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Summary

This paper deals with an investor loss function for earnings forecasts. Specifically we develop a theoretical framework that measures loss in the context of the problem of resource allocation under uncertainty. The framework maps a set of forecasts into an expected return. This expected return is compared to that return which could be expected given perfect knowledge of future earnings and the resulting difference measures the investor's loss. Some empirical results are given.

This paper deals with an investor loss function for earnings forecasts. Specifically we develop a theoretical framework that measures loss in the context of the problem of resource allocation under uncertainty. The framework maps a set of forecasts into an expected return. This expected return is compared to that return which could be expected given perfect knowledge of future earnings and the resulting difference measures the investor's loss.

The need for a loss function arises from the need of investors to assess the value of alternative forecasts. In addition empirical research studies have often compared various forecast models. The typical approach has been to compare forecast accuracy or dispersion. This approach, however, is limited. For example Foster [1977, p. 10] stated "It is important to recognize that our measures of dispersion are essentially surrogate criteria for evaluating alternative forecasting models. A more complete analysis would specify the loss function in a specific decision context." In addition Gonedes et al [1976, p. 94] wrote, "There is a more fundamental deficiency in these prediction performance studies.... Specifically they are not based upon any explicit theoretical structure that connects their frameworks to resource allocation under uncertainty."

The purpose of the present study is to develop a theoretical framework to overcome these limitations. This framework takes the form of an investor loss function (henceforth ILF). A secondary purpose is to empirically apply the ILF for purposes of comparing forecasts generated from several models that have recently been employed in the literature.

The paper is in four parts. Part one discusses some of the issues associated with an ILF, part two presents an operational form of the

ILF, part three is an empirical application and part four contains summary and conclusions.

BACKGROUND ISSUES

An important result of research on the information content of accounting earnings is that ex ante knowledge of annual earnings can provide an opportunity for an investor to earn an abnormal return. For example, Ball and Brown [1968] reported that if one were to know the sign of the unexpected annual earnings change 12 months in advance it would be possible to earn a 7% abnormal return via a simple trading rule.[1] These findings pose some interesting questions with respect to earnings forecasts.

1) If the market is efficient, then we wouldn't expect a forecast model to enable an individual to earn an abnormal return via utilizing only publicly available information.

2) If the expectation in (1) is correct, then from the individual investor's standpoint the problem of comparing various sets of forecasts might become irrelevant. One could expect to earn no better than the risk conditioned rate of return since the risk-return relationship should not depend on the portfolio selection process.

3) Looking at (2) from another side, we would not expect a return less than the risk conditioned return via the same reasoning.

Given the above reasoning, it might seem that investors would only be concerned with constructing minimum variance portfolios and would not be concerned with using earnings forecasts in their decision models. Research, however, points to the exact opposite. For example, Nordby [1973] found that 99% of responding analysts claimed that they use earnings forecasts in their decision making process.

What then accounts for the extensive use of forecasts in practice? The answer seemingly must be one of two things:

(1) Some individuals do earn an abnormal return through use of forecasts and the market is not efficient.

(2) Some individuals think that they can earn an abnormal return, but the market is efficient and they are possibly irrationally allocating resources for purposes of obtaining forecasts.

Research and reasoning can be used to support both (1) and (2). A large amount of research has been conducted which favors efficiency. On the other hand there is evidence which is not consistent with efficiency. A good example of this is the Value Line Investment survey. Black [1973] found reasonably strong evidence that the survey is able to predict returns of securities in a way that cannot be accounted for by differences in risk. (Note that the survey relies heavily on a determination of "earnings momentum".) In addition, Joy et al [1977, p. 207] presented evidence that, "...the information contained in quarterly earnings was not fully impounded into stock prices at the time of announcement."

It is not the purpose of the present paper to take a position on efficiency or lack of efficiency in the market. However it must be noted that the theory of market efficiency does not explain the empirically observed behavior of users of earnings forecasts. An alternative framework which might explain such behavior is that of Grossman and Stiglitz[2] [1976] who pointed out that costless information is not only sufficient for market efficiency but <u>necessary as well</u>. Their alternative is summarized (p. 218):

> In the structure we have developed, the market never fully adjusts. Prices never fully reflect all the information possessed by the informed individuals. Capital markets are not efficient, but the difference is just enough to provide the revenue required to compensate the informed for purchasing the information.

Note that this framework allows for the possibility that there is a value of gathering information and therefore a corresponding loss for gathering information which is less than optimal. (It is this loss that is the focus of the present study.) We define optimal information to be that information which produces the maximum possible net revenue associated with its use, where net revenue is computed as the difference between the revenue associated with the use of the information and the acquisition cost of that information.

If the market is assumed to be efficient and the market's earnings expectation model is assumed to be optimal, then one might gauge the usefulness of a given forecast method by measuring the abnormal returns associated with an investment strategy based on an ex ante knowledge of the forecast error (i.e., unexpected earnings) of the given model. This statement is elaborated on by Brown and Kennelly [1972, p. 404]:

> 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 that 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, 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. To our knowledge, Ball and Brown (1968) were the first to make use of this fact.

This basic type of reasoning can be used to derive several types of empirical tests all based on different sets of assumptions as listed below.

Category	Assumptions	Test
1	A) Efficient market B) Earnings has information content	Compare prediction models on ability to approximate market prediction model (assumed to be optimal as defined above)
2	A) Efficient market B) Given prediction model approximates market model	Information content
3	A) Efficient market	Joint test of information content and prediction model

Most of the accounting research has fallen in one of the above three categories. For example Foster's [1977] study on quarterly accounting data falls into category 1 while Ball and Brown [1968] and Brown and Kennelly [1972] among many others fall into category 2. It can be argued also that categories 1 and 2 are subsumed under category 3 which reduces to the first two cases if the assumptions are correct. In the present study we develop a methodology (ILF) for comparing prediction methods which does not rely on any of the Table 1 assumptions. Instead we assume that there exists some market expectation (prediction) for earnings (not necessarily optimal as defined above) which has been impounded in the market equilibrium (price). The error in this market earnings expectation has not been impounded by the market. An investor who had knowledge of this (non-impounded) information would be able to use it to formulate an investment strategy which would produce an abnormal return (as measured by the market model). Therefore <u>we define the investor's loss (due to inaccurate earnings predictions) to be the difference between the abnormal return he/she could earn given a</u>

strategy based on correct forecasts of earnings (and thereby of the non-impounded information) and the return he/she could earn given a strategy based on less than perfect forecasts. This definition is operationalized below and discussed in the context of decision theory. It is also applied to a comparison of several forecasts models found in the literature.

It should be emphasized that in developing the loss function we are not concerned with market efficiency per se but rather an individual investor's perceptions with respect to market efficiency. In particular we assume that the investor believes that there is a possibility of earning a return higher than predicted by the Sharp-Lintner [1964, 1965] capital asset pricing model. As pointed out previously, unless this assumption holds, there is no private value of earnings forecasts based on publicly available information. If there is no private value, then from the individual's standpoint the process of comparing forecasts is dubious. It is also pointed out that the loss function derived in this paper does not depend on the need to compare forecast methods but simply specifies the loss associated with different forecast sources. If all forecast methods have equal loss, then there is no need to compare forecast methods. This is an empirical question.

OPERATIONALIZATION OF THE ILF

In order to use the ILF, it is first necessary to operationally define a market earnings expectation model. In this study we use the cross-sectional model employed by Ball and Brown [1968] which regresses individual firms' earnings changes on market earnings changes. We use this model since Ball and Brown observed that ex ante knowledge of its residuals made it possible for an investor to earn a 7% abnormal return.

To facilitate operationalization of the loss function we make the following definitions:

(1) $E(F_{it_0} | r_i)$

(2) $A_{it} = \hat{a}_i + \hat{b}_i \sum_{\substack{j=1 \\ i \neq j}}^{N} A_{jt} + e_{it}$

(3) $E(F_{it_0} | \phi_i) = \hat{a}_i + \hat{b}_i \left(\sum_{\substack{j=1 \\ i \neq j}}^{N} E(F_{jt_0} | r_i) \right) \qquad \phi_i = \{A_{jt_0}\}, j \neq i$

(4) $E[\ln(1 + R_{it} - R_{ft})] = B_i E(\ln(1 + R_{mt} - R_{ft}))$

Where:

a) (1) represents the investor's expectation of earnings change for firm i and period t_0. This expectation could be the result of intuition, statistical modeling or judgmental opinion and is conditioned upon r, the set of prior earnings for firm i.

b) (2) is an empirical description of the relationship between market earnings changes and firm i earnings changes, A_{it}. The coefficients $\hat{a}_i$ and $\hat{b}_i$ are assumed to be estimated by the investor. Note that the investor is assumed to use the same coefficients in (3). Also the subscript t denotes time previous to t_0. (In the empirical application, $\hat{a}_i$ and $\hat{b}_i$ are estimated by regression on previous years' data.)

c) (3) represents the investor's expectation of earnings changes (A_{it_0}) for firm i in period t_0 conditioned upon his expectation of the market earnings (ϕ_i) in period t_0. Since this depends on $E(F_{jt_0} | r_i)$ (which is ex ante), it is ex ante. The coefficients $\hat{a}_i$ and $\hat{b}_i$ are from (2) and are taken as known in the equation.

d) (4) is the log form Sharp-Lintner [1964, 1965] capital asset pricing model where R_{it} represents the return on asset i in period t, R_{mt} represents the market return in period t and R_f is the risk free rate of return.

Given the above definitions we can define the investor's anticipation of the individual components of change in earnings. It is this individual component which Ball and Brown [1968] found to enable one to earn an abnormal return when known in advance. We proceed to define the investor's anticipation of the individual component of changes in earnings subtracting (3) from (1):

$$(5)\quad a_{it_0} = E(F_{it_0}|r_i) - E(F_{it_0}|\phi_i)$$

When a_{it_0} is greater than zero, then the investor expects a positive individual component of change in earnings. When a_{it_0} is less than zero, a negative individual component of change is anticipated. This is consistent with the Ball and Brown market conditioned definition of individual component of change in earnings except it is based on predicted earnings as opposed to actual earnings.

Given that a_{it_0} is positive (negative), the investor would be expected to buy long (sell short) in asset i. Also to the degree that his expectations are correct, he will earn an abnormal return, AR_F. Similarly let AR_{PF} represent the abnormal return assuming that the investor has perfect forecasts of the future earnings (i.e., his predictions of all firms are perfectly accurate). Then define the investors loss function (ILF) as

$$(6)\quad ILF = AR_{PF} - AR_F$$

where ILF has the interpretation as being the loss incurred from not having perfect forecasts. The minimum expected value is expected to be 0 in the case of having perfect forecasts, and equal to the abnormal return of having perfect forecasts in the case of having useless forecasts.

A Further Interpretation

In terms of standard decision theory the ILF measures the cost, in terms of return, of not having perfect forecasts. A larger abnormal return earned means a smaller loss. This relationship is depicted in Figure 1. In point A the loss is at a maximum and the abnormal return

[Figure 1 about here]

is at a minimum. Point B depicts the case of perfect forecasts.

Note that the loss depends strictly on the abnormal return. This is important because abnormal returns are risk adjusted or independent of the market. This means that forecasting methods can be preference ranked based on the ILF without a separate consideration of risk.

EMPIRICAL APPLICATION

Forecast Models

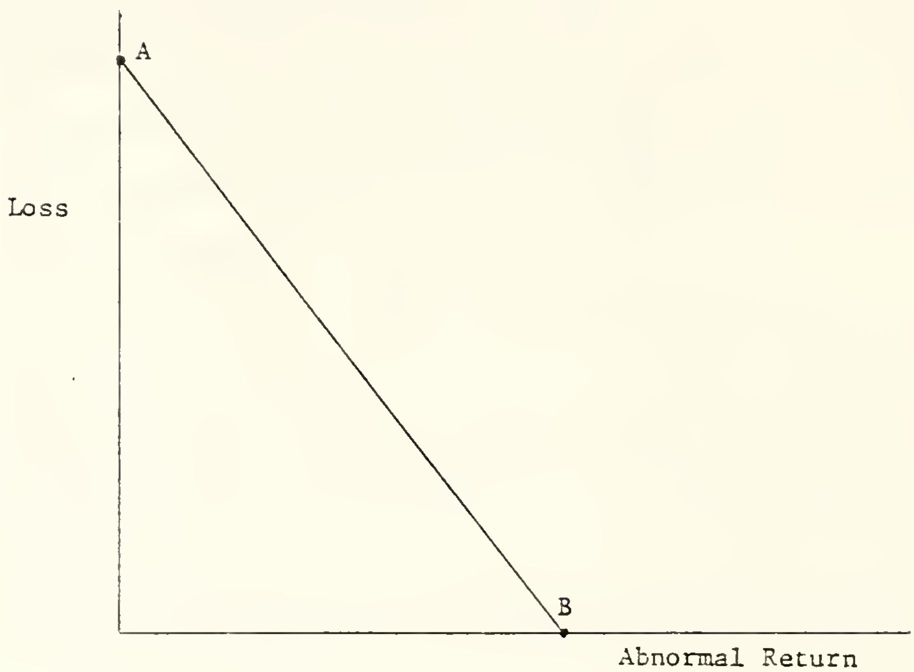
The empirical results of this study focus on the ability of several statistical models to predict annual EPS from quarterly EPS. This purpose has been suggested by the Financial Accounting Standards Board in the discussion memorandum, Interim Financial Accounting and Reporting (FASB, 1978). In addition there has been a considerable amount of research done on the predictive ability of models using quarterly EPS (e.g., Lorek, 1979; Foster, 1977; Brown and Rozeff, 1978).

We focus on several models that have been given considerable attention with respect to their ability to represent the time series of quarterly EPS. These are

1) a seasonally and consecutively differenced first order and seasonal moving average model [Griffin, 1977; Watts, 1975]

Figure 1

The Relationship Between Loss and Abnormal Return



2) a seasonally differenced first order autoregression model with a constant drift term[3] [Foster, 1977]

3) a seasonally differenced first order autoregressive and seasonal moving average model [Brown and Rozeff, 1978]

4) individually identified and estimated Box-Jenkins models for each firm.

In the Box-Jenkins notation the first three are referred to as (0,1,1) x (0,1,1), (1,0,0) x (0,1,0) and (1,0,0) x (0,1,1), respectively. For the remainder of the study these are referred to as the GW, F, and BR models.

Population Studied

Data pertaining to 267 firms was obtained from the Compustat quarterly and CRSP monthly tapes. For a firm to be included in the group, it was required to have no missing EPS or returns data for the 64 consecutive quarters beginning with the first quarter of 1962. This provided a sample period from 1962 through 1977. The EPS number used was primary earnings per share excluding extraordinary items and discontinued operations, adjusted for capital changes. The return figure selected from CRSP included both a dividend and price component.

Note that, unlike previous research, all firms which met the survivorship test were retained for analysis. We define this group to be the population of interest and make no attempt to generalize to a larger number of years or group of firms. To use statistical testing to make inferences about a larger group of firms would be unwarranted because there is no reason to believe that firms which fail to meet the survivorship test are the same as those that do. In fact, *a priori* reasoning indicates that firms meeting the test are very likely to be larger and less risky than on the average. Also attempting to generalize across all years would be unwarranted because structural changes in the economy might produce a shifting in the relative performance of different forecast methods. Even if this was not a problem, in order to generalize to all years, it would be necessary to obtain a reasonably large random sample of years. This is not possible because of limited data availability.

Since statistical testing is used for making inferences about a larger population and under the circumstances we felt that such inferences would be unwarranted, no statistical tests are presented in this paper. Instead our goal is to present results for an entire population therefore avoiding the need to make statistical generalizations. We feel that this approach is useful because it presents results for a large population which is of interest in its own right.

Application of the Forecasting Models

For purposes of assessing the ILF's of the 4 forecast methods, the years of 1974 through 1977 were used as holdout periods. Therefore the 267 series were each modeled 16 times, once for each method using pre 1974 data (48 quarters in the base period) and again for each method (52 quarters in the base period) using all pre 1975 data, etc. The result was that each model made predictions for the 4 quarters in each of the four hold out years. These quarterly forecasts were aggregated within each year to form annual forecasts. These forecasts represent F_{it_0} in (1) above.

Next the coefficients a_i and b_i in (3) were estimated for each firm. The procedure was done for each hold out year and was based on all data prior to the holdout year. The market index was a weighted average of all of the sample firms' EPS except the one for which the model was being estimated. The residuals of the models were tested for autocorrelation and the null hypothesis of no autocorrelation was rejected for only 8 firms which was attributed to chance.

The a_i and b_i coefficients were then applied to compute the investor's anticipation of the market conditioned EPS in (3) and finally the anticipation of the unexpected earnings change in (5).

Application of the Market Model

The equilibrium market model (4) was estimated for each firm and for each of the four years. The estimation included data in the 5 years preceeding the holdout year.[4] The residuals from these models when applied to the four holdout years constitute abnormal returns. The market index used was the value weighted market index containing the dividend-price returns of all firms as supplied on the CRSP tape.

Empirical Results: Losses

The loss for each forecast method was calculated by computing the annual cumulative abnormal return (CAR) associated with each forecast method and subtracting this from the CAR associated with an investment strategy based on ex ante knowledge of the actual EPS. The CARs were computed by assuming a long investment given a_{it_0} in (5) was positive (henceforth CAR+) and a short investment given that a_{it_0} was negative (henceforth CAR−).

Table 1 gives the cumulative abnormal residuals for the 4 forecast methods and actual EPS, for the 12 months prior to and including the earnings announcement date. For example, long investments for the BR method made 11 months prior to the annual announcement month and terminating at the end of the announcement month show an abnormal return of .00391 for 1976. Quick inspection reveals that only the GW (for the year 1977) and the actuals demonstrate a strong apparent pattern of abnormal return.

Table 2 presents the loss (as defined in equation 6) for each of the four methods. Note that in all cases the loss is positive with the smallest average loss being associated with the GW method and the largest average loss being associated with the BJ method. Also note that the GW method had the smallest loss in three out of the four years with 1975 being the exception. In addition, the percentage difference between the GW and other methods was substantial for 1976 and 1977. This can be seen by examining the ratio of the next smaller loss to the GW for these two years. This ratio is 1.39 (.0501 ÷ .0360) for 1976 and 1.99 (.0730 ÷ .0367) for 1977. Also, with the exception of 1975, the percentage differences between the F, BR and BJ methods were small. Finally, note that no consistent pattern of rankings exists between these three methods.

Empirical Results: Forecast Errors

The question is now examined as to whether forecast error measures are consistent with those of the ILF. Therefore Table 3 presents the average absolute percentage forecast errors for the four methods over the hold out period. The results are presented for the quarterly and annual forecasts.

[Table 3 about here]

For both the quarterly and annual forecasts the rankings based on the five year averages are fairly consistent. In all cases the BR method has the smallest error and the F method has the largest error. Also the BJ method performs better than the GW in all cases except for the two quarter ahead forecasts. These results are consistent with those of Collins and Hopwood [1980] who found identical rankings for the annual forecast generated prior to the first quarter of the year.

Table 4 presents the same error analysis as Table 3 but based on the mean ranks. This information is presented because it has the advantage of not depending on a particular choice of an error metric.

[Table 4 about here]

Note that, while the average quarterly rankings vary depending on the forecast horizon, the rankings based on the annual error are identical to those based on the absolute percentage error. The fact that the rankings are the same is particularly relevant to the present study since the losses in Table 2 are based on annual forecasts.

Discussion of the Empirical Results

One thing immediately noticeable about the results is that the ILF and error analysis produced different rankings of the methods. The ILF ranks were: GW = 1, F = 4, BR = 2 and BJ = 3, and the error analysis ranks were: GW = 3, F = 4, BR = 1, BJ = 2. This discrepancy can be accounted for by the fact that for a given investment decision the size of the forecast error need not necessarily be related to whether or not the best investment decision is made. For example, two different forecasts can be quite different in terms of accuracy but both can induce the same investment decision. This can be seen from the situation where the magnitude of the unexpected earnings implied from one forecast is much larger than another but both induce a buy decision.

The net result is that the investment performance is determined by the percent of time that the correct decision is made where each decision outcome is weighted by its investment return for that outcome. These percentages are presented in Table 5. Note that these ranks are consistent with those of the ILF.

[Table 5 about here]

Another way of looking at investment performance is by considering the percentage of time that a given method results in the same decision which would have been made had the forecast been perfectly accurate. This approach will be exactly the same as that presented in Table 5 if it is true that a perfect forecast will always lead to the correct investment decision. One reason for looking at investment performance in this manner is that it is that it eliminates as noise the cases where utilization of a perfect forecast leads to the wrong investment decision. This method of describing investment performance will henceforth be referred to as "weighted agreement with the actual" (WAA) and the first method will be referred to as "weighted agreement with the market" (WAM).

Table 6 presents the WAA results. Notice that the rankings are again the same but the means are larger. Their increased magnitude is expected since a positive abnormal return is produced any time that the same decision is made as would be made with a perfect forecast.

[Table 6 about here]

Since Tables 5 and 6 explain the losses in terms of the combined percentage of investment success and individual decision outcome weighted by returns, it is possible to further explain these results by considering how much of each percentage is due to the percentage of success and how much is due to the weighting. To this end, Table 7 presents the percentage of time that each forecast method led to the same decision as would have been made had the forecast been perfect. This is identical to WAA but the weighting has been eliminated. Note that the rankings are not the same as in WAA in the case of the F, BR and BJ methods. This implies that making the correct decision more often does not necessarily imply a higher average return. Keep in mind however that is for the case where a perfect forecast is assumed to always produce the correct investment decision.

[Table 7 about here]

Table 8 removes the weighting for WAM. The rankings are fairly consistent with the exception of a tie between F and BR. However, this is not surprising since on the WAM they were virtually identical.

[Table 8 about here]

In summary, the conflict in rankings between the ILF and error analysis is explained by the WAM and AM which imply that the method with smaller error does not correspondingly make the correct investment decision a larger percent of the time. The WAA and AA imply that, given that perfect forecasts always lead to the optimal decision, it is possible for a method to fare better in terms of the number of times that it leads to the correct decision but fare worse in terms of its total return.

Summary and Conclusions

Previous research involving comparisons among forecast methods has typically relied on various error metrics. In the present study an alternative approach has been taken, namely comparing forecast methods based on the outcomes of investment decisions which depend on earnings forecasts. In particular an investors loss was defined as: the difference between the abnormal return he/she could earn given a strategy based on correct forecasts of earnings (and thereby of the non-impounded information) and the return he/she could earn given a strategy based on less than perfect forecasts.

Several forecast models were examined based on their observed loss. The results indicated that the models studied by Griffin and Watts ((0,1,1) x (0,1,1)) performed better than those of Brown and Rozeff ((1,0,0) x (0,1,1)), Foster ((1,0,0) x (0,1,0)) and individually identified Box-Jenkins models.

Furthermore these same models were examined based upon an outlier adjusted mean absolute percentage error metric and a mean rank criterion. These rankings were found to be identical to previous research on a different sample [Collins and Hopwood, 1980] but were different than those produced by the loss function. This was explained by showing that a smaller forecast error did not lead to a corresponding increase in percentage of times that the correct investment decision was made.

FOOTNOTES

[1] In the present study, we define unexpected earnings as the unexpected difference between an individual firm's earnings and the market conditioned expectation of the same number. This definition is the same as used by Ball and Brown [1968].

[2] The reader is referred to the Grossman and Stiglitz [1976] paper for details relating to the assumptions and logic of their analysis.

[3] In the present study, we exclude the constant term based on the evidence provided by Brown and Rozeff [1978] that this term is not significant.

[4] For 1974, there were only 4 years of data available for regression estimation.

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Table 1

Cumulative Abnormal Residuals for Prediction Methods and Actual Earnings

		GW (0,1,1) x (0,1,1)				P (1,1,0) x (0,1,0)				BR (1,0,0) x (0,1,1)	
	Month*	1974	1975	1976	1977	1974	1975	1976	1977	1974	1975
CAR+		N=114	N=134	N=146	N=151	N=61	N=117	N=131	N=120	N=59	N=99
	-11	-.01053	-.00083	-.00572	.00539	-.02256	.00841	.00216	.00415	-.01798	-.00148
	-10	-.01823	.00008	-.01020	.00082	-.04265	.01904	.00442	-.00742	-.02423	.00246
	-9	-.02419	-.00590	-.00712	.00723	-.06697	.01912	-.00573	-.00761	-.04701	.00319
	-8	-.02966	-.01343	-.00523	.01739	-.07956	.00955	-.00700	-.00265	-.06016	.00361
	-7	-.04574	-.01439	-.00356	.01709	-.09444	.01199	-.00259	-.00742	-.07290	.01124
	-6	-.03846	-.01480	-.00980	.02608	-.07094	.01567	-.01752	.00313	-.05619	.01397
	-5	-.04684	-.01139	-.00724	.02563	-.09224	.01733	-.02313	.00157	-.07112	.01302
	-4	-.03165	-.01185	-.00695	.02793	-.07698	-.00030	-.02979	.00044	-.05564	.01269
	-3	-.00327	-.01870	.00139	.03753	-.05193	-.01042	-.01903	.00678	-.01773	.00806
	-2	-.00010	-.01537	-.00763	.03641	-.04814	-.00568	-.02840	.00562	-.03006	.00857
	-1	-.00700	-.02164	-.00789	.03709	-.04575	-.00713	-.03169	.01258	-.02138	-.00317
	0	-.01550	-.02368	-.01306	.04641	-.04538	.00417	-.03846	.01312	-.03179	.00288
CAR-		N=150	N=132	N=118	N=116	N=203	N=149	N=133	N=147	N=205	N=167
	-11	.01203	.00030	-.01074	-.00452	.00975	-.00708	-.01793	-.00142	.00811	.00045
	-10	.02221	-.00595	-.00756	-.00371	.01899	-.02015	-.02226	.00397	.01308	-.00610
	-9	.02397	-.00087	-.00695	-.00261	.02425	-.02109	-.00834	.01159	.01762	-.00731
	-8	.02138	-.00515	-.00737	-.01151	.02305	-.02414	-.00538	.01095	.01646	-.01699
	-7	.02672	.00355	-.01272	-.02488	.02244	-.01921	-.01264	.00398	.01510	-.01540
	-6	.03657	-.00056	-.01364	-.03177	.02675	-.02627	-.00560	-.00083	.02154	-.02060
	-5	.02666	.00880	-.01575	-.03466	.02111	-.01605	.00086	-.00230	.01393	-.00990
	-4	-.00176	-.00104	-.02407	-.03452	.00405	-.01134	.00036	.00108	-.00288	-.01785
	-3	-.00401	.00861	-.01294	-.03702	.00780	-.00101	.00878	.00380	.00035	-.01296
	-2	-.00667	.00490	-.01784	-.04421	.00948	-.00502	.00376	-.00207	.00371	-.01354
	-1	-.00246	.00465	-.00751	-.04386	.00800	-.00975	.01589	-.00678	.00046	-.01181
	0	.00904	.02462	-.00782	-.04791	.01161	-.00276	.01661	-.00085	.00714	-.00124
C**OMPOSITE	-11	-.01138	-.00057	.00164	.00501	-.01271	.00767	.01011	.00265	-.01032	-.00083
	-10	-.02049	.00299	-.00226	.00208	-.02556	.01966	.01341	-.00552	-.01558	.00475
	-9	-.02406	-.00254	-.00083	.00522	-.03412	.02023	.00136	-.00980	-.02419	.00576
	-8	-.02495	-.00421	.00040	.01483	-.03611	.01772	-.00076	-.00722	-.02623	.01201
	-7	-.03493	-.00901	.00371	.02048	-.03907	.01603	.00508	-.00552	-.02602	.01385
	-6	-.03739	-.00718	.00068	.02855	-.03696	.02170	-.00587	.00186	-.02929	.01813
	-5	-.03538	-.01010	.00304	.02955	-.03755	.01661	-.01191	.99197	-.02671	.01106
	-4	-.01267	-.00546	.00692	.03079	-.02091	.00622	-.01496	-.00040	-.01020	.01593
	-3	.00087	-.01369	.00655	.03731	-.01569	-.00402	-.01387	.00095	-.00423	.01115
	-2	.00375	-.01017	.00375	.03979	-.01841	.00031	-.01599	.00367	-.00960	.01169
	-1	-.00162	-.01321	-.00100	.04003	-.01672	.00233	-.02373	.00938	-.00513	.00624
	0	-.01183	-.02415	-.00373	.04706	-.01941	.00338	-.02746	.00637	-.01265	.00185

*Relative to announcement date for annual earnings.
**Based on a weighted average of CAR+ and CAR-.

Table 1 Continued

	Month*	BR (continued) (1,0,0) x (0,1,1) 1976	1977	BJ 1974	1975	1976	1977	Actual 1974	1975	1976	1977
		N=107	N=120	N=90	N=132	N=123	N=120	N=132	N=151	N=151	N=156
	-11	.00391	.00223	-.01558	.00160	-.00978	.00529	.00235	.00893	-.01028	-.00018
	-10	.00189	-.00894	-.03323	.00133	-.01362	-.00839	.01974	.01937	-.00568	.00494
	-9	-.00813	-.00527	-.05257	-.00571	-.01795	-.01413	.03610	.02324	-.00562	.01717
	-8	-.00700	.00265	-.06458	-.00958	-.01282	-.00796	.03711	.02101	-.00625	.03037
	-7	-.00297	-.00301	-.08813	-.01173	-.00929	-.00937	.04590	.02902	.00054	.03486
CAR+	-6	-.01707	.00335	-.07979	-.00909	-.02205	.00232	.07362	.02900	.00356	.04766
	-5	-.02261	.00133	-.09295	-.01011	-.02123	.00875	.06065	.03724	.00688	.05318
	-4	-.02993	-.00228	-.07083	-.01027	-.02418	.00297	.06894	.04089	.01198	.05682
	-3	-.01834	.00226	-.04103	-.01597	-.01303	.00681	.09618	.04436	.01984	.06588
	-2	-.02768	.00328	-.04258	-.01662	-.01996	.01053	.08582	.04328	.01722	.06460
	-1	-.032389	.00996	-.03301	-.02128	-.01873	.01196	.08085	.04000	.01871	.06532
	0	-.04608	.01247	-.02873	-.01926	-.03133	.01801	.07287	.04490	.01880	.07535
		N=157	N=147	N=174	N=134	N=141	N=147	N=132	N=115	N=113	N=109
	-11	-.01605	.00015	.01152	-.00211	-.00637	-.00234	.00222	-.01235	-.00487	.00292
	-10	-.01646	.00521	.02439	-.00708	-.00502	.00476	-.01025	-.03216	-.01349	-.00997
	-9	-.00631	.00968	.03201	-.00113	.00247	.01690	-.02975	-.03839	-.00895	-.01765
	-8	-.00563	.00062	.03240	-.00907	-.00040	.01528	-.03843	-.04915	-.00610	-.03218
	-7	-.01085	.00037	.03865	.00066	-.00623	.00556	-.05503	-.05079	-.01861	-.05334
CAR-	-6	-.00773	-.00101	.04760	-.00640	-.00232	-.00017	-.06528	-.05598	-.03166	-.06677
	-5	-.00316	-.00210	.04037	.00724	-.00216	-.00816	-.07080	-.05207	-.03499	-.07846
	-4	-.00415	.00331	.01438	-.00276	-.00624	-.00098	-.09828	-.06870	-.05012	-.08041
	-3	.00406	.00749	.01562	.00551	.00197	.00378	-.10356	-.07016	-.03824	-.08291
	-2	-.00164	-.00017	.01621	.00583	-.00542	-.00608	-.09349	-.06912	-.05150	-.09025
	-1	.00944	-.00464	.01037	.00390	.00189	-.00267	-.08969	-.07241	-.04303	-.08997
	0	.01338	-.00031	.01250	.01955	.00726	-.00484	-.07598	-.05828	-.05016	-.09591
	-11	.01113	.00092	-.01291	.00186	-.00115	.00367	.00007	.01041	-.00379	-.00130
C**	-10	.01055	-.00689	-.02740	.00423	-.00367	-.00639	.01500	.02490	.00253	.00699
O	-9	.00046	-.00770	-.03902	-.00227	-.00968	-.01566	.03293	.02979	.00062	.01737
M	-8	.00051	-.00246	-.04337	-.00018	-.00576	-.01199	.03777	.03318	-.00096	.03111
P	-7	.00525	-.00156	-.05552	-.00615	-.00100	-.00727	.05046	.03843	.00827	.04241
O	-6	-.00232	.00207	-.05858	-.00128	-.00904	.00113	.06945	.04067	.01559	.05546
S	-5	-.00729	.00175	-.05829	-.00866	-.00874	.00843	.06473	.04365	.01891	.06350
I	-4	-.00966	-.00284	-.03363	-.00371	-.00793	.00187	.08361	.05291	.02830	.06645
T	-3	-.00985	-.00311	-.02428	-.01070	-.00712	.00098	.09987	.05551	.02772	.07283
E	-2	-.01025	.00157	-.02520	-.01119	-.00640	.00808	.08965	.05445	.03189	.07507
	-1	-.01895	.00703	-.01809	-.01252	-.00974	.00883	.08527	.05401	.02912	.07538
	0	-.02663	.00578	-.01803	-.01940	-.01847	.01076	.07442	.05068	.03222	.08374

*Relative to announcement date for annual earnings.
**Based on a weighted average of CAR+ and CAR-.

Table 2

Losses Associated With Each of the

Four Forecast Methods*

	GW	F	BR	BJ
1974	.0863	.0938	.0871	.0925
1975	.0748	.0473	.0488	.0701
1976	.0360	.0597	.0589	.0501
1977	.0367	.0774	.0780	.0730
Mean	.0585	.0696	.0682	.0714
Rank	1	3	2	4

*Based on a composite investment.

Table 3

Mean Absolute Percentage Forecast Errors

for the Four Methods*

Horizon 1 quarter ahead	2 quarters ahead	3 quarters ahead	4 quarters ahead	Annual
.3168049	.3415264	.3707929	.5296023	.3030187
.3131468	.3495478	.3946708	.5308849	.3069276
.3061375	.3393090	.3816767	.5381678	.3082423
.3112299	.3848678	.3865412	.5247461	.3225231
.5466285	.5507753	.5682686	.6131159	.5053421
.5173653	.5714754	.5496354	.5739701	.4871677
.4795169	.4954936	.4833038	.5172408	.4242318
.5150834	.4876365	.4882317	.5441138	.4296102
.3580204	.3591631	.3986770	.5185392	.3398120
.4006113	.4279471	.4062940	.5335978	.3441070
.3430058	.3365913	.3671510	.4812312	.3188220
.3310875	.3659078	.3940491	.4635779	.3034558
.3239681	.3166372	.3378085	.4160805	.2949488
.3249985	.3067774	.3605339	.4476179	.3078918
.3072657	.3228528	.3222657	.4003121	.2880671
.3128735	.3333958	.3465253	.4405104	.3082472
.3863555	.3920255	.4188867	.5193345	.3607804
.3890305	.4139370	.4277835	.5215177	.3615235
.3589815	.3735617	.3885993	.4842380	.3348408
.3675686	.3929520	.4038368	.4932370	.3409591

*Errors larger than 3 were set equal to 3.

Table 4

Mean Ranks* of Forecast Errors Associated

with the Four Forecast Methods

	1 quarter ahead	2 quarter ahead	Horizon 3 quarters ahead	4 quarters ahead	Annual
			Year 1		
GW	2.498127	2.310861	2.239700	2.344569	2.423221
F	2.513109	2.438202	2.576779	2.543071	2.438202
BR	2.329588	2.397004	2.584270	2.535581	2.468165
BJ	2.659176	2.853933	2.599251	2.576779	2.670412
			Year 2		
GW	2.647940	2.524345	2.704120	2.625468	2.726592
F	2.535581	2.749064	2.576779	2.610487	2.655431
BR	2.370787	2.397004	2.367041	2.292135	2.314607
BJ	2.445693	2.329588	2.352060	2.471910	2.314607
			Year 3		
GW	2.400749	2.325843	2.479401	2.438202	2.468165
F	2.831461	2.831461	2.632959	2.692884	2.711610
BR	2.411985	2.333333	2.453184	2.516854	2.505618
BJ	2.355805	2.509363	2.434457	2.352060	2.314607
			Year 4		
GW	2.539326	2.494382	2.434457	2.307116	2.483146
F	2.408240	2.340824	2.475655	2.565543	2.337079
BR	2.543071	2.486891	2.554307	2.441948	2.479401
BJ	2.509363	2.677903	2.535581	2.685393	2.700375
			Average		
GW	2.521536	2.413858	2.464419	2.428839	2.525281
F	2.572097	2.589888	2.565543	2.602996	2.535581
BR	2.413858	2.403558	2.489700	2.446629	2.439139
BJ	2.492509	2.592697	2.480337	2.521536	2.500000

Table 5

Weighted Percentage of Times that the Decision Leading to a Positive Return Was Made

	Year 1	Year 2	Year 3	Year 4	Average	Overall Rank
GW	.4656	.4270	.4907	.6603	.5062	1
F	.4445	.5059	.4097	.5303	.4712	3
BR	.4633	.5012	.4179	.5189	.4746	2
BJ	.4484	.4416	.4436	.5453	.4675	4

Table 6

Weighted Percentage of Times that the Same Decision Was Made as Would Have Been Made Had a Perfect Forecast Been Made

	Year 1	Year 2	Year 3	Year 4	Average	Overall Rank
GW	.5380	.5867	.6781	.6429	.6080	1
F	.2233	.5944	.6266	.5188	.5652	3
BR	.5430	.6138	.6020	.5607	.5792	2
BJ	.5054	.5496	.6422	.5523	.5603	4

Table 7

Percentage of Times That the Same Decision Was Made as Would Have Been Had the Perfect Forecast Been Made

	Year 1	Year 2	Year 3	Year 4	Average	Overall Rank
GW	.5785	.5709	.6628	.6207	.6082	1
F	.5517	.5862	.5939	.5211	.5632	4
BR	.5900	.6015	.5824	.5862	.5900	2
BJ	.5479	.5709	.6360	.5824	.5825	3

Table 8

Percentage of Times That the Decision Leading to

a Positive Return Was Made

	Year 1	Year 2	Year 3	Year 4	Average	Overall Rank
GW	.4904	.4444	.4789	.6207	.5086	1
F	.4556	.4751	.4176	.5211	.4674	3.5
BR	.4789	.4904	.3985	.5019	.4674	3.5
BJ	.4751	.4521	.4598	.5519	.4847	2

Faculty Working Papers

ORGANIZATIONAL SENSE MAKING AND ALTERNATIVE ACCOUNTING SYSTEMS: A CASE ANALYSIS

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