns and annual forecast errors from both statistical models and financial analysts. Their study included forecasts from Standard and Poor's Earnings Forecaster (financial analysts) and two statistical models: a variation on the Ball and Brown [1968] index model and a random walk model with drift. Their overall results (p. 97) indicated a correlation between abnormal returns and annual forecast errors to be .33 for the analysts and .27 for the two statistical models. The authors noted, however, that their results have limited generality. First, they only considered firms for which at least four contemporaneous forecasts were available in the Earnings Forecaster. They noted that this led to exclusion of firms to which relatively less attention was given by analysts. Second they considered only two time series models, both of which do not exploit interim earnings information, whereas the analysts are able to use this information. This is important since Hopwood, McKeown and Newbold [1982] found that the disaggregated interim earnings have more information than the annual earnings alone.

An additional limitation of the Fried and Givoly [1982] study is that it focused on annual as opposed to interim earnings. In the previous paragraph it was indicated that the models used to predict annual earnings did not use quarterly data for parameter estimation. The point here is that object of prediction was annual as opposed to interim earnings. Therefore, in this respect, the interim results in this paper are an extension of Fried and Givoly [1982].

A final problem with the previous literature is that many studies have not controlled for timing advantages pertinent to analyst forecasts. In particular, analysts' forecasts are released throughout the entire year and sometimes right before the earnings announcement. It should be no surprise that forecasts released relatively close to the announcement date are more accurate than those generated by statistical models that generate forecasts made from different base points in time.

Methodological Refinements

Our methodology parallels that of Fried and Givoly ([1982], henceforth FG) in comparing the abilities of statistical model forecasts versus financial analyst forecasts to serve as surrogates for market expectations of annual earnings per share. However, in addition to addressing different research questions, we included a larger number of statistical models that are more representative of those contained in the current accounting literature. We also incorporated a number of other methodological refinements. First, we utilized the actual announcement dates of the firms' earnings in computing the abnormal returns. FG used the more restrictive and potentially biasing assumption that earnings for all firms were announced at the end of February.

Second, we used Spearman correlations to avoid distriubtional problems. FG cited the investigation of Beaver, Clark and Wright [1979] as justification for using the correlation coefficient as a measure of association between forecast error and abnormal return. However, they used the Pearson correlation whereas Beaver, Clark and Wright investigated only the use of the Spearman correlation. This difference is important because it is well known that forecast error distributions based on percentage accuracy metrics are nonnormal and highly skewed.

Third, we avoid the use of the weighted API statistic which we show (see Appendix A) is heavily influenced by bias. The issue of bias is important because for the FG data, the analysts have an overall negative bias (over-prediction) in excess of 5% whereas the two statistical models have a substantially smaller bias, less than 1.5%. The negative bias for the analysts forecasts combined with the overall negative CAR for their data produces a situation where the numerator in the weighted API, (equation 3, Appendix A) is likely to be biased upward by causing an excessively high number of positive cross products in the numerator as compared to what would be obtained from the numerator of (equation 4, Appendix A) which adjusts for bias. Similarly the weighted API statistics for their index model are likely to be understated because of a positive bias. Of course, we would expect the biasing effect to be larger for the analysts since the magnitude of the bias in their forecast was larger.

We note also the possible impact of bias on FG's frequency analysis (p. 96) which measured (in a 2 x 2 table for each forecast method) cases where the signs of the forecast errors were consistent with the signs of cumulative abnormal returns. One explanation why the analysis did better for their negative CAR cases was that they simply had far more forecast errors less than zero (630 versus 483 and 444). We avoid all of these problems by simply using the Spearman rank correlation coefficient, as originally suggested by Beaver, Clark and Wright [1979]. We do not use the other measures of association because of the problems stated above.

Fourth, the present study uses a market based methodology to directly assess the relative ability of different models to surrogate the market expectation. FG did not directly address this question. (It appears that they were primarily interested in addressing a different question, as discussed below.) This contrasts to the FG study is that they computed the following set of partial correlations:

(A) $R(E, FAF \mid MSM)$

(B) $R(E, FAF \mid IM)$

(C) $R(E, FAF \mid MSM, IM)$

(D) $R(E, MSM \mid FAF)$

(E) $R(E, IM \mid FAF)$

where E denotes the realized earnings, FAF, IM and MSM denote forecasted earnaings for the financial analysts, index model and modified submartingale models respectively. Their data indicated that (A), (B) and (C) were all nonzero while (D) and (E) were typically not different from zero. This led them to conclude (p. 100) that analysts use autonomous information and also fully exploit the time-series and cross sectional properties of the earnings series that are captured by the MSM and IM.

We note that these partial correlation tests relate only indirectly to the surrogation issue for market expectations, since risk adjusted returns are not included. Furthermore, ranking models based on the correlation between their forecasts and realized earnings can be misleading if the forecasts are biased. An example of this problem can be seen from the hypothetical situation where a forecast method results in forecasts exactly double the realized earnings. If this occurs for all firms in a given year, there will be a correlation of 1, but this forecast method clearly would not be preferred to a method that had a correlation of .9, but with no bias. Of course, if the bias of the former method is stable over time, one could adjust the forecasts by dividing by two. If this were possible, the former method would be preferred. The problem is that FG made such adjustments (p. 92) without any reduction in forecast error, thus indicating a lack of stability in bias over time.

Timing Advantage

As previously discussed, financial analysts have a potential timing advantage over statistical models (henceforth SM's). SM forecasts are effectively made based on information up to and including the most recent earnings announcement. For example, consider a forecast of the third quarter's earnings made one quarter into the future. A model that uses interim earnings will incorporate the second quarter's earnings. Therefore, this forecast is effectively made at the time of the second quarter's earnings announcement date.

In the present example, the analyst's timing advantage arises because the analyst's forecast will typically be made after the second quarter's announcement. In fact the analyst's forecast might even be released within the two weeks before the third quarter's earnings release. The present study controls for this timing advantage by explicitly considering (in terms of the present example) the number of days of timing advantage.

Statistical Expectations Models

The present study uses a broad set of 18 statistical expectation models (discussed in a separate section) that forecast both interim and annual earnings. This broad set of models removes at least three limitations found in previous literature. First, as discussed above, models forecasting interim earnings serve as a basis for comparing interim forecasts of financial analysts versus statistical models within a capital market context. Second, the incorporation of interim earnings into the model forecasting annual earnaings allows the statistical model access to a broader information set than used by studies (e.g., FG) incorporating only annual data. This is important because interim data can improve forecast accuracy for annual earnings (Hopwood, McKeown and Newbold [1982]). Third, we use multivariate time series models which can incorporate market information and simultaneously exploit the time series properties of the earnings series.

MODELS PREVIOUSLY USED IN THE LITERATURE

Earnings expectation models can be classified as univariate and multivariate. We use the term multivariate to include models which consider the structural relationship between two or more variables. In addition these models can be further classified as to those based solely on annual data versus those based on quarterly data; therefore, producing four categories of models. Each of these categories is discussed invididually.

Multivariate Models Using Annual Data

These include the model of Ball and Brown [1968] who regressed an index of annual market earnings changes against the annual earnings changes of individual firms. This model is of the form:

$$(1)\quad (y_t - y_{t-1}) = \alpha+\beta(x_t - x_{t-1}) + e_t$$

Where y_t represents the annual earnings of the firm, x_t represents a market-wide earnings index, and t is a time subscript denoting a particular year. Also, α and β are estimated using historical data.

Multivariate Models Using Quarterly Data

Similarly, Brown and Kennelly [1972] used the same model as Ball and Brown but applied it to quarterly, instead of annual, data. Henceforth, these will be referred to as the BB and BK models.[2]

A priori, both the BB and BK models have the advantage of defining expected earnings relative to the market's earnings. This type of expectation eliminates the effect of market fluctuations on the individual firm expectations. As long as a firm maintains a constant earnings relation to the market from period to period, unexpected earnings will be zero.

On the other hand, neither of these models explicitly models earnings performance of a firm relative to previous performance for the same firm. In other words, the times-series properties of earnings are not explicitly modeled. The BK model also ignores the fact that firm earnings are seasonally correlated and therefore is likely to have a problem of seasonally auto-correlated residuals.

To address these and other problems Hopwood and McKeown [1981] introduced two single input transfer function-noise models (henceforth HM1 and HM2) which, within a bivariate time-series context, structurally relate a market index of earnings to the individual firm's earnings. The two models are of the form:

$$(1)\quad y_t - y_{t-4} = \theta_o + \omega_o\,(x_t - x_{t-4}) + \phi_1 n_{t-1} + \theta_4 a_{t-4} + a_t$$

$$(2)\quad y_t - y_{t-4} = \theta_o + \omega_o\,(x_t - x_{t-4}) + \theta_4 \omega_o\,[(x_t - x_{t-4}) - (x_{t-1} - x_{t-5})] + \phi_1 n_{t-1} + \theta_4 a_{t-4} + a_t$$

Where y_t denotes quarterly adjusted earnings per share, x_t denotes an index of market earnings, $[\theta_i, \omega_o, \phi_1]$ are model parameters, a_t is an uncorrelated residual series, and n_t is the noise series or the error from the transfer function part of the model.

Actual versus Forecasted Index Models

Note that all of the bivariate models (i.e., HM1, HM2, BK and BB) can be based on either a forecasted or actual index. We have therefore added the HM1F, HM2F, BKF and BBF models which are based on a forecasted index. Henceforth we shall refer to the latter type of models as FI (Forecasted Index) models, and the HM1, HM2, BK and BB models as AI (Actual Index) models.

The question arises as to whether the AI or FI models are the more appropriate models for investigation. One might argue that AI model forecasts aren't really forecasts at all since they rely on knowing an index value that exists in the same period to which the forecast relates. Nevertheless, this use of the term "forecast" is well entrenched in the literature. Therefore, the present paper seeks to differentiate between the objectives of the two kinds of forecasts rather than debate nomenclature.

Univariate Models Using Quarterly Data

Unlike the bivariate regression models, univariate models ignore the firm's relation to the market (or other indicators) but explicitly model the time-series properties of the earnings number. Collins and Hopwood [1980] studied the major univariate time-series models found in recent literature. These include: (1) a consecutively and seasonally differenced first order moving average and seasonal moving average model (Griffin [1977] and Watts [1975]), (2) a seasonally differenced first order auto-regressive model with a constant drift term (Foster [1977]), and (3) a seasonally differenced first order auto-regressive and seasonal moving average model (Brown and Rozeff [1978, 1979]). In the

Box and Jenkins terminology, these models are designated as (0,1,1) x (0,1,1), (1,0,0) x (0,1,0) and (1,0,0) x (0,1,1) respectively. In this study, they are referred to as the GW, F, and BR models. Collins and Hopwood [1980] found that the BR and GW models produced annual forecasts which were more accurate than the F model. In addition, they concluded that they also did at least as well as the more costly individually identified Box-Jenkins (BJ) models. Most important, they found the analysts' forecasts significantly more accurate than all of the univariate models examined.

Univariate Models Using Annual Data

The results of a large number of studies provide a substantial amount of evidence that annual earnings follow a random walk (henceforth RW) or a random walk with a drift. Support for this conclusion comes from Ball and Watts [1972], Beaver [1970], Brealy [1969], Little and Rayner [1965], Lookabill [1976] and Salamon and Smith [1977]. In addition, Albrecht et al. [1977] and Watts and Leftwich [1977] found that full Box-Jenkins analysis of individual series did not provide more accurate forecasts than those of the random walk or random walk with drift.

Synthesis

The above models are summarized in Figure 1.

Figure 1

		Data Used for Estimation: Annual	Data Used for Estimation: Quarterly
Structure:	Univariate	BJ RW-Drift I	BR GW BJ F II
	Multivariate	BB III	HM1 HM2 BK IV

Previous research has focused on comparing models within Category II (e.g., Collins and Hopwood [1980] and Brown and Rozeff [1979]), within Category I (e.g., Watts and Leftwich [1977]), or between Categories II and IV (Hopwood and McKeown [1981]). Relatively little attention has been devoted to comparing models between (I, III) and (II,IV), in spite of the fact that models in both of these sets have been used to forecast the same objective, annual earnings. The present research investigates all four categories[3] (and in addition financial analysts forecasts), thereby providing a unified framework for model evaluation.

ANNUAL FORECASTS

Sample

The sample in this study includes all firms which met the following criteria:

1. Quarterly earnings available on Compustat for all quarters for the period 1962-1978 with fiscal year ending in December for each year in that period.
2. <u>Value Line Investment Survey</u> forecasts available from the period 1974-1978.[4]
3. Monthly market returns available on the CRSP tape from 1970 through 1978.

These restrictions resulted in a sample of 258 firms.[5]

The first criterion assured that a sufficient number of observations (17 years or 68 quarters) were available for time series modeling. Based upon the Box-Jenkins [1970] rule of thumb requiring approximately 50 observations, 20 time-series models were estimated for each firm based on 48, 49, ..., 67 observations. In other words, the first model estimation used data for the 48 quarters beginning at the first quarter of 1962 and ending with the 4th quarter of 1973. The next model incorporated data from the first quarter of 1962 through the first quarter of 1974.

<u>Application of the Models to the Capital Market</u>

The market model of the form:

$$(2) \quad E[\ln(1 + R_{it} - R_{ft})] = \alpha_i + \beta_i \ln(1 + R_{mt} - R_{ft})$$

was estimated, where (2) is the log form of the Sharp-Lintner [Lintner, 1965] capital asset pricing model[6] and R_{it} represents the return on asset i in period t, R_{mt} represents the return on a value-weighted market index in period t and R_{ft} is the risk free (treasury bill) rate of return in period t. The estimation of α_i and β_i was done using ordinary least squares regression for each year in the hold-out period. The estimations were performed in each case by including monthly data for the 5 years preceding the hold-out year. The sum of the residuals (post-sample forecast errors) from these models when applied to the hold-out years (the twelve months up to and including the annual earnings announcement date) constitute risk-adjusted abnormal returns. The market index used was the value-weighted market index containing dividend and price returns as supplied on the CRSP tape.[7]

The next phase was to estimate the association between the unexpected annual earnings from the earnings expectation models and the annual cumulative abnormal returns (CAR's). (These were computed by adding the monthly returns.) This approach was outlined by Foster [1977, p. 13]:

> This analysis examines whether there is an association between unexpected earnings changes and relative risk adjusted security returns. Given a maintained hypothesis of an efficient market, the strength of the association is dependent on how accurately each expectation model captures the market's expectation.....

Foster applied this approach assuming a long investment given that the unexpected earnings was positive and a short investment given that it was negative. He then proceeded to measure the abnormal returns for different forecast methods given this investment strategy.

Subsequent to Foster's research, Beaver, Clarke and Wright [1979] showed that the magnitude of the unexpected earnings is an important determinant of the size of the associated abnormal return (also see Joy et al. [1977]). Furthermore, these empirical results were supported by the analytical work of Ohlson [1978]. We therefore measured association via Spearman's rank correlation between the scaled ((Actual - Predicted)/|Predicted|) unexpected earnings of the individual models and the residuals (annual CAR) and averaged these results across 4 hold-out years.

ANNUAL FORECAST RESULTS

Forecast accuracy results were computed, based on mean absolute relative errors for all of the models discussed in Section 1. For each quarterly model the mean annual errors are given for forecasts made 4, 3, 2 and 1 quarters prior to year end. For 4 quarters prior to year end, the annual forecast is the sum of the forecasts for each of the one through four quarters ahead. For 3 quarters prior to year end, the annual forecast is the actual first quarter earnings plus forecasts of the second, third and fourth quarter's earnings. Therefore, realizations were substituted for forecasts as the end of the year approached. Also, all of the statistical forecast models were reestimated and reidentified as new quarters of earnings became available.

Model Performance

Table 1 gives the forecast errors, based on the mean absolute relative error, defined as the average of $|(\text{actual-predicted})/(\text{actual})|$. Each column represents errors for different quarters relative to year end. Note in column 1 (which represents four quarter ahead annual forecast errors) that the financial analysts forecasts are most accurate. This superior forecast accuracy is consistent with many other studies (e.g., Brown and Rozeff [1978]) and is therefore no surprise. Therefore these data simply confirm that our sample does not differ substantially in this respect from other studies. We also note that among the time series models using quarterly data, the HM1 model has the lowest average error for four quarter ahead forecasts. However, it is also important to note that the difference between the best and worst -

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TABLE 1 ABOUT HERE

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(other than BBF) of these models is fairly small. Also it appears (consistent with Collins and Hopwood [1980]) that the differences between all forecast methods tend to decrease as the year end approaches.

Capital Market Results

Tables 2 through 4 give the rank correlations (as defined above) between forecast errors and abnormal returns. In each table, each forecast method is associated with 2 lines of data. The first line gives the rank correlation and the second line the associated t values for the null hypothesis of a zero correlation. Note in Table 2 that the analysts have the highest association in each of the test years. Also the right hand column of Table 2 indicates that (for the ranks pooled across years) the analyst association is substantially higher than that of all of the statistical models.

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TABLES 2 THROUGH 4 ABOUT HERE

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Table 3 gives the rank correlations between risk adjusted returns and model errors with the analyst errors held constant. This shows that the model forecast errors have no consistent pattern of association with abnormal return beyond that which is explained by the analysts. On the other hand, Table 4 strongly indicates that the analyst errors have a significant association with abnormal returns even when the model errors are partialled out (models are partialled out one at a time).

Finally, note in Table 2 that the BBF and BKF models have substantially lower rank correlations, thus indicating that the market does react at the individual firm level to forecast errors for the index.

Rank Correlations Between Actual Earnings and Forecasts

Tables 5 through 7 present results comparable to those in Tables 2 through 4, but using actual earnings instead of abnormal returns, and forecasted earnings instead of forecast errors. We present these numbers

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TABLES 5 THROUGH 7 ABOUT HERE

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for comparability to Fried and Givoly [1982], though, as discussed above, there are limitations to their interpretation. The most significant aspect of this analysis is Table 6 which indicates that virtually all of the models appear to have significant explanatory power beyond that of the analysts. Note, however, that these results do not carry over into a capital market context (i.e., they are inconsistent with Table 3). There are at least two possible explanations for this finding. The first is (as discussed in Section 1) that there are problems with the statistics. If this is the case, then our data indicate that this correlation is not a good surrogate for the capital market based statistic used in Tables 2 through 4. A second explanation is that the analysts do not utilize all information available and exploited by the statistical models.

If the latter is true, then an interesting hypothesis <u>may</u> also be true. That is, the analyst forecasts are (at least for our sample years and models) the best surrogate for the market expectation even though they are not optimal. One possible explanation for this is that the analysts' expectations strongly influence (or even completely determine) the market expectation, even when not optimal.

QUARTERLY FORECAST RESULTS

Tables 8 through 14 are direct analogs of tables 1 through 7, but are based on quarterly (as opposed to annual) forecasts. Table 8 gives forecast errors for forecast horizons extending 1, 2, 3 and 4 quarters into the future. Tables 9, 10 and 11 give correlations between forecast errors and CAR. Finally, tables 12, 13 and 14 give correlations between forecasts and reported earnings.

Overall, the quarterly forecast error results in Table 8 are similar to the annual results reported in the previous section. The analysts consistently produce the most accurate forecasts. For example, for one quarter ahead forecasts the average analyst error is .2804 while the next best average is .3450 for the HM2 model. In summary, these results are consistent with previous literature supporting superiority of analysts forecasts.

Table 9 indicates a consistent pattern of significant association between the forecasts of all forecast methods and CAR. These data are again consistent with our annual forecast data. Table 10 reports the correlation between the statistical model forecast error and CAR after controlling for the financial analyst forecast error. These data indicate for the large part that the statistical models do retain some marginal association with CAR, even after controlling for the analyst forecast error. For example, the GW model has significant (alpha=.05, one tailed) t-values in 14 out of the 20 quarters (i.e., quarters 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17, 18, 20).

Table 11 presents the correlations between analyst forecast errors and CAR with the model forecast errors partialled out. These data indicate an overall pattern of significance, but there are many cases where the t-values are small. For example, for the GW model the t-value is significant at alpha=.05 in only 9 out of the 20 quarters. Therefore, taken together tables 10 and 11 are consistent with the hypothesis that the analyst forecasts do not uniquely capture the markets' expectations for earnings. Furthermore, the large number of significant correlations in table 10 are supportive of the hypothesis that the statistical model forecasts have incremental explanatory power relative to analyst forecasts in terms of explaining CAR.

Tables 12, 13 and 14 represent results similar to Tables 9, 10 and 11, but forecasts are correlated with actual earnings. As expected, Table 12 shows that forecasts and earnings are highly correlated. However, note that Table 13 contains a large number of significant correlations. For example the t-values are significant (alpha=.05) for the GW model in 17 out of the 20 quarters. Therefore these data are consistent with the hypothesis that the analysts' forecasts do not fully exploit the univariate time-series properties of reported quarterly earnings. Similarly, the results of Table 14 support the hypothesis that the time-series models do not fully exploit the information available to the analysts.

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TABLES 8 THROUGH 14 ABOUT HERE

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<u>Timing Advantage Hypothesis</u>

The present section investigates the hypothesis that the advantage of analysts over statistical models is due to a timing advantage. Such a possibility arises because analysts typically make their forecasts closer to the announcement date of the target earnings than do the statistical models. Consider, for example, forecasts of the second quarter's earnings. The statistical models rely on the first (and previous) quarter's earnings and are therefore effectively made from the date that the first quarter's earnings are announced (although using only information through the end of the first quarter). However, in this case the analyst forecast will often be made weeks later. Therefore, there exists the possibility that the findings of "superiority" in favor of the analysts can be accounted for by this timing advantage (based on the analysts' opportunity to observe economic events in the second quarter before making the forecast).

To test for a timing advantage, we first investigate the correlation between the difference ≡ (BJ absolute relative forecast error - Analyst absolute relative forecast error) and the number of days separating these two forecasts.[8] If there is an analyst timing advantage then this correlation should have a tendency to be positive in each of the 20 quarters of our data sample. In other words, we would expect that a larger number of days separating the analyst forecast from the model forecast would be associated with a larger timing advantage. Table 15 presents this correlation statistic for each of the 20 quarters over the sample period. Note that the correlations are positive in all 20 quarters. Under the null hypothesis of no timing advantage, a simple sign test rejects the null hypothesis at the .01 level. Furthermore, the individual correlations are significant at the .05 level in 12 cases. Overall, Table 15 is supportive of an analyst timing advantage.

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INSERT TABLE 15 ABOUT HERE

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To further investigate the timing advantage hypothesis and to provide an alternative statistical approach, we also partition the quarterly forecast accuracy results based on the number of days of timing advantage. Tables 16 through 20 give these results for 5 separate equal sample size sub-partitions (Appendix B gives specifics on the timing advantages associated with each sub-partition.) Table 16, the first sub-partition, includes cases where the analyst timing advantage is the least. Going from Table 16 to Table 20 the timing advantage increases and is largest in Table 20. Table 16 reveals that, in contrast to the sample as a whole, the analyst forecasts are no longer the most accurate after controlling for the timing advantage,. Note that in the one-quarter-ahead case the analyst forecasts are no more accurate than those of the BR and four HM models. Furthermore, in the four quarter ahead case the analyst forecasts are not more accurate than any of the model forecasts, including those of the BK forecasts which are generally quite poor (e.g.,) in the one-quarter-ahead case the BK forecast errors are almost twice as large as the BR forecast errors). Note on the other hand in the partition where the analyst timing advantage is at a maximum (Table 20) that the analyst forecast errors are consistently smaller than those of all models. This is true for all forecast horizons, ranging from one to four quarters into the future.

Summary and Conclusions

This study investigated the use of statistical model forecasts versus financial analyst forecasts as surrogates of capital market expectations for both interim and annual earnings per share. In addition, this study provides extensions to previous research by: incorporating fairly broad sampling constraints, including a very general set of statistical models, making certain critical methodological refinements and controlling for financial analysts' timing advantages.

The empirical results for annual earnings indicated that the financial analysts' forecast errors were more highly associated with risk adjusted security returns than the forecast errors of statistical models. In addition, the partial correlations between analyst errors (controlling for the statistical model forecast errors) and risk adjusted security returns were generally non-zero. On the other hand, the partial correlations between the statistical model forecast errors (controlling for the analyst forecast error) and risk adjusted security returns were not statistically significantly different from zero. These data are consistent with the hypothesis that, in a capital market context, the analysts' forecasts more closely approximate the markets' expectation for annual earnings.

Similar tests were conducted for interim earnings forecasts. Both sets of partial correlations described in the previous paragraph were non-zero. Of particular interest is that the data indicated that the partial correlations between risk adjusted security returns and statistical model forecasts (controlling for the analyst forecast error) were typically non-zero. These data are consistent with the hypothesis that analyst forecasts do not uniquely surrogate for the markets' expectation of interim earnings.

We also investigated the association between earnings and forecasts. In both cases the partial correlations between statistical model forecasts and reported earnings were usually non-zero. These data are consistent with the hypothesis that the financial analysts do not fully exploit the information contained in previously published time series data.

Finally, the empirical forecast accuracy results were consistent with previous literature and overall the financial analysts produced the most accurate forecasts. This was true for both interim and annual forecast errors. However, detailed analysis of the interim forecasts indicated that the advantage of the financial analysts were essentially due to a timing advantage. After controlling for the timing advantage the analysts' forecasts were no longer the most accurate forecasts.

Table 1
Mean Absolute Relative Error
(Truncated at 1)

Model	Annual Forecasts Beginning With Quarter 1	2	3	4
Griffin-Watts	.2679	.2149	.1543	.1047
Griffin-Watts with Constant	.2767	.2193	.1618	.1072
Foster	.2651	.2183	.1642	.1147
Foster with Constant	.2665	.2180	.1645	.1148
Brown-Rozeff	.2640	.2150	.1502	.1053
Brown-Rozeff with Constant	.2601	.2087	.1495	.1047
Box-Jenkins	.2654	.2224	.1560	.1021
Brown-Kennelly	.3150	.2922	.1785	.1273
Brown-Kennelly (FI)	.3035	.2934	.1775	.1324
Hopwood-McKeown 1 (AI)	.2550	.2048	.1500	.1017
Hopwood-McKeown 1 (FI)	.2606	.2059	.1521	.1041
Hopwood-McKeown 2 (AI)	.2631	.2112	.1510	.1032
Hopwood-McKeown 2 (FI)	.2623	.2142	.1514	.1026
Analyst	.2248	.1845	.1359	.0780
Ball-Brown (AI)	.2508			
Ball-Brown (FI)	.5173			
Random Walk	.2610			
Random Walk with Drift	.2562			

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Table 2
Rank Correlation of Annual Forecast Error with CAR

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	.3107	.2780	.2324	.2184	.2606
	4.8485	4.3419	3.7776	3.4667	8.2813
Griffin-Watts with Constant	.2748	.2794	.2129	.2645	.2600
	4.2399	4.3641	3.4452	4.2483	8.2585
Foster	.3513	.2715	.1229	.3162	.2607
	5.5654	4.2323	1.9582	5.1629	8.2827
Foster with Constant	.3202	.2757	.1269	.3286	.2597
	5.0141	4.3016	2.0231	5.3903	8.2500
Brown-Rozeff	.3696	.2460	.2198	.2778	.2777
	5.8990	3.8074	3.5629	4.4800	8.8689
Brown-Rozeff with Constant	.3867	.2288	.2235	.3143	.2883
	6.2197	3.5263	3.6260	5.1297	9.2372
Box-Jenkins	.3645	.2519	.2039	.2299	.2604
	5.8062	3.9036	3.2924	3.6599	8.2746
Brown-Kennelly (AI)	.2286	.2825	.1789	.2473	.2363
	3.4822	4.4181	2.8746	3.9533	7.4611
Brown-Kennelly (FI)	.1801	.2289	.1407	.2601	.2065
	2.7163	3.5276	2.2462	4.1739	6.4752
Hopwood-McKeown 1 (AI)	.2709	.2660	.3195	.3587	.3134
	4.1736	4.1398	5.3305	5.9537	10.1226
Hopwood-McKeown 1 (FI)	.1997	.2784	.1449	.3624	.2500
	3.0226	4.3482	2.3162	6.0239	7.9188
Hopwood-McKeown 2 (AI)	.3713	.2514	.2829	.2946	.3027
	5.9312	3.8962	4.6633	4.7752	9.7430
Hopwood-McKeown 2 (FI)	.3346	.2256	.1840	.2989	.2609
	5.267	3.4736	2.9595	4.8524	8.2910
Ball-Brown (AI)	.3242	.3028	.1841	.4399	.3133
	5.0839	4.7652	2.9612	7.5883	10.1208
Ball-Brown (FI)	.0902	.1595	.1452	-.0261	.0979
	1.3430	2.4240	2.3210	-.4044	3.0188
Random Walk	.3651	.2721	.0595	.4267	.2740
	5.8174	4.2411	.9429	7.3088	8.7397
Random Walk with Drift	.3477	.2771	.0711	.4321	.2764
	5.4996	4.3257	1.1268	7.4223	8.8234
Analyst	.4731	.3279	.3750	.4833	.4184
	7.9647	5.2069	6.3958	8.5523	14.1316

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 3

Partial Rank Correlation of Model Annual Forecast Error with CAR
(Analyst Forecast Error Held Constant)

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	-.0646	.1042	.0905	-.0151	.0427
	-.9586	1.5686	1.4345	-.2328	1.3095
Griffin-Watts with Constant	-.0707	.1074	.0638	.0649	.0519
	-1.0488	1.6166	1.0093	1.0057	1.5929
Foster	-.0057	.0778	-.0041	.0538	.0345
	-.0845	1.1684	-.0644	.8325	1.0572
Foster with Constant	-.0519	.0835	-.0025	.0593	.0302
	-.7695	1.2542	-.0394	.9181	.9260
Brown-Rozeff	.0289	.0363	.0497	-.0093	.0317
	.4284	.5437	.7854	-.1432	.9726
Brown-Rozeff with Constant	-.0062	-.0133	.0245	.0182	.0140
	-.0923	-.1985	.3861	.2822	.4282
Box-Jenkins	-.0048	.0444	.0140	-.0113	.0123
	-.0704	.6645	.2211	-.1749	.3756
Brown-Kennelly (AI)	-.0814	.1360	.1362	.0609	.0825
	-1.2092	2.0549	2.1698	.9432	2.5381
Brown-Kennelly (FI)	-.0889	.0743	.0634	.0799	.0456
	-1.3204	1.1151	1.0023	1.2393	1.4002
Hopwood-McKeown 1 (AI)	-.2088	.0929	.1294	.0744	.0584
	-3.1600	1.3968	2.0598	1.1529	1.7949
Hopwood-McKeown 1 (FI)	-.2256	.0840	-.0491	.0792	-.0134
	-3.4270	1.2617	-.7753	1.2283	-.4094
Hopwood-McKeown 2 (AI)	-.0219	.0538	.1184	.0170	.0593
	-.3240	.8070	1.8819	.2627	1.8212
Hopwood-McKeown 2 (FI)	-.0905	-.0046	-.0193	.0189	-.0122
	-1.3452	-.0695	-.3039	.2922	-.3737
Ball-Brown (AI)	-.1973	.1009	-.0826	.1118	.0005
	-2.9783	1.5181	-1.3081	1.7400	.0139
Ball-Brown (FI)	-.1606	.0611	.0446	-.2865	-.0661
	-2.4082	.9166	.7046	-4.6227	-2.0323
Random Walk	-.1541	.0244	-.2040	.0927	-.0615
	-2.3086	.3657	-3.2874	1.4388	-1.8899
Random Walk with Drift	-.1672	.0379	-.1798	.1024	-.0500
	-2.5095	.5678	-2.8841	1.5909	-1.5360

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 4

Partial Rank Correlation of Analyst Annual Forecast Error with CAR
(Model Forecast Error Held Constant)

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	.3801	.2080	.3147	.4420	.3414
	6.0810	3.1828	5.2309	7.6180	11.1365
Griffin-Watts with Constant	.4057	.2077	.3217	.4236	.3430
	6.5684	3.1785	5.3611	7.2287	11.1959
Foster	.3385	.2057	.3570	.3885	.3406
	5.3231	3.1464	6.0308	6.5176	11.1051
Foster with Constant	.3707	.2022	.3557	.3792	.3409
	5.9072	3.0898	6.0065	6.3358	11.1175
Brown-Rozeff	.3190	.2265	.3150	.4118	.3271
	4.9818	3.4800	5.2368	6.9854	10.6135
Brown-Rozeff with Constant	.2956	.2416	.3098	.3871	.3169
	4.5786	3.7267	5.1411	6.4899	10.2449
Box-Jenkins	.3239	.2213	.3218	.4369	.3394
	5.0658	3.3962	5.3625	7.5093	11.0617
Brown-Kennelly (AI)	.4318	.2192	.3587	.4321	.3636
	7.0848	3.3629	6.0642	7.4068	11.9673
Brown-Kennelly (FI)	.4518	.2518	.3561	.4280	.3743
	7.4943	3.8933	6.0131	7.3213	12.3757
Hopwood-McKeown 1 (AI)	.4460	.2188	.2429	.3539	.2973
	7.3735	3.3552	3.9504	5.8496	9.5454
Hopwood-McKeown 1 (FI)	.4824	.1984	.3525	.3510	.3468
	8.1502	3.0299	5.9448	5.7957	11.3353
Hopwood-McKeown 2 (AI)	.3164	.2238	.2810	.4012	.3083
	4.9363	3.4367	4.6204	6.7722	9.9361
Hopwood-McKeown 2 (FI)	.3648	.2443	.3329	.3983	.3390
	5.7986	3.7711	5.5713	6.7140	11.0487
Ball-Brown (AI)	.4079	.1658	.3414	.2481	.2920
	6.6115	2.5156	5.7313	3.9600	9.3611
Ball-Brown (FI)	.4875	.2961	.3519	.5441	.4132
	8.2622	4.6391	5.9327	10.0244	13.9111
Random Walk	.3545	.1918	.4165	.2665	.3339
	5.6110	2.9242	7.2282	4.2749	10.8602
Random Walk with Drift	.3765	.1863	.4052	.2598	.3302
	6.0149	2.8380	6.9935	4.1600	10.7266

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 5

Correlation of Annual Forecast to Actual EPS

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	.6248	.6502	.7521	.7384	.7018
	11.8702	12.8367	18.0430	16.9628	30.2178
Griffin-Watts with Constant	.6275	.6763	.7480	.7135	.7002
	11.9548	13.7701	17.8173	15.7737	30.0826
Foster	.6163	.6511	.7352	.7124	.6882
	11.6089	12.8666	17.1513	15.7255	29.0996
Foster with Constant	.6073	.6480	.7278	.7171	.6847
	11.3385	12.7614	16.7814	15.9404	28.8204
Brown-Rozeff	.6064	.6854	.7475	.7245	.7006
	11.3118	14.1189	17.7903	16.2822	30.1205
Brown-Rozeff with Constant	.5937	.6731	.7318	.7402	.6948
	10.9430	13.6507	16.9780	17.0531	29.6322
Box-Jenkins	.5981	.6829	.7228	.7027	.6851
	11.0689	14.0223	16.5369	15.3001	28.8533
Brown-Kennelly (AI)	.5986	.6922	.7045	.6930	.6792
	11.0835	14.3857	15.6940	14.8915	28.3867
Brown-Kennelly (FI)	.6058	.7107	.7283	.6890	.6909
	11.2942	15.1553	16.8038	14.7287	29.3129
Hopwood-McKeown 1 (AI)	.5833	.6956	.7270	.7400	.6961
	10.6521	14.5238	16.7420	17.0438	29.7430
Hopwood-McKeown 1 (FI)	.5895	.6622	.7173	.7371	.6863
	10.8239	13.2557	16.2757	16.8967	28.9472
Hopwood-McKeown 2 (AI)	.5891	.7139	.7241	.7437	.7014
	10.8132	15.2944	16.5998	17.2369	30.1902
Hopwood-McKeown 2 (FI)	.6056	.7073	.7290	.7434	.7048
	11.2887	15.0090	16.8379	17.2178	30.4729
Ball-Brown (AI)	.5700	.7099	.7129	.7072	.6835
	10.2884	15.1192	16.0747	15.4976	28.7265
Ball-Brown (FI)	.3733	.1500	.1908	.4252	.2879
	5.9685	2.2754	3.0728	7.2783	9.2229
Random Walk	.5672	.6196	.7478	.7090	.6741
	10.2162	11.8420	17.8110	15.5737	27.9954
Random Walk with Drift	.5695	.6197	.7410	.7161	.6744
	10.2761	11.8453	17.4476	15.8957	28.0213
Analyst	.5960	.7371	.7945	.7193	.7226
	11.0078	16.3604	20.6841	16.0395	32.0648

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 6

Partial Correlation of Model Annual Forecasts to Actual EPS
(Analyst Forecast Held Constant)

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	.2673	.0389	.3610	.4131	.2820
	4.1050	.5827	6.1089	7.0122	9.0109
Griffin-Watts with Constant	.2851	.0942	.3498	.3432	.2756
	4.4019	1.4155	5.8919	5.6486	8.7913
Foster	.2453	.0129	.3456	.2949	.2325
	3.7440	.1926	5.8112	4.7714	7.3295
Foster with Constant	.2226	.0128	.3319	.3057	.2256
	3.3792	.1912	5.5511	4.9637	7.1000
Brown-Rozeff	.2194	.1113	.3003	.3531	.2530
	3.3284	1.6767	4.9687	5.8337	8.0170
Brown-Rozeff with Constant	.1647	.0761	.2357	.3535	.2113
	2.4713	1.1425	3.8268	5.8415	6.6276
Box-Jenkins	.1999	.1354	.2098	.3117	.2165
	3.0198	2.0452	3.3862	5.0709	6.7984
Brown-Kennelly (AI)	.2483	.1919	.3232	.3242	.2715
	3.7929	2.9260	5.3886	5.2980	8.6494
Brown-Kennelly (FI)	.2702	.2066	.3977	.3137	.2985
	4.1534	3.1606	6.8390	5.1079	9.5898
Hopwood-McKeown 1 (AI)	.1529	.1993	.1624	.3343	.2093
	2.2903	3.0442	2.5967	5.4829	6.5611
Hopwood-McKeown 1 (FI)	.1959	.0363	.2632	.3239	.2093
	2.9564	.5441	4.3055	5.2934	6.5623
Hopwood-McKeown 2 (AI)	.1732	.1854	.2079	.3768	.2370
	2.6026	2.8232	3.3536	6.2890	7.4797
Hopwood-McKeown 2 (FI)	.2102	.1373	.2307	.3733	.2411
	3.1825	2.0748	3.7409	6.2203	7.6157
Ball-Brown (AI)	.0938	.2340	.1063	.2053	.1528
	1.3948	3.6026	1.6867	3.2424	4.7390
Ball-Brown (FI)	.2074	.1508	.1236	-.0432	.0999
	3.1368	2.2834	1.9660	-.6679	3.0776
Random Walk	.0693	-.0814	.2575	.2123	.1227
	1.0279	-1.2221	4.2045	3.3509	3.7896
Random Walk with Drift	.0804	-.0686	.2511	.2383	.1318
	1.1936	-1.0287	4.0934	3.7939	4.0762

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 7

Partial Correlation of Analyst Annual Forecast to Actual EPS
(Model Forecast Held Constant)

Model	1974	1975	1976	1977	POOLED
Griffin-Watts	.1332	.4583	.5114	.3461	.3651
	1.9893	7.7171	9.3916	5.7037	12.0231
Griffin-Watts with Constant	.1507	.4073	.5150	.3644	.3658
	2.2566	6.6743	9.4816.	6.0492	12.0489
Foster	.1507	.4554	.5414	.3245	.3757
	2.2557	7.6559	10.1601	5.3033	12.4311
Foster with Constant	.1702	.4614	.5496	.3150	.3822
	2.5560	7.7832	10.3816	5.1314	12.6823
Brown-Rozeff	.1709	.3865	.4895	.3329	.3485
	2.5672	6.2712	8.8589	5.4581	11.4003
Brown-Rozeff with Constant	.1766	.4122	.5000	.2567	.3427
	2.6550	6.7710	9.1111	4.1065	11.1850
Box-Jenkins	.1902	.3999	.5116	.3731	.3762
	2.8669	6.5291	9.3955	6.2172	12.4502
Brown-Kennelly (AI)	.2388	.3944	.5868	.4111	.4223
	3.6396	6.4227	11.4340	6.9719	14.2824
Brown-Kennelly (FI)	.2359	.3413	.5821	.4142	.4090
	3.5929	5.4345	11.2956	7.0348	13.7399
Hopwood-McKeown 1 (AI)	.2132	.3877	.4881	.2289	.3369
	3.2288	6.2943	8.8259	3.6346	10.9690
Hopwood-McKeown 1 (FI)	.2229	.4333	.5413	.2326	.3690
	3.3840	7.1947	10.1586	3.6980	12.1727
Hopwood-McKeown 2 (AI)	.2051	.3170	.5081	.2706	.3348
	3.1013	5.0027	9.3088	4.3460	10.8945
Hopwood-McKeown 2 (FI)	.1633	.3214	.5048	.2674	.3252
	2.4488	5.0794	9.2269	4.2903	10.5423
Ball-Brown (AI)	.2309	.3602	.5084	.2740	.3521
	3.5118	5.7785	9.3156	4.4039	11.5346
Ball-Brown (FI)	.5319	.7372	.7894	.6418	.6958
	9.2964	16.3279	20.2892	12.9389	29.7012
Random Walk	.2320	.5134	.4676	.2708	.3705
	3.5289	8.9536	8.3472	4.3498	12.2311
Random Walk with Drift	.2276	.5118	.4834	.2560	.3723
	3.4593	8.9172	8.7128	4.0934	12.2986

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero ($t \geq 1.645$ indicates significance at $\alpha = .05$ for a one-tailed test)

Table 8

Mean Absolute Relative Quarterly Forecast Errors
(Truncation at 3)

Model	FORECASTS HORIZON 1	2	3	4
Griffin-Watts	.3548	.4117	.4439	.4723
Griffin-Watts with Constant	.3717	.4302	.4620	.4901
Foster	.3700	.4290	.4515	.4762
Foster with Constant	.3744	.4343	.4570	.4814
Brown-Rozeff	.3402	.3909	.4207	.4394
Brown-Rozeff with Constant	.3456	.3957	.4224	.4389
Box-Jenkins	.3614	.4040	.4243	.4435
Brown-Kennelly (AI)	.4502	.5169	.5229	.4555
Brown-Kennelly (FI)	.4531	.5163	.5342	.4591
Hopwood-McKeown 1 (AI)	.3485	.3941	.4127	.4241
Hopwood-McKeown 1 (FI)	.3484	.4033	.4279	.4430
Hopwood-McKeown 2 (AI)	.3503	.3984	.4200	.4381
Hopwood-McKeown 2 (FI)	.3450	.3946	.4250	.4382
Analyst	.2804	.3669	.3978	.4336

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Table 9

Rank Correlation of Quarterly Forecast Error with CAR

Model	Quarter 1	2	3	4	5	6	7	8	9	10
Griffin-Watts	.2365	.1558	.2175	.2920	.2569	.1959	.3960	.1565	.2348	.2370
	3.8181	2.4745	3.4946	4.7789	4.1697	3.1330	6.7806	2.4859	3.7815	3.8256
Griffin-Watts with Constant	.2235	.1778	.2870	.3166	.2554	.2028	.4343	.1624	.1867	.2412
	3.5972	2.8340	4.6985	5.2251	4.1433	3.2409	7.5614	2.5810	2.9749	3.8986
Foster	.1504	.1528	.2440	.3159	.2368	.2100	.3607	.2316	.3375	.2671
	2.3863	2.4251	3.9466	5.2115	3.8220	3.3697	6.0666	3.7341	5.6116	4.3467
Foster with Constant	.1548	.1719	.2492	.3204	.2415	.2172	.3685	.2414	.3400	.2739
	2.4582	2.7376	4.0359	5.2940	3.9031	3.4900	6.2170	3.9016	5.6580	4.4670
Brown-Rozeff	.2213	.1602	.2094	.2407	.1945	.1184	.3844	.1595	.2219	.1614
	3.5598	2.5450	3.3586	3.8809	3.1094	1.8709	6.5309	2.5346	3.5620	2.5658
Brown-Rozeff with Constant	.2512	.2207	.2397	.2264	.1834	.1300	.3824	.1301	.2247	.1522
	4.0704	3.5494	3.8717	3.6386	2.9262	2.0561	6.4916	2.0574	3.6096	2.4157
Box-Jenkins	.2592	.2377	.2221	.2349	.2271	.1514	.3214	.0934	.1968	.1615
	4.2005	3.8385	3.5722	3.7834	3.6581	2.4030	5.3236	1.4710	3.1420	2.5664
Brown-Kennelly (AI)	.0685	.2149	.2249	.0495	.0805	-.0733	.2577	.1218	-.1128	.1862
	1.0772	3.4517	3.6194	.7753	1.2674	-1.1530	4.1826	1.9239	-1.7777	2.9721
Brown-Kennelly (FI)	-.0045	.3138	.2073	.2161	.0839	-.0572	.2669	.1283	.2273	.1803
	-.0700	5.1840	3.3228	3.4649	1.3204	-.8989	4.3435	2.0296	3.6531	2.8750
Hopwood-McKeown 1 (AI)	.2521	.1147	.2451	.0664	.1510	.0875	.3547	.1191	.0715	.1779
	4.0867	1.8108	3.9647	1.0410	2.3961	1.3774	5.9501	1.8807	1.1217	2.8347
Hopwood-McKeown 1 (FI)	.1192	.1632	.2468	.2538	.2162	.1254	.3677	.1429	.4103	.1743
	1.8826	2.5947	3.9943	4.1078	3.4735	1.9832	6.2008	2.2646	7.0419	2.7761
Hopwood-McKeown 2 (AI)	.3062	.1511	.2578	.1195	.1542	.0792	.3937	.1295	-.0592	.1687
	5.0445	2.3979	4.1851	1.8840	2.4483	1.2464	6.7177	2.0478	-.9281	2.6845
Hopwood-McKeown 2 (FI)	.2103	.1900	.2456	.2091	.1617	.1009	.3981	.1761	.2568	.1704
	3.3735	3.0346	3.9740	3.3463	2.5707	1.5912	6.8064	2.8063	4.1597	2.7116
Analyst	.1053	.2107	.2259	.1797	.1387	.0869	.3128	.1201	.2731	.2343
	1.6605	3.3810	3.6364	2.8596	2.1967	1.3675	5.1647	1.8976	4.4431	3.7793

Table 9 Continued

Model	Quarter 11	12	13	14	15	16	17	18	19	20
Griffin-Watts	.1829	.2315	.0983	-.2278	.2095	.1407	.1848	.2270	.0677	.1664
	2.9184	3.7327	1.5500	-3.6700	3.3603	2.2287	2.9492	3.6556	1.0638	2.6469
Griffin-Watts with Constant	.1626	.1550	.0557	-.1828	.2109	.1354	.1561	.2077	.0973	.2426
	2.5839	2.4601	.8749	-2.9157	3.3840	2.1440	2.4784	3.3294	1.5338	3.9222
Foster	.1757	.1653	.0425	-.0254	.2546	.2490	.1982	.1446	.2156	.2374
	2.7995	2.6280	.6669	-.3987	4.1297	4.0322	3.1720	2.2926	3.4630	3.8330
Foster with Constant	.1741	.1669	.0390	-.0155	.2763	.2526	.2005	.1616	.2167	.2451
	2.7730	2.6555	.6115	-.2425	4.5089	4.0950	3.2095	2.5681	3.4813	3.9658
Brown-Rozeff	.1277	.1859	.0632	-.1916	.1639	.1362	.1674	.1494	.0064	.1337
	2.0192	2.9681	.9925	-3.0621	2.6064	2.1563	2.6629	2.3704	.1010	2.1160
Brown-Rozeff with Constant	.1181	.2053	.0739	-.2174	.2172	.1232	.1580	.1969	-.0265	.1472
	1.8659	3.2896	1.1629	-3.4936	3.4898	1.9465	2.5093	3.1491	-.4156	2.3338
Box-Jenkins	.2343	.1320	-.0019	-.1667	.2053	.1707	.1986	.2420	.0164	.1326
	3.7795	2.0892	-.0291	-2.6514	3.2909	2.7167	3.1775	3.9111	.2569	2.0980
Brown-Kenelly (AI)	.2212	.1269	-.0279	-.1505	.2229	.0407	-.0666	.1328	-.0761	.1340
	3.5577	2.0061	-.4371	-2.3880	3.5856	.6384	-1.0468	2.1023	-1.1976	2.1202
Brown-Kennelly (FI)	.3092	.1285	-.0471	-.2141	.2166	.0483	-.0932	.1778	-.0191	.1037
	5.0994	2.0322	-.7392	-3.4379	3.4805	.7577	-1.4689	2.8332	-.3000	1.6353
Hopwood-McKeown 1 (AI)	.1495	.1742	.0442	-.1182	.2321	.1496	.2207	.1660	-.0122	.1857
	2.3710	2.7741	.6938	-1.8665	3.7431	2.3726	3.5497	2.6410	-.1918	2.9636
Hopwood-McKeown 1 (FI)	.2505	.1788	.0352	-.1693	.2330	.1477	.2029	.1729	.0399	.1815
	4.0589	2.8506	.5521	-2.6937	3.7582	2.3421	3.2499	2.7525	.6264	2.8950
Hopwood-McKeown 2 (AI)	.0673	.1684	.0583	-.1680	.2128	.1675	.2028	.2010	-.0432	.1899
	1.0576	2.6795	.9160	-2.6733	3.4167	2.6641	3.2477	3.2178	-.6783	3.0340
Hopwood-McKeown 2 (FI)	.1093	.1583	.0485	-.2034	.2070	.1626	.1918	.1932	-.0229	.1667
	1.7240	2.5153	.7620	-3.2591	3.3178	2.5841	3.0649	3.0886	-.3592	2.6521
Analyst	.1399	.1391	.1154	.0804	.2482	.1129	.1165	.2361	.0614	.1747
	2.2155	2.2037	1.8216	1.2654	4.0193	1.7819	1.8397	3.8103	.9656	2.7831

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero

Table 10

Partial Rank Correlation of Quarterly Model Forecast Error with CAR
(Analyst Forecast Error Held Constant)

Model	Quarter 1	2	3	4	5	6	7	8	9	10
Griffin-Watts	.2130	.0192	.1157	.2345	.2214	.1802	.2784	.1059	.1124	.1455
	3.4126	.3012	1.8228	3.7677	3.5534	2.8677	4.5377	1.6676	1.7674	2.3017
Griffin-Watts with Constant	.1983	.0582	.2044	.2650	.2190	.1871	.3285	.1145	.0362	.1508
	3.1668	.9130	3.2683	4.2936	3.5139	2.9808	5.4435	1.8041	.5665	2.3872
Foster	.1142	.0081	.1402	.2644	.1976	.1948	.2361	.1995	.2463	.1811
	1.7999	.1263	2.2172	4.2823	3.1546	3.1084	3.8027	3.1862	3.9705	2.8831
Foster with Constant	.1188	.0344	.1465	.2699	.2025	.2034	.2446	.2110	.2503	.1887
	1.8725	.5385	2.3177	4.3789	3.2374	3.2517	3.9486	3.3787	4.0391	3.0081
Brown-Rozeff	.1958	.0137	.1037	.1706	.1494	.0844	.2636	.1105	.0961	.0543
	3.1249	.2137	1.6324	2.7047	2.3642	1.3251	4.2770	1.7407	1.5086	.8510
Brown-Rozeff with Constant	.2311	.0978	.1353	.1525	.1349	.0985	.2525	.0712	.0872	.0345
	3.7175	1.5389	2.1382	2.4104	2.1303	1.5488	4.0854	1.1166	1.3672	.5402
Box-Jenkins	.2388	.1338	.1159	.1667	.1861	.1247	.1735	.0290	.0424	.0500
	3.8500	2.1130	1.8260	2.6412	2.9649	1.9666	2.7572	.4534	.6630	.7835
Brown-Kennelly (AI)	.0406	.1545	.1709	-.0195	.0471	-.1162	.1662	.0662	-.1887	.0985
	.6367	2.4473	2.7154	-.3051	.7381	-1.8311	2.6382	1.0390	-3.0019	1.5487
Brown-Kennelly (FI)	-.0337	.2511	.1401	.1492	.0439	-.0936	.1727	.0738	.1533	.0902
	-.5284	4.0610	2.2148	2.3570	.6875	-1.4720	2.7437	1.1584	2.4226	1.4172
Hopwood-McKeown 1 (AI)	.2319	-.0514	.1439	-.0329	.1111	.0458	.2069	.0557	-.0785	.0632
	3.7312	-.8063	2.2763	-.5135	1.7496	.7182	3.3093	.8736	-1.2294	.9913
Hopwood-McKeown 1 (FI)	.0812	.0131	.1415	.1874	.1731	.0924	.2280	.0910	.3272	.0576
	1.2754	.2048	2.2378	2.9800	2.7515	1.4518	3.6648	1.4310	5.4096	.9029
Hopwood-McKeown 2 (AI)	.2959	.0093	.1542	.0279	.1071	.0363	.2670	.0697	-.1909	.0752
	4.8482	.1454	2.4433	.4355	1.6861	.5687	4.3367	1.0930	-3.0374	1.1803
Hopwood-McKeown 2 (FI)	.1830	.0643	.1398	.1297	.1115	.0628	.2755	.1304	.1184	.0756
	2.9143	1.0080	2.2102	2.0440	1.7565	.9849	4.4866	2.0586	1.8625	1.1872

Table 10 Continued

Model	Quarter 11	12	13	14	15	16	17	18	19	20
Griffin-Watts	.1455	.1874	.0474	-.3021	.0943	.0906	.1491	.1369	.0429	.1063
	2.3017	2.9864	.7434	-4.9608	1.4822	1.4236	2.3594	2.1631	.6714	1.6736
Griffin-Watts with Constan	.1179	.0942	.0010	-.2570	.0890	.0845	.1145	.1061	.0777	.1949
	1.8586	1.4817	.0151	-4.1626	1.3991	1.3276	1.8045	1.6703	1.2195	3.1105
Foster	.1350	.1140	-.0156	-.0917	.1440	.2239	.1622	.0521	.2092	.1817
	2.1329	1.7968	-.2439	-1.4417	2.2782	3.5963	2.5731	.8163	3.3485	2.8920
Foster with Constant	.1323	.1158	-.0209	-.0812	.1687	.2283	.1649	.0694	.2108	.1906
	2.0893	1.8242	-.3265	-1.2758	2.6785	3.6700	2.6164	1.0882	3.3752	3.0386
Brown-Rozeff	.0800	.1319	.0076	-.2680	.0356	.0865	.1256	.0561	-.0314	.0724
	1.2560	2.0825	.1193	-4.3547	.5575	1.3595	1.9821	.8794	-.4911	1.1359
Brown-Rozeff with Constant	.0656	.1544	.0161	-.2995	.0932	.0679	.1141	.1075	-.0700	.0881
	1.0284	2.4465	.2524	-4.9130	1.4658	1.0654	1.7983	1.6920	-1.0984	1.3851
Box-Jenkins	.1972	.0652	-.0531	-.2191	.0863	.1310	.1619	.1662	-.0177	.0797
	3.1482	1.0222	-.8317	-3.5142	1.3554	2.0677	2.5686	2.6384	-.2765	1.2511
Brown-Kennelly (AI)	.1951	.0731	-.0707	-.2017	.1271	-.0071	-.1155	.0818	-.1127	.1037
	3.1134	1.1481	-1.1092	-3.2233	2.0054	-.1105	-1.8207	1.2844	-1.7761	1.6322
Brown-Kennelly (FI)	.2866	.0775	-.0883	-.2770	.1178	.0011	-.1446	.1147	-.0461	.0588
	4.6829	1.2174	-1.3868	-4.5131	1.8575	.0175	-2.2877	1.8073	-.7228	.9225
Hopwood-McKeown 1 (AI)	.0957	.1139	-.0195	-.1888	.1094	.1016	.1889	.0834	-.0559	.1336
	1.5045	1.7939	-.3050	-3.0093	1.7229	1.5979	3.0103	1.3106	-.8763	2.1096
Hopwood-McKeown 1 (FI)	.2112	.1222	-.0305	-.2515	.1069	.0990	.1678	.0797	.0081	.1267
	3.3816	1.9269	-.4775	-4.0666	1.6828	1.5572	2.6649	1.2508	.1264	1.9998
Hopwood-McKeown 2 (AI)	.0064	.1076	-.0014	-.2486	.0938	.1251	.1671	.1162	-.0920	.1356
	.1002	1.6948	-.0220	-4.0169	1.4749	1.9737	2.6534	1.8317	-1.4463	2.1422
Hopwood-McKeown 2 (FI)	.0566	.0953	-.0137	-.2840	.0828	.1187	.1538	.1028	-.0681	.1078
	.8871	1.4987	-.2147	-4.6360	1.3003	1.8714	2.4371	1.6171	-1.0678	1.6977

AI = multivariate model using actual index
I = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero

Table 11

Partial Rank Correlation of Quarterly Analyst Forecast Error with CAR
(Model Forecast Error Held Constant)

	Quarter									
odel	1	2	3	4	5	6	7	8	9	10
Griffin-Watts	-.0040	.1449	.1313	.0161	.0372	-.0382	.1106	.0318	.1815	.1409
	-.0618	2.2915	2.0724	.2511	.5834	-.5988	1.7414	.4975	2.8827	2.2271
Griffin-Watts with Constant	.0005	.1287	.0952	.0038	.0337	-.0344	.0900	.0318	.2059	.1389
	.0086	2.0306	1.4962	.0595	.5284	-.5392	1.4150	.4979	3.2869	2.1953
Foster	.0374	.1471	.1038	.0129	.0394	-.0336	.1437	.0004	.1378	.1252
	.5859	2.3270	1.6335	.2017	.6172	-.5261	2.2730	.0063	2.1740	1.9756
Foster with Constant	.0330	.1283	.0994	.0118	.0350	-.0387	.1361	-.0058	.1385	.1209
	.5166	2.0248	1.5639	.1838	.5488	-.6062	2.1509	-.0904	2.1850	1.9057
Brown-Rozeff	.0010	.1394	.1348	.0521	.0586	.0242	.1223	.0323	.1888	.1801
	.0164	2.2033	2.1296	.8144	.9181	.3791	1.9283	.5061	3.0028	2.8662
Brown-Rozeff with Constant	-.0290	.0713	.1078	.0611	.0597	.0166	.1033	.0504	.1810	.1833
	-.4534	1.1187	1.6977	.9557	.9354	.2602	1.6257	.7905	2.8750	2.9189
Box-Jenkins	-.0190	.0728	.1232	.0650	.0413	.0058	.1555	.0812	.1975	.1789
	-.2981	1.1423	1.9437	1.0180	.6471	.0903	2.4633	1.2750	3.1472	2.8457
Brown-Kennelly (AI)	.0898	.1484	.1723	.1741	.1226	.1251	.2457	.0631	.3099	.1744
	1.4111	2.3494	2.7374	2.7610	1.9331	1.9738	3.9672	.9902	5.0909	2.7729
Brown-Kennelly (FI)	.1104	.0829	.1670	.0865	.1191	.1141	.2400	.0582	.2170	.1762
	1.7388	1.3015	2.6508	1.3558	1.8778	1.7973	3.8694	.9118	3.4721	2.8025
Hopwood-McKeown 1 (AI)	-.0270	.1850	.1062	.1705	.0934	.0446	.1102	.0580	.2749	.1670
	-.4224	2.9468	1.6720	2.7028	1.4691	.6993	1.7353	.9089	4.4653	2.6518
Hopwood-McKeown 1 (FI)	.0588	.1357	.0985	.0444	.0444	.0167	.1050	.0471	.0802	.1688
	.9215	2.1443	1.5494	.6944	.6963	.2607	1.6529	.7386	1.2562	2.6808
Hopwood-McKeown 2 (AI)	-.0657	.1488	.0873	.1380	.0829	.0509	.0919	.0499	.3243	.1808
	-1.0302	2.3560	1.3718	2.1763	1.3013	.7982	1.4441	.7822	5.3546	2.8774
Hopwood-McKeown 2 (FI)	-.0015	.1128	.0992	.0715	.0736	.0358	.0965	.0130	.1520	.1794
	-.0236	1.7772	1.5596	1.1191	1.1551	.5611	1.5182	.2037	2.4020	2.8547

Table 11 Continued

	Quarter									
odel	11	12	13	14	15	16	17	18	19	20
Griffin-Watts	.0842	.0145	.0769	.2184	.1651	.0327	.0372	.1520	.0321	.1191
	1.3226	.2277	1.2074	3.5039	2.6209	.5125	.5829	2.4065	.5029	1.8776
Griffin-Watts with Constant	.0834	.0645	.1012	.2001	.1604	.0385	.0469	.1559	.0178	.0950
	1.3100	1.0112	1.5921	3.1961	2.5435	.6024	.7354	2.4696	.2790	1.4944
Foster	.0823	.0703	.1085	.1191	.1319	-.0164	.0156	.1954	-.0305	.0809
	1.2924	1.1029	1.7079	1.8778	2.0820	-.2565	.2447	3.1181	-.4782	1.2697
Foster with Constant	.0813	.0690	.1106	.1131	.1139	-.0200	.0142	.1873	-.0338	.0775
	1.2775	1.0832	1.7424	1.7815	1.7947	-.3125	.2228	2.9844	-.5289	1.2162
Brown-Rozeff	.0984	.0437	.0970	.2066	.1922	.0402	.0340	.1929	.0687	.1344
	1.5484	.6846	1.5261	3.3055	3.0652	.6294	.5321	3.0768	1.0772	2.1222
Brown-Rozeff with Constant	.0998	.0252	.0902	.2252	.1540	.0465	.0388	.1703	.0892	.1295
	1.5700	.3944	1.4183	3.6172	2.4402	.7282	.6071	2.7054	1.4022	2.0436
Box-Jenkins	.0545	.0787	.1268	.1647	.1661	.0237	.0039	.1572	.0618	.1394
	.8538	1.2360	2.0013	2.6130	2.6372	.3715	.0611	2.4922	.9692	2.2041
Brown-Kennelly (AI)	.0914	.0930	.1322	.1574	.1689	.1056	.1497	.2126	.1035	.1531
	1.4364	1.4621	2.0876	2.4955	2.6822	1.6625	2.3696	3.4054	1.6282	2.4244
Brown-Kennelly (FI)	.0706	.0943	.1372	.1966	.1706	.1022	.1604	.1943	.0744	.1529
	1.1080	1.4826	2.1678	3.1386	2.7093	1.6077	2.5437	3.1001	1.1674	2.4217
Hopwood-McKeown 1 (AI)	.0796	.0423	.1084	.1683	.1416	.0238	.0056	.1890	.0821	.1176
	1.2502	.6635	1.7070	2.6719	2.2391	.3730	.0875	3.0124	1.2894	1.8533
Hopwood-McKeown 1 (FI)	.0235	.0457	.1140	.2045	.1381	.0249	.0141	.1812	.0475	.1166
	.3680	.7161	1.7967	3.2707	2.1832	.3900	.2209	2.8836	.7436	1.8377
Hopwood-McKeown 2 (AI)	.1231	.0493	.0997	.2019	.1605	.0125	.0037	.1711	.1018	.1129
	1.9411	.7731	1.5688	3.2273	2.5444	.1954	.0576	2.7184	1.6017	1.7780
Hopwood-McKeown 2 (FI)	.1044	.0572	.1057	.2171	.1623	.0153	.0120	.1717	.0887	.1200
	1.6428	.8974	1.6633	3.4820	2.5752	.2398	.1878	2.7276	1.3941	1.8921

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: Second row of each set is t-statistic testing correlation against a null hypotheses of correlation equal to zero

Table 12

Rank Correlation on Quarterly Basis--Actual vs Forecast

Model	Quarter 1	2	3	4	5	6	7	8	9	10
Griffin-Watts	.7858	.8917	.8794	.7527	.7241	.7297	.6996	.7107	.7753	.8013
	18.8878	31.3952	29.3761	17.8951	15.7501	17.0751	15.6332	16.0674	19.4073	21.2589
Griffin-Watts with Constant	.7974	.8981	.8806	.7480	.7127	.7236	.6914	.6922	.7694	.7891
	19.6436	32.5488	29.5582	17.6418	15.2407	16.7752	15.2815	15.2539	19.0466	20.3951
Foster	.7830	.8861	.8755	.7460	.7340	.7263	.7145	.6431	.6869	.7487
	18.7141	30.4678	28.8127	17.5331	16.2115	16.9064	16.3060	13.3568	14.9456	17.9270
Foster with Constant	.7760	.8805	.8738	.7486	.7306	.7244	.7152	.6445	.6851	.7436
	18.2894	29.6090	28.5873	17.6711	16.0519	16.8134	16.3396	13.4080	14.8699	17.6569
Brown-Rozeff	.7935	.9001	.8838	.7324	.7525	.7537	.7565	.7157	.7705	.8378
	19.3810	32.9179	30.0423	16.8388	17.1371	18.3487	18.4714	16.2977	19.1109	24.3589
Brown-Rozeff with Constant	.7917	.8779	.8742	.7281	.7378	.7284	.7289	.7224	.7624	.8187
	19.2653	29.2256	28.6349	16.6262	16.3948	17.0105	17.0039	16.6172	18.6272	22.6321
Box-Jenkins	.7680	.8370	.8336	.7359	.7072	.7337	.6399	.7216	.7460	.7429
	17.8242	24.3772	24.0073	17.0110	15.0023	17.2748	13.2989	16.5784	17.7110	17.6189
Brown-Kennelly (AI)	.5623	.7595	.7864	.5499	.7066	.7229	.5245	.6029	.6189	.7433
	10.1092	18.6069	20.2475	10.3050	14.9793	16.7412	9.8375	12.0186	12.4599	17.6400
Brown-Kennelly (FI)	.6433	.7673	.8216	.6910	.7022	.7220	.5553	.5067	.6093	.7343
	12.4927	19.0679	22.9225	14.9623	14.7927	16.6968	10.6622	9.3496	12.1481	17.1721
Hopwood-McKeown 1 (AI)	.7375	.8663	.8636	.6905	.7247	.7318	.7033	.7252	.7703	.8422
	16.2344	27.6418	27.2484	14.9419	15.7756	17.1812	15.7975	16.7531	19.1004	24.7921
Hopwood-McKeown 1 (FI)	.7580	.8725	.8738	.7346	.7522	.7309	.6946	.6973	.7266	.8421
	17.2749	28.4628	28.5778	16.9486	17.1212	17.1368	15.4197	15.4747	16.7209	24.7824
Hopwood-McKeown 2 (AI)	.7496	.8721	.8561	.7003	.7799	.7364	.7207	.7010	.7273	.8448
	16.8359	28.4052	26.3459	15.3542	18.6892	17.4178	16.6001	15.6346	16.7554	25.0608
Hopwood-McKeown 2 (FI)	.7512	.8675	.8636	.7284	.7553	.7457	.7170	.7130	.7808	.8443
	16.9177	27.7884	27.2474	16.6387	17.2856	17.9046	16.4268	16.1724	19.7621	25.0063
Analyst	.8462	.8592	.8466	.8477	.8659	.8125	.8072	.7885	.8582	.8883
	23.6071	26.7621	25.3054	25.0103	25.9643	22.3036	21.8337	20.3930	26.4379	30.7114

Table 12 continued

Model	Quarter 11	12	13	14	15	16	17	18	19	20
GW	.8431	.7575	.7625	.7811	.8515	.8114	.8226	.7973	.7925	.7941
	24.7429	18.2333	18.2594	19.8166	25.9264	22.1711	22.7325	20.9287	20.5899	20.3703
Griffin-Watts with Constant	.8246	.7429	.7369	.8138	.8215	.8068	.8125	.7796	.7887	.7837
	23.0034	17.4439	16.8864	22.1856	23.0068	21.8099	21.9024	19.7201	20.3257	19.6667
Foster	.7923	.6872	.7654	.8446	.8188	.7905	.8227	.8477	.7893	.8190
	20.4922	14.8657	18.4234	24.9888	22.7775	20.6114	22.7467	25.3223	20.3681	22.2520
Foster with Constant	.7953	.6897	.7662	.8457	.8203	.7919	.8273	.8467	.7913	.8193
	20.7007	14.9701	18.4736	25.1095	22.9069	20.7110	23.1463	25.2153	20.5021	22.2776
Brown-Rozeff	.8516	.7544	.7685	.8067	.8233	.8021	.8267	.8052	.7973	.8284
	25.6340	18.0633	18.6091	21.6294	23.1597	21.4503	23.0952	21.5084	20.9282	23.0574
Brown-Rozeff with Constant	.8357	.7472	.7759	.8065	.8064	.8100	.8405	.8142	.8048	.8257
	24.0080	17.6721	19.0509	21.6098	21.7730	22.0565	24.3781	22.2175	21.4806	22.8194
Box-Jenkins	.7844	.7170	.7822	.7627	.7788	.7750	.8047	.8015	.7420	.8263
	19.9545	16.1637	19.4496	18.6823	19.8291	19.5801	21.3003	21.2343	17.5360	22.8714
Brown-Kennelly (AI)	.7214	.5935	.6157	.6373	.7534	.6668	.6826	.6707	.7072	.7525
	16.4392	11.5902	12.1036	13.1013	18.2962	14.2881	14.6801	14.3276	15.8468	17.8111
Brown-Kennelly (FI)	.6724	.5425	.5971	.5899	.7221	.6630	.6696	.6215	.7314	.6544
	14.3342	10.1492	11.5303	11.5731	16.6707	14.1425	14.1706	12.5691	16.9911	13.4907
Hopwood-McKeown 1 (AI)	.8408	.7509	.7709	.8381	.8291	.8007	.8392	.8387	.7846	.8352
	24.5065	17.8694	18.7473	24.3434	23.6839	21.3411	24.2477	24.3974	20.0490	23.6784
Hopwood-McKeown 1 (FI)	.8427	.7519	.7551	.8378	.8326	.8029	.8371	.8365	.7906	.8523
	24.6991	17.9247	17.8429	24.3122	24.0016	21.5109	24.0497	24.1820	20.4550	25.3976
Hopwood-McKeown 2 (AI)	.8138	.7316	.7813	.8134	.8118	.8125	.8480	.8210	.7970	.8539
	22.1005	16.8674	19.3921	22.1544	22.2036	22.2577	25.1497	22.7807	20.9071	25.5752
Hopwood-McKeown 2 (FI)	.8285	.7411	.7824	.8082	.8217	.8126	.8478	.8007	.8037	.8568
	23.3498	17.3456	19.4623	21.7399	23.0216	22.2668	25.1206	21.1780	21.4014	25.9061
Analyst	.8474	.8659	.8767	.8988	.8904	.9051	.8968	.9124	.8697	.9147
	25.1887	27.2095	28.2394	32.4755	31.2384	33.9909	31.8518	35.3237	27.9216	35.2893

Table 13

Rank Correlation on Quarterly Basis--Actual vs Forecast

Correlations Between Model Forecast and Actual-- Analyst Held Constant

Model	Quarter 1	2	3	4	5	6	7	8	9	10
GW	.2121	.5167	.5094	.1420	.1065	.1930	.1819	.2881	.2244	.3585
	3.2194	9.5981	9.3966	2.2410	1.6028	3.1406	2.9476	4.7751	3.6344	6.0849
Griffin-Watts with Constant	.2447	.5485	.5196	.1473	.0675	.1802	.1700	.2692	.2012	.3333
	3.7434	10.4344	9.6531	2.3270	1.0127	2.9261	2.7497	4.4370	3.2418	5.6010
Foster	.2219	.4663	.4790	.1395	.0928	.2367	.1812	.1666	.1661	.2843
	3.3759	8.3840	8.6624	2.2003	1.3951	3.8898	2.9368	2.6825	2.6581	4.6978
Foster with Constant	.1894	.4417	.4689	.1494	.0762	.2371	.1827	.1686	.1644	.2733
	2.8603	7.8306	8.4264	2.3599	1.1435	3.8971	2.9621	2.7147	2.6306	4.5020
Brown-Rozeff	.2436	.5416	.5225	.1122	.1283	.2504	.2927	.2919	.1737	.3900
	3.7260	10.2478	9.7283	1.7642	1.9367	4.1303	4.8794	4.8444	2.7831	6.7096
Brown-Rozeff with Constant	.1648	.4121	.4798	.0999	.1140	.2010	.2534	.2928	.1636	.3525
	2.4777	7.1940	8.6803	1.5683	1.7179	3.2761	4.1743	4.8603	2.6167	5.9675
Box-Jenkins	.1235	.3382	.3497	.1073	.0935	.2011	.1071	.3036	.1561	.2042
	1.8456	5.7162	5.9258	1.6859	1.4060	3.2790	1.7173	5.0588	2.4944	3.3047
Brown-Kennelly (AI)	.1176	.3246	.4479	.0979	.3707	.2528	.1720	.1880	.2468	.2580
	1.7564	5.4582	7.9524	1.5365	5.9732	4.1732	2.7820	3.0389	4.0189	4.2315
Brown-Kennelly (FI)	.2502	.3063	.4786	.0928	.2660	.2594	.1837	.1182	.1607	.2420
	3.8323	5.1175	8.6520	1.4557	4.1304	4.2888	2.9779	1.8898	2.5687	3.9518
Hopwood-McKeown 1 (AI)	.0677	.4505	.4892	.1159	.2662	.2270	.1429	.3111	.2139	.3915
	1.0064	8.0266	8.9037	1.8224	4.1327	3.7226	2.3013	5.1959	3.4545	6.7397
Hopwood-McKeown 1 (FI)	.2034	.4276	.5072	.1118	.1682	.2350	.1520	.2987	.2025	.3871
	3.0814	7.5234	9.3414	1.7570	2.5531	3.8609	2.4512	4.9692	3.2633	6.6504
Hopwood-McKeown 2 (AI)	.0675	.4547	.4395	.1197	.1941	.2482	.1834	.2624	.2197	.4163
	1.0032	8.1198	7.7681	1.8831	2.9608	4.0917	2.9741	4.3175	3.5536	7.2537
Hopwood-McKeown 2 (FI)	.1286	.3999	.4483	.0704	.0997	.2587	.1808	.2871	.1867	.4175
	1.9235	6.9391	7.9606	1.1024	1.4990	4.2769	2.9299	4.7585	2.9995	7.2791

Table 13 Continued

Model	Quarter 11	12	13	14	15	16	17	18	19	20
GW	.5375	.2282	.1513	.2464	.3368	.2167	.2092	.0884	.1213	.1912
	0.0389	3.6765	2.3660	4.0196	5.7016	3.5375	3.3550	1.4027	1.9325	3.0311
Griffin-Watts with Constant	.4924	.2131	.0995	.2588	.2224	.2302	.1110	-.0189	.1313	.1971
	8.9089	3.4217	1.5454	4.2370	3.6351	3.7697	1.7524	-.2995	2.0936	3.1281
Foster	.4581	.1814	.0740	.2195	.2141	.1657	.1670	.1568	.1316	.2355
	8.1157	2.8924	1.1467	3.5569	3.4940	2.6775	2.6563	2.5105	2.0994	3.7692
Foster with Constant	.4670	.1824	.0649	.2206	.2081	.1650	.1635	.1421	.1288	.2323
	8.3180	2.9103	1.0050	3.5765	3.3913	2.6670	2.5998	2.2702	2.0535	3.7152
Brown-Rozeff	.5469	.2155	.1185	.2516	.2075	.1786	.2083	.1511	.1298	.2519
	0.2866	3.4607	1.8454	4.1110	3.3798	2.8933	3.3408	2.4168	2.0696	4.0490
Brown-Rozeff with Constant	.5106	.1636	.1096	.2795	.1566	.1810	.2153	.1104	.1724	.2078
	9.3531	2.6002	1.7053	4.6025	2.5272	2.9338	3.4576	1.7570	2.7678	3.3041
Box-Jenkins	.3884	.1332	.1829	.2509	.1296	.1730	.1298	.1281	.0372	.2851
	6.6369	2.1073	2.8764	4.0984	2.0837	2.7999	2.0537	2.0418	.5879	4.6275
Brown-Kennelly (AI)	.3581	.0385	.1201	.1457	.2156	.2114	.0773	.0415	.0938	.2801
	6.0406	.6041	1.8695	2.3281	3.5191	3.4464	1.2157	.6569	1.4894	4.5388
Brown-Kennelly (FI)	.2840	.0213	.0977	.1120	.1360	.2160	.0660	-.0121	.1595	.1624
	4.6641	.3346	1.5172	1.7818	2.1872	3.5255	1.0378	-.1912	2.5538	2.5606
Hopwood-McKeown 1 (AI)	.5078	.1614	.1094	.2385	.2253	.1295	.1958	.2004	.0308	.3721
	9.2828	2.5648	1.7023	3.8825	3.6855	2.0806	3.1317	3.2342	.4878	6.2370
Hopwood-McKeown 1 (FI)	.4937	.1832	.0847	.2633	.1991	.1358	.1830	.1795	.0763	.3353
	8.9399	2.9235	1.3147	4.3153	3.2382	2.1849	2.9192	2.8843	1.2103	5.5373
Hopwood-McKeown 2 (AI)	.4556	.1370	.1275	.2408	.2221	.1805	.2137	.1315	.0653	.3955
	8.0598	2.1692	1.9874	3.9231	3.6310	2.9243	3.4314	2.0975	1.0354	6.6979
Hopwood-McKeown 2 (FI)	.4827	.1486	.1253	.2564	.2386	.1794	.2130	.0629	.1125	.3368
	8.6807	2.3573	1.9525	4.1947	3.9160	2.9065	3.4192	.9958	1.7905	5.5648

Table 14

Rank Correlation on Quarterly Basis--Actual vs Forecast
Correlations Between Analyst and Actual--Model Held Constant

	Quarter									
Model	1	2	3	4	5	6	7	8	9	10
GW	.5395	.2517	.2738	.6031	.6927	.5480	.5832	.5470	.6107	.6977
	9.5041	4.1362	4.5189	11.8118	14.3748	10.4621	11.4407	10.3725	12.1688	15.4281
Griffin-Watts with Constant	.5167	.2314	.2816	.6123	.7027	.5567	.5930	.5714	.6168	.7094
	8.9507	3.7834	4.6583	12.0971	14.7806	10.7012	11.7374	11.0528	12.3647	15.9452
Foster	.5497	.2153	.2564	.6146	.6798	.5667	.5581	.6107	.7176	.7477
	9.7612	3.5072	4.2106	12.1712	13.8733	10.9834	10.7201	12.2423	16.2583	17.8383
Foster with Constant	.5584	.2489	.2557	.6117	.6829	.5703	.5572	.6094	.7190	.7507
	9.9849	4.0873	4.1981	12.0771	13.9901	11.0862	10.6937	12.2012	16.3248	18.0025
Brown-Rozeff	.5281	.1604	.2443	.6328	.6578	.5126	.5050	.5392	.6093	.6327
	9.2250	2.5856	3.9991	12.7670	13.0694	9.5321	9.3250	10.1627	12.1252	12.9429
Brown-Rozeff with Constant	.5097	.2276	.2746	.6380	.6767	.5526	.5515	.5260	.6227	.6634
	8.7878	3.7178	4.5338	12.9406	13.7571	10.5891	10.5353	9.8191	12.5580	14.0444
Box-Jenkins	.5643	.4751	.4303	.6271	.7098	.5422	.6454	.5325	.6485	.7410
	0.1375	8.5877	7.5682	12.5745	15.0816	10.3031	13.4668	9.9879	13.4414	17.4814
Brown-Kennelly (AI)	.7684	.6682	.6378	.7749	.7542	.5777	.7304	.6533	.7739	.7485
	7.8106	14.2868	13.1453	19.1485	17.1925	11.3022	17.0421	13.6981	19.2848	17.8797
Brown-Kennelly (FI)	.7388	.6505	.5729	.6827	.7357	.5814	.7163	.7058	.7693	.7545
	6.2607	13.6234	11.0956	14.5928	16.2593	11.4097	16.3617	15.8167	19.0021	18.2121
Hopwood-McKeown 1 (AI)	.6167	.4045	.3903	.6851	.7144	.5533	.5697	.5285	.6179	.6213
	1.6186	7.0359	6.7303	14.6895	15.2786	10.6072	11.0467	9.8835	12.3993	12.5616
Hopwood-McKeown 1 (FI)	.6002	.3220	.3326	.6295	.6634	.5575	.5849	.5740	.6818	.6196
	1.1298	5.4107	5.5980	12.6537	13.2676	10.7224	11.4930	11.1269	14.7059	12.5049
Hopwood-McKeown 2 (AI)	.5957	.3642	.3803	.6750	.6208	.5507	.5471	.5545	.6839	.6255
	0.9992	6.2194	6.5285	14.2913	11.8506	10.5366	10.4161	10.5788	14.7915	12.7020
Hopwood-McKeown 2 (FI)	.5992	.3338	.3311	.6352	.6506	.5348	.5533	.5424	.5904	.6276
	1.1022	5.6321	5.5711	12.8473	12.8210	10.1058	10.5871	10.2478	11.5423	12.7721

Table 14 Continued

	Quarter									
Model	11	12	13	14	15	16	17	18	19	20
GW	.5540	.6661	.6782	.7327	.5764	.7039	.6489	.7375	.5956	.7577
	0.4783	14.0072	14.2671	17.0254	11.2402	15.7954	13.3760	17.2653	11.7236	18.0612
Griffin-Watts with Constant	.5768	.6834	.7063	.6848	.6279	.7137	.6565	.7571	.6056	.7703
	1.1208	14.6818	15.4232	14.8574	12.8586	16.2393	13.6518	18.3241	12.0315	18.7892
Foster	.6338	.7359	.6668	.6015	.6326	.7288	.6411	.6476	.6042	.7291
	2.9046	17.0488	13.8307	11.9049	13.0166	16.9654	13.1006	13.4366	11.9906	16.5707
Foster with Constant	.6328	.7340	.6649	.5981	.6277	.7268	.6294	.6483	.5995	.7281
	2.8689	16.9507	13.7613	11.8003	12.8494	16.8655	12.7029	13.4620	11.8435	16.5221
Brown-Rozeff	.5302	.6681	.6654	.6959	.6203	.7135	.6389	.7313	.5854	.7159
	9.8477	14.0822	13.7819	15.3228	12.6023	16.2315	13.0274	16.9508	11.4179	15.9517
Brown-Rozeff with Constant	.5562	.6698	.6526	.7022	.6498	.7011	.6033	.7136	.5738	.7134
	0.5399	14.1495	13.3134	15.5932	13.6234	15.6685	11.8663	16.1063	11.0791	15.8393
Box-Jenkins	.6148	.7031	.6511	.7546	.6944	.7489	.6737	.7344	.6774	.7260
	2.2750	15.5083	13.2633	18.1810	15.3805	18.0135	14.2999	17.1093	14.5589	16.4239
Brown-Kennelly (AI)	.6983	.7838	.7955	.8265	.7370	.8301	.7972	.8343	.7191	.8082
	5.3636	19.7963	20.2958	23.2177	17.3768	23.7214	20.7128	23.9292	16.3611	21.3456
Brown-Kennelly (FI)	.7260	.8035	.8025	.8419	.7583	.8321	.8041	.8527	.6997	.8497
	6.6250	21.1725	20.7906	24.6726	18.5391	23.9133	21.2144	25.8125	15.4874	25.0687
Hopwood-McKeown 1 (AI)	.5351	.6644	.6609	.6250	.6089	.7104	.6029	.6768	.6058	.7313
	9.9753	13.9415	13.6126	12.6594	12.2332	16.0885	11.8533	14.5362	12.0403	16.6796
Hopwood-McKeown 1 (FI)	.5144	.6661	.6824	.6323	.5929	.7075	.6063	.6785	.5952	.6859
	9.4470	14.0089	14.4319	12.9035	11.7349	15.9535	11.9589	14.6026	11.7113	14.6620
Hopwood-McKeown 2 (AI)	.5819	.6869	.6449	.6818	.6498	.6966	.5785	.7037	.5790	.7011
	1.2666	14.8230	13.0437	14.7346	13.6254	15.4746	11.1240	15.6588	11.2270	15.2945
Hopwood-McKeown 2 (FI)	.5572	.6763	.6426	.6944	.6313	.6963	.5793	.7315	.5664	.6749
	0.5685	14.3997	12.9655	15.2589	12.9733	15.4597	11.1463	16.9638	10.8653	14.2278

Table 15

Spearman Correlations Between Analyst Forecast Superiority*
and the Number of Days Separating the Two Forecasts
(Quarterly Forecasts)

Quarter	N	Correlation	Alpha Level
1	136	.1644	.028
2	173	.0348	.325
3	172	.1910	.007
4	163	.0147	.427
5	145	.0671	.212
6	175	.1213	.055
7	174	.2842	.001
8	172	.2237	.002
9	168	.1527	.025
10	171	.1780	.010
11	168	.1303	.047
12	167	.1425	.034
13	159	.1332	.048
14	170	.0173	.412
15	174	.0826	.140
16	174	.1309	.043
17	167	.1405	.036
18	170	.0918	.118
19	170	.2135	.003
20	162	.0883	.132

*Analyst Forecast Superiority ≡

$$\frac{|\text{Actual EPS} - \text{Analyst Forecast}|}{|\text{Actual EPS}|} - \frac{|\text{Actual EPS} - \text{BJ Forecast}|}{|\text{Actual EPS}|}$$

Table 16

Mean Absolute Relative Quarterly Forecast Errors
(Truncated at 3)
Partition 1

MODEL	FORECAST HORIZON 1	2	3	4
Griffin-Watts	.2816	.2965	.3330	.3308
Griffin-Watts with Constant	.2980	.3060	.3428	.3415
Foster	.2897	.2981	.3264	.3258
Foster with Constant	.2952	.3044	.3321	.3330
Brown-Rozeff	.2638	.2760	.3010	.3040
Brown-Rozeff with Constant	.2687	.2804	.2979	.3003*
Box-Jenkins	.2841	.2900	.3136	.3057
Brown-Kennelly (AI)**	.5008	.5120	.5560	.3565
Brown-Kennelly (FI)***	.4933	.5009	.5555	.3268
Hopwood-McKeown 1 (AI)**	.2728	.2762	.2981	.2992
Hopwood-McKeown 1 (FI)	.2706	.2778	.3030	.3083
Hopwood-McKeown 2 (AI)**	.2712	.2699	.2972	.2962
Hopwood-McKeown 2 (FI)	.2661	.2705	.2996	.2978
Analyst	.2781	.2915	.3244	.3685

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Key to significnce testing:

An * next to a number indicates that given number is significantly different than the financial analyst error at alpha = .05.

** These models were not tested since AI models are not extrapolative.

*** This model was not tested due to the fact that it is severely misspecified (i.e., it ignores seasonality).

Table 17

Mean Absolute Relative Quarterly Forecast Errors
(Truncated at 3)
Partition 2

MODEL	FORECAST HORIZON 1	2	3	4
Griffin-Watts	.3137	.3690	.4073	.3903
Griffin-Watts with Constant	.3186	.3800	.4083	.4067
Foster	.3182	.3773	.3944	.4095
Foster with Constant	.3229	.3823	.4020	.4140
Brown-Rozeff	.3022	.3511	.3774	.3693
Brown-Rozeff with Constant	.3068	.3614	.3797	.3718
Box-Jenkins	.3150*	.3702*	.3781	.3830
Brown-Kennelly (AI)**	.4500	.5269	.4887	.3978
Brown-Kennelly (FI)***	.4325	.5204	.5182	.4065
Hopwood-McKeown 1 (AI)**	.3121	.3655	.3734	.3622
Hopwood-McKeown 1 (FI)	.3157	.3596	.3911	.3890
Hopwood-McKeown 2 (AI)**	.3068	.3627	.3713	.3635
Hopwood-McKeown 2 (FI)	.3051	.3547	.3843	.3681
Analyst	.2754	.3369	.3840	.3870

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Key to significance testing:
An * next to a number indicates that given number is significantly different than the financial analyst error at alpha = .05.

** These models were not tested since AI models are not extrapolative.

*** This model was not tested due to the fact that it is severely misspecified (i.e., it ignores seasonality).

Table 18

Mean Absolute Relative Quarterly Forecast Errors
(Truncated at 3)
Partition 3

MODEL	FORECAST HORIZON 1	2	3	4
Griffin-Watts	.3935*	.4557*	.4991	.5792
Griffin-Watts with Constant	.4188*	.4934*	.5365*	.6234*
Foster	.4255*	.5061*	.5233*	.5985*
Foster with Constant	.4326*	.5147*	.5320*	.6047*
Brown-Rozeff	.3701*	.4249*	.4521*	.5526*
Brown-Rozeff with Constant	.3718*	.4242	.4650	.5484
Box-Jenkins	.4063*	.4382*	.4988*	.5771*
Brown-Kennelly (AI)**	.4350	.5182	.5575	.5514
Brown-Kennelly (FI)***	.4473	.5439	.5754	.5835
Hopwood-McKeown 1 (AI)**	.3787	.4262	.4714	.5444
Hopwood-McKeown 1 (FI)	.3643*	.4280	.4708	.5582
Hopwood-McKeown 2 (AI)**	.3869	.4414	.4929	.5714
Hopwood-McKeown 2 (FI)	.3618*	.4247*	.4660	.5649*
Analyst	.3091	.4137	.4510	.5286

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Key to significance testing:
An * next to a number indicates that given number is significantly different than the financial analyst error at alpha = .05.

** These models were not tested since AI models are not extrapolative.

*** This model was not tested due to the fact that it is severely misspecified (i.e., it ignores seasonality).

Table 19

Mean Absolute Relative Quarterly Forecast Errors
(Truncated at 3)
Partition 4

MODEL	FORECAST HORIZON 1	2	3	4
Griffin-Watts	.4487*	.5227*	.5830*	.5605*
Griffin-Watts with Constant	.4744*	.5433*	.6136*	.5713*
Foster	.4562*	.5221*	.5502*	.5468*
Foster with Constant	.4640*	.5273*	.5570*	.5538*
Brown-Rozeff	.4237*	.4841*	.5389*	.5017*
Brown-Rozeff with Constant	.4434*	.5092*	.5525*	.5156*
Box-Jenkins	.4360*	.5000*	.5280*	.4975*
Brown-Kennelly (AI)**	.4895	.5745	.6252	.5184
Brown-Kennelly (FI)***	.5099	.5743	.6472	.5206
Hopwood-Mckeown 1 (AI)**	.4533	.5086	.5426	.4790
Hopwood-Mckeown 1 (FI)	.4549*	.5222*	.5610*	.5178*
Hopwood-Mckeown 2 (AI)**	.4573	.5266	.5503	.5412
Hopwood-Mckeown 2 (FI)	.4567*	.5230*	.5726*	.5305*
Analyst	.3297	.4182	.4771	.4414

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Key to significance testing:
An * next to a number indicates that given number is significantly different than the financial analyst error at alpha = .05.

** These models were not tested since AI models are not extrapolative.

*** This model was not tested due to the fact that it is severely misspecified (i.e., it ignores seasonality).

Table 20

Mean Absolute Relative Quarterly Forecast
(Truncated at 3)
Partition 5

MODEL	FORECAST HORIZON 1	2	3	4
Griffin-Watts	.3370*	.3962*	.4159*	.4429*
Griffin-Watts with Constant	.3704*	.4326*	.4466*	.4596*
Foster	.3323*	.4068*	.4346*	.4157*
Foster with Constant	.3341*	.4089*	.4361*	.4186
Brown-Rozeff	.3166*	.3745*	.4152*	.4130*
Brown-Rozeff with Constant	.3200*	.3717*	.4049*	.4038*
Box-Jenkins	.3390*	.3889*	.4072*	.4390*
Brown-Kennelly (AI)**	.4340	.4849	.4698	.4035
Brown-Kennelly (FI)***	.4204	.4715	.4728	.4004
Hopwood-Mckeown 1 (AI)**	.3146	.3623	.3697	.3889
Hopwood-Mckeown 1 (FI)	.3178*	.3820*	.4044*	.4112
Hopwood-Mckeown 2 (AI)**	.3258	.3807	.3997	.3945
Hopwood-Mckeown 2 (FI)	.3203*	.3750*	.4120*	.4014
Anlayst	.2313	.3230	.3314	.3631

AI = multivariate model using actual index
FI = multivariate model using forecasted index

Note: The "F" models are the immediately preceding model, but based on a forecasted index.

Key to significance testing:
An * next to a number indicates that given number is significantly different than the financial analyst error at alpha = .05.

** These models were not tested since AI models are not extrapolative.

*** This model was not tested due to the fact that it is severely misspecified (i.e., it ignores seasonality).

Appendix A

The Impact of Bias on the Weighted API Statistic

FG report a weighted API statistic computed as (without scaling)

$$(1) \quad \sum_{i=1}^{n} |FE_i| \cdot API_i$$

where the first term in the product is the absolute value of the forecast error for firm i and API is the abnormal performance index for firm i.

Note that since API = Sign (FE_i) CAR_i, which is the sign of the forecast error times the cumulative abnormal return, then (1) becomes

$$\sum_{i=1}^{n} |FE_i| \cdot \text{Sign } (FE_i) \cdot CAR_i \text{ which is of course}$$

$$(2) \quad \sum_{i=1}^{n} FE_i \cdot CAR$$

The above analysis is unscaled, whereas FG scaled by dividing by $\sum_{i=1}^{n} |FE_i|$. Therefore their weighted API on a scaled basis is

$$(3) \quad \sum_{i=1}^{n} \frac{FE_i \cdot CAR_i}{\sum_{i=1}^{n} |FE_i|}$$

Note the similarity between (3) and that of the sample Pearson correlation coefficient for FE and CAR_i, namely

$$(4) \quad \sum^{n} \frac{(FE_i - \overline{FE})\,(CAR_i - \overline{CAR})}{\delta_{FE}\ \delta_{CAR}}$$

In particular note that (3) reduces to (4) in the numerator when the mean forecast error equals zero (i.e., unbiased forecasts) and the mean CAR equals zero. Their denominator represents a different choice of a scale factor. (This term assures that the investment sums to 1.) The term $\sum_{i=1}^{n} |FE_i|$ in (3) is a measure of dispersion similar to δ_{FE} in (4), but measures mean absolute deviation for forecasts presumed to be unbiased (as opposed to mean squared deviation for possibly biased forecasts). Therefore their scale factor is also affected by bias.

Appendix B

Maximum number of days of Analyst Timing
Advantage in Each Partition

Quarter	1	2	3	4	5
1	9.00	18.00	25.00	57.00	92.00
2	14.00	22.00	38.00	72.00	94.00
3	11.00	18.00	37.00	65.00	98.00
4	18.00	36.00	64.00	91.00	134.00
5	9.00	15.00	25.00	51.00	92.00
6	15.00	21.00	36.00	70.00	95.00
7	14.00	18.00	37.00	67.00	94.00
8	11.00	18.00	35.00	65.00	92.00
9	4.00	14.00	28.00	65.00	88.00
10	11.00	22.00	46.00	74.00	95.00
11	9.00	17.00	43.00	74.00	99.00
12	11.00	25.00	59.00	80.00	130.00
13	8.00	22.00	52.00	71.00	87.00
14	9.00	30.00	56.00	74.00	95.00
15	11.00	32.00	60.00	74.00	95.00
16	11.00	36.00	60.00	74.00	105.00
17	3.00	21.00	56.00	71.00	120.00
18	14.00	32.00	60.00	77.00	94.00
19	11.00	35.00	64.00	77.00	163.00
20	16.00	36.00	60.00	78.00	106.00

NOTES

[1]Brown et al. [1985, 1986] provide some evidence in support of a timing advantage. Our analysis is not so much concerned with whether such an advantage exists, but rather whether the analysts outperform statistical models given control for timing. Our analysis differs in other important ways, including the set of statistical models considered and our incorporation of earnings release dates for purposes of measuring timing advantage.

[2]We use these and other abbreviations for convenience and do not wish to imply that the authors necessarily advocated the general use of these models.

[3]We do not include the category I BJ model, since Box and Jenkins [1970] suggest that a minimum of 50 observations be used in the modeling process. We were unable to obtain annual series that met all of our sampling constraints and approached this recommended minimum number of observations. Even if the data were available, models incorporating a half of a century's data would be problematic due to structural changes in the economy.

[4]We did not delete firms with some missing Value Line data since there were a considerable number of firms where only one number was unavailable. However, this had virtually no effect on our overall sample size since the percentage of missing data was less than 2%.

[5]These sample constraints apply to our annual analysis. The sampling procedures and capital market analysis was slightly different for the quarterly analysis. Specifically, the quarterly analysis required returns on the daily CRSP tape to compute weekly returns (Tuesday to Tuesday) for the period from the fourth quarter of 1972 through the fourth quarter of 1978. The resulting sample contained 9 fewer firms (249 in total) than for the annual analysis.

[6]The logarithmic form of the market model is used so the variable being analyzed equals the continuously compounded return. This also allows some appeal to a central limit theorem argument (Fama [1976, p. 20]; Alexander and Francis [1986, p. 145]) concerning normality of the variable.

[7]The procedure to compute quarterly abnormal returns was analogous to that used to compute annual abnormal returns. This log form of the market model (risk free rates of return were generally not available for periods less than one month) with a value weighted index was used. Regression estimations were done for each holdout quarter (between 1974 and 1978) using OLS regression and in each case including weekly data for the 65 weeks preceding the week containing the first market day of the quarter. The residuals (post sample forecast errors) from these models when applied to the holding periods (the inclusive interval from the week containing the first market day of the quarter to the week containing the announcement date) constitute risk adjusted returns. The abnormal returns were then individually summed across each holding period to give the firms' cumulative abnormal returns.

[8]This required the additional sampling constraint of requiring availability of Value Line forecast publication dates. Due to resource constraints we collected dates for a subsample of 182 firms. To insure that this procedure had no biasing effect, we ran the forecast error analysis for the subsample and sample as a whole and obtained virtually identical results.

[9]The statistical test in the various sub-partitions are based on the distribution-free multiple comparison test (using Friedman Rank Sums) for multiple treatment versus a control (Hollander and Wolfe [1973, p. 155].

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