October 1983

Relative Accuracy of Judgmental and Extrapolative Methods in Forecasting Annual Earnings

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Postprint version. Published in *Journal of Forecasting*, Volume 2, Issue 4, October 1983, pages 437-447.
Publisher URL: http://dx.doi.org/10.1002/for.3980020411

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Published in the *Journal of Forecasting*, Vol. 2, 437-447 (1983)

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ABSTRACT

This paper identifies and analyses previously published studies on annual earnings forecasts. Comparisons of forecasts produced by management, analysts, and extrapolative techniques indicated that: (1) management forecasts were superior to professional analyst forecasts (the mean absolute percentage errors were 15.9 and 17.7, respectively, based on five studies using data from 1967-1974) and (2) judgmental forecasts (both management and analysts) were superior to extrapolation forecasts on 14 of 17 comparisons from 13 studies using data from 1964-1979 (the mean absolute percentage errors were 21.0 and 28.4 for judgment and extrapolation, respectively). These conclusions, based on recent research, differ from those reported in previous reviews, which commented on less than half of the studies identified here.

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This paper examines the accuracy of those methods currently used in forecasting annual earnings management judgment, outside analyst judgment, and extrapolations.

The first section draws upon research in finance and other fields to develop hypotheses concerning which forecasting methods would be most accurate for annual earnings forecasts. Section 2 presents a quantitative analysis of previously published studies, comparing management forecasts with analyst forecasts. In Section 3, a quantitative analysis is made of the evidence on judgment and extrapolative forecasts. The final sections offer proposals for further research and summarize the major conclusions.

1. **Hypotheses on Methods and Accuracy**

The literature on financial forecasting provides little indication of which forecasting methods should be most accurate in a given situation. To obtain some initial hypotheses, evidence from the social sciences was collected (Armstrong, 1978). This yielded the following conclusions for forecasting in situations involving large changes:

(1) Causal methods provide more accurate forecasts than naive methods.

(2) Objective methods provide more, accurate forecasts than subjective methods.

(3) Independent (unbiased) experts are more accurate than those involved in the situation.

(4) Amalgamated forecasts are more accurate than the typical error for the components of the amalgamated forecast.

Annual earnings forecasts qualify as a situation involving large changes. The average year-to-year change in earnings (in absolute terms) is about 28 per cent: Carey (1978) reported 28 per cent, Collins (1976) reported 26 per cent, Copeland and Marioni (1972) reported 28 per cent, Green and Segall (1966) reported 30 per cent, Johnson and Schmitt (1974) reported 29 per cent and Richards et al. (1977) reported 29 per cent.

Unfortunately, the published research on annual earnings forecasts does not allow for direct testing of the preceding four conclusions. The most popular methods used to forecast earnings, judging from the published studies, are judgment (by either management or outside analyst) and extrapolation. Judgment involves causality (a plus given the first conclusion) and subjectivity (a minus given the second conclusion). Extrapolation is objective (a plus), but does not incorporate causality (a minus): The effects of these two key dimensions, causality and objectivity, have been confounded in the research published to date.

For judgmental forecasts, the third conclusion suggests that outside analysts should generate more accurate forecasts than management. However, in this situation management may have some control over earnings. This control might lead one to prefer management over analysts. Thus, in Stewart"s (1973) survey, portfolio managers expected management forecasts to be superior to analyst forecasts.

In view of an inadequate framework for enquiry, the assessment of methods for annual earnings forecasts becomes primarily an empirical question. Which methods have proved most accurate?

Research on judgmental forecasts was reviewed by Richards and Fraser (1978), who concluded that there were no differences in accuracy between analysts and managers.

Conclusions by researchers who have examined judgmental and extrapolative forecasts have been mixed. Collins and Hopwood (1980) and Brandon and Jarrett (1977) concluded that judgment was superior; Gray (1974) found judgment by analysts was better, but only in rapidly changing industries; Cragg and Malkiel (1968) concluded that judgment performed "only a little better." Others (Carey, 1978; Green and Segall, 1967; Richards and Fraser, 1978) have concluded that there were no differences. Lorek *et* al. (1976) concluded that extrapolation was superior. An extensive review of the literature by Abdel-khalik and Thompson (1977-1978) concluded that judgment (by analysts and by management) was about as accurate as extrapolations. They said: "Unfortunately, the evidence to date is inconclusive" (p. 202).

Lorek *et al*. (1976) suggested amalgamated forecasts (conclusion four) as a logical area for research on earnings forecasts. Prior research from other disciplines was clear-cut. Amalgamated forecasts were more accurate than the average error for the components. All that is required is that there be some compensating errors; that is cases where one method"s forecast is too low and another method"s forecast is too high. In earlier work (Armstrong, 1978, pp. 263-268), I reported that amalgamated forecasts were more accurate in 10 of 18 comparisons (the others being ties). None of these studies, however, examined earnings forecasts.

This paper is an updated review of the empirical research on annual earnings forecasts. Much relevant research has been published recently. For example, four of the five key studies on management versus analyst forecasts were published after the Richards and Fraser (1978) review. Most of the 17 comparisons of judgment and extrapolation were published after Abdel-khalik and Thompson (1977-1978). Unfortunately, no papers were found that compared amalgamated earnings forecasts with those from judgmental and extrapolative methods.

The conclusions from this review differ substantially from those provided in the earlier reviews by Richards and Fraser (1978) and by Abdel-khalik and Thompson (1977-1978).

2. Management vs. Analyst

The mean absolute percentage error (MAPE) was used to assess accuracy.

$$MAPE = 100\left(\frac{\sum_{i=1}^{N}\left|\frac{A_i - P_i}{A_i}\right|}{N}\right)$$

where

A_j is actual annual earnings for firm i,
P_i is forecasted annual earnings for firm i,
N is the total number of firms in the sample.

The MAPE has certain advantages: (1) it can be averaged across years as well as across firms; (2) it is easy to interpret; and (3) it has been commonly used in previous research on earnings forecasts. Its major defect is that it is not relevant for negative earnings or those near zero. Some studies discarded these observations, others used the median rather than the mean, and some used a cutoff value for outliers (e.g. Brown and Niederhoffer, 1968).

Five studies allowed for direct comparisons of management and analyst forecasts of annual earnings per share (EPS). The forecast horizon was less than one year and the final earnings report was available for the previous year. Management was superior in all five studies, and the superiority of management forecasts was statistically significant ($p < 0.05$) in three of them. With a null hypothesis that management and analysts are equal in accuracy, the probability that management would be superior in all five studies is 0.03 (one-tailed binomial test assuming each study to be independent and of equal validity). Over all five studies, management forecasts had a lower MAPE than analyst forecasts (MAPEs of 15.9 vs. 17.7). A major shortcoming of these studies, however, is the limited time span (1967-1974). Exhibit I summarizes the results.

Exhibit 1
Management vs. Analyst Forecast

Author (year)	Number of forecasts	Years	MAPE* *(M)* Management	MAPE* *(A)* Analyst	Error ratio (A/M)	Statistical significance
Basi et al. (1976, p. 249)	88	1970-1971	10.1	13.8	1.36	0.01[1]
Imhoff (1978, p.846)	95	1971-1974	16.1	16.7	1.04	n.s.
Jaggi (1978, p.28)	156	1971-1974	26.7	28.3	1.06	0.05
Ruland (1978)	65	1970-1973	14.7[2]	16.0[3]	1.09	0.01
Barefield et al. (1979, p. 144)	134	(1967-1969) (1972-1974)	11.7	13.8	1.18	0.06
		Averages[3]	15.9	17.7	1.11	—

* MAPE is the Mean Absolute Percentage Error.
[1] This significance level was reported in Basi *et al* (1977). A critique of Basi *et al* is provided by Albrecht *et al*. (1977b)
[2] These results were provided in a private communication from Ruland.
[3] All studies were weighted equally. The average ratio was based on the averages from the management and analyst columns. The geometric mean of the error ratios for each study was 1.14.

Why were the management forecasts superior? One possible explanation is because of "inside information"; another is management"s control over performance; a third is that management may influence reported earnings; finally, management may have more recent information than the analysts have.

Managers sometimes have inside information. Brooks (1969) describes one such case – Texas Gulf Sulphur. Finnerty (1976) and Jaffe (1974) showed that insiders outperformed the market. Ruland (1978 79) showed that management"s inside information was valuable in predicting changes in the price of the firm"s stock. Additional support was provided by Nichols and Tsay (1979) who found that the announcement of long-term forecasts affected the stock price. Given that management has inside information, their forecasts should be superior to analysts" forecasts, all other things being equal.

The superiority of management forecasts over analyst forecasts might also be explained by management"s impact on performance. Forecasts by management often become targets, with efforts then being made to reach them.

Reported earnings can be manipulated to bring them into line with management"s forecast. For example, extraordinary items are often a significant component of earnings per share (Nichols, 1973) and are subject to control by management. Since 1973, however, changes in generally accepted accounting procedures (GAAP) have made it more difficult to manipulate earnings by arbitrarily classifying certain events as extraordinary. Nevertheless, management still can smooth earnings. To avoid pressure from stockholders, management can decrease expenditures to boost earnings in bad years. To avoid high expectations among stockholders (and in some cases to avoid government regulation), management would increase spending to bring earnings down in good years. Kamin and Ronen (1978) and Smith (1976) found evidence that firms engage in smoothing (more often in management-run than in owner-run companies). Circumstantial evidence on smoothing was also provided by Niederhoffer and Regan (1972) and by Kross (1981): firms with poor earnings reported earnings later, which could relate to attempts to improve reported earnings.

Managers have more recent information than analysts. This is especially true just prior to the release of the interim reports. If this more recent information on the current earnings were valuable, one would expect analysts to improve relative to management after the publication of the interim reports. Jaggi (1978) found that management forecasts were significantly better than analysts before, but not after, the release of interim reports (Jaggi (1980) provided additional analyses of these data). Ruland (1978) also found that management"s superiority over analysts decreased after the release of interim reports. Similarly, Crichfield *et al*. (1978) found that the later in the year that analysts made forecasts, the better their forecasts.

3. Judgment vs. Extrapolation Forecasts

Below, forecasts from both management and analysts are grouped. The common assumption was made that management and analysts depended primarily upon their judgment in producing the forecasts. Firth"s (1975) description of how experts forecast earnings is consistent with this assumption. Of course, many of these analysts would also have had access to quantitative forecasts as an input to their judgments.

Numerous extrapolation techniques have been used for earnings forecasts, ranging from the no change (martingale) model to Box-Jenkins modeling (Mabert and Radcliffe (1974) describe the use of the Box-Jenkins procedure in financial problems). Some studies found that errors were not sensitive to the choice of an extrapolative technique. Among these were comparisons for seven extrapolative techniques by Brandon and Jarrett (1977), ten by Johnson and Schmitt (1974), three by Hagerman and Ruland (1979), and twenty-one by Carey (1978). Other studies have found differences. Frank (1969) found increased accuracy by weighting the most recent data more heavily (exponential smoothing was more accurate than moving averages) as did Elton and Gruber (1972). Brandon and Jarrett (1979) found that mechanical revisions improved extrapolation forecasts. In an analysis of over 4000 forecasts for the years 1973-1977, Ruland (1980) compared 8 extrapolative models. His major conclusion was that the simple martingale model was superior to the models that incorporated information about trends. Albrecht et al. (1977a) found the martingale model to be equal in accuracy to firm-specific Box-Jenkins models.

In general, then, it was difficult to generalize about the best way to extrapolate earnings. As a result, the comparisons of judgment and extrapolation included all studies. That is, no studies were discarded because of poor techniques. Furthermore, if a study used more than one extrapolative technique, the average error was calculated across methods, with each component weighted equally.

Results

All studies that I found that compared judgment and extrapolation of annual earnings were included. All forecasts were made with horizons of less than one year and were conditioned upon knowledge of earnings for the previous year.

The MAPE was used as the measure of accuracy. MAPEs were given in most of the published studies. For Ruland (1978), the MAPE was provided by personal correspondence. I calculated the extrapolation MAPE for Barefield and Comiskey"s paper (1975) using data provided by Comiskey. Elton and Gruber (1972) provided data on squared errors in their paper, which was converted to an estimate of MAPE. (I used the formula presented by Brown (1963, p.283.) In making these calculations7 it was not possible to obtain an extrapolation forecast for 1967.) The median absolute percentage error was used for Brown and Rozeff"s (1978) data because it was not possible to estimate the mean. Drafts of my paper were sent to authors of each study included in Exhibit 2, so that they could check my interpretation of their study.

Exhibit 2 [next page] summarizes the results. Judgment was more accurate than extrapolation for 14 of the 17 comparisons (significant at $p < 0.05$ by the two-tailed binomial test, assuming that these were independent observations and using the null hypothesis that the methods do not differ in accuracy). For eight of the comparisons, the superiority of judgment was significant at $p < 0.05$. For the 16 comparisons that allowed an estimate, the average MAPE for judgment was 21.0, whereas for extrapolation it was 28.4.

Each of the three comparisons that showed extrapolation to be superior was suspect. In the work of Hagerman and Ruland (1979), the high MAPEs were due to one outlier which was 4400 percent; judgment was found to be superior using the median absolute percentage error. Lorek (personal communication) reported that he was unable to replicate his findings on the superiority of extrapolation when using a new sample. Finally, Elton and Gruber selected the best of nine extrapolative methods for comparison against the analyst forecasts; but even here extrapolation had an insignificant advantage.

Sophisticated extrapolation methods were used in six of the comparisons (Lorek *et al*., Elton and Gruber (3), Collins and Hopwood and Brown and Rozeff). Judgment was superior in four of these six comparisons. But the two cases showing extrapolation to be superior (Lorek *et al*. and Elton and Gruber) were suspect, as noted in the preceding paragraph.

Five studies (Hagerman and Ruland, Crichfield *et al.*, Collins and Hopwood, Brandon and Jarrett and Brown and Rozeff) used a criterion that compensated for the effect of outliers. Judgment was superior in each of these comparisons.

Possible explanations for superiority of judgment

One possibility is that the samples were not typical of the total population. In the work of McDonald (1973), managers expecting bad years were found to be less likely to make forecasts of their firm"s earnings. The results from studies of management forecasts (such as the present study) are only applicable to situations where managers publish their forecasts.

Part of the superiority of the judgment methods may be due to the advantages of management forecasts; that is, inside information and the control over earnings by management. However, the analysts were also superior to extrapolation: for the 12 studies allowing a comparison, the MA PE for the analysts" error was 17.7 compared with 27.4 for the extrapolations.

Experts possess information about a variety of factors that cause changes in earnings, such as recent tax changes, new competitive developments, new products or new laws. It is possible that this additional information allows them to forecast changes in annual earnings more accurately than can be done by naive extrapolations of historical data.

Typically, published accounting data lags behind actual events. Quarterly earnings are published about a month after the end of a reporting period and annual earnings are published about two months after the end of the year. Managers and analysts usually have more recent information than is published in these reports. In other words, they have a better knowledge of current earnings. Previously (Armstrong, 1978, pp.84 89) I concluded that the relative advantage of experts is in assessing how things are now, rather than how they will change in the future. If current earnings estimates are unreliable, one might expect expert information to yield more accurate estimates of the current rate of earnings.

Exhibit 2. Accuracy of Judgmental and Extrapolation Earnings Forecasts

Study	Source[1]	Time span	# of firms	MAPE[2]		Error ratio (exploration/ judgment)	Statistical significance	Comments
				Judgment	Extrapolation			
Hagerman & Ruland (1979, p. 174, 175)	W.S.J.	1969-1973	98	(M) 76.4	65.3	0.85	0.05	Median percentage errors were 7.4 for judgment vs. 13.6 for extrapolation.
Crichfield et al. (1978)	S & P	1967-1976	46	(M) —	—	1.0	n.t.	Researchers unable to provide MAPEs
Copeland & Marioni (1972, p. 505)	W.S.J.	1968	49	(M) 20.1	33.8 (2)	1.68	0.05	
Lorek et al (1976, pp. 324, 325)	W.S.J.	1966-1970	37	(M) 13.0	5.6	0.43	0.01	Loreck was unable to replicate. (Personal communication. See also Lorek, 1979)
Ruland (1978)	W.S.J.	1970-1973	65	(M) 14.7	21.5	1.46	0.01	MAPEs from personal communication from Ruland
Ruland (1978)	S & P.	1970-1973	65	(M) 16.0	21.5	1.34	0.05	
Elton & Gruber (1972, p. B-419)	S & P	1964-1966	213	(A) 12.2	11.9	0.98	n.s.	MAPE estimated from data of E&G Table 3, where the best of nine extrapolation models was used
			177	(A) 14.8	15.0	1.01	n.s.	
			84	(A) 14.1	16.8	1.19	n.s.	
Klepczynksi, in Basi et al. (1976, p. 245)	S & P	1966-1968	47	(A) 7.3 (2)	13.3	1.82	n.t.	
Barfield & Comiskey (1975)	S & P	1968-1972	100	(A) 16.5	27.9	1.69	0.01	Calculated extrapolation error with data from Comiskey
Collins & Hopwood (1980, p.398)	Value Line	1970-1974	50	(A) 34.1	59.6 (4)	1.74	0.05	Judgment also superior when MAPE was adjusted for outliners.
Brandon & Jarrett (1977, p. 44)	S & P	1970-1974	27	(A) 20.3	60.9 (7)	3.00	n.s.	Judgment was significantly more accurate by the sing test.
Brown & Jarrett (1977, p. 44)	Moody"s	1972-1975	50	(A) 18.6	23.5(3)	1.26	≈0.05	Median error from B & R Table 2
Richards et al, (1977, p. 82)	S & P	1969-1972	50	(A)) 18.1	24.2(3)	1.34	n.t.	
Richards et al, (1977, p. 82)	S & P	1972-1976	92	(A) 24.1	34.3	1.42	0.05	
Fried & Givoly (1982, p. 91)	S & P	1969-1979	424	(A) 16.4	19.8(2)	1.21	0.01	
Averages (each comparison weighted equally)				21.0	28.4	1.35		

[1] W.S.J. = *Wall Street Journal*; S. & P. = Standard and Poor"s.

[2] Where alternative forecasts were provided, an average error was calculated. The number of forecasts in the average is indicated by the number in parentheses. All errors based on MAPE except as indicated under notes column. The (M) designates a management forecast and the (A) designates an analyst forecas

It seems obvious that better information on the current situation should improve the annual earnings estimate. Surprisingly, this argument was challenged by Green and Segall (1966, 1967), who concluded that interim reports did not improve annual earnings forecasts. Numerous researchers contested this (e.g. Coates, 1972). Brown and Rozeff(1979) reanalyzed data used by Green and Segall and found that interim reports had, in fact, led to improvements in accuracy.

In summary, the evidence suggests that experts, including management and analysts, have valuable information on a firm"s current status. This information apparently helps them make better forecasts than those obtained from extrapolations.

4. Proposals for Further Research

The research to date has been useful for assessing differences in accuracy among the various forecasting methods. But more could be done to explain the conditions under which one method would be better than another. For example, under what circumstances is the accuracy of management forecasts likely to be superior to that of analysts? To assess this question, detailed data would be required on the situation faced by each firm in the sample.

The possibility also exists that econometric models would yield superior forecasts, but little research was found on this topic. Hagerman and Ruland (1979), Chant (1980) and Hopwood (1980) used crude econometric models, but the accuracy of those models did not differ substantially from the accuracy of naive extrapolations. A more relevant test would be to incorporate firm-specific causal information. Collins (1976) took a step in this direction and found that a segmentation method with firm-specific data was more accurate than six extrapolative methods. The use of econometric methods for each firm offers a promising area for further research.

Research using econometric methods would help to identify the importance of the two key dimensions objectivity and causality—upon the accuracy of forecasts. A comparison of econometric and judgmental methods, each of which examines causality, would allow for an examination of the importance of using causality in a more objective manner.

Amalgamated forecasts also offer some promise. In view of the lack of research to date, efforts in this area would be useful. Granger and Newbold (1977, pp.268-278) discuss procedures for combining forecasts.

5. Conclusions

The accuracy of management and analyst forecasts was compared by reanalysing data from previously published studies. In each of the five studies allowing a comparison, management forecasts were superior. Across all studies, the MAPEs for management and analysts were 15.9 and 17.7, respectively. Unfortunately, these results were drawn from a limited time period, 1967 to 1974. Four possible explanations were proposed for management"s superiority: (1) Managers sometimes have inside information; (2) managers exert control over performance; (3) managers can influence the reported earnings; and (4) managers have more recent information. Additional research is needed to assess the validity of each of these various explanations.

Judgmental forecasts (both management and analysts) and extrapolative forecasts were compared using evidence from 13 studies. In 14 of the 17 comparisons, judgmental forecasts were found to be superior. Further research is needed to determine whether the superiority of judgment is due to information on causality or to better information about current earnings.

Research was suggested in additional areas. First, a more complete description is required of each firm"s situation. Secondly, econometric models for each firm might be superior to either judgment or extrapolation. Thirdly, amalgamated forecasts should be evaluated.

The implications for those who use annual earnings forecasts for financial planning within the firm, for investment purposes by outsiders, or for research are:

1. Use earnings forecasts as published by top management if they are available. This conclusion contrasts with the use of extrapolative forecasts in studies on market expectations (e.g. Beaver et al., 1979).

2. Use published forecasts by outside analysts if published forecasts from top management are not available.

3. Use extrapolations if judgmental forecasts are not available.
4.

When forecasts are available from more than one of the above sources, a weighted average might be considered, perhaps with more weight on the forecasts by management than on extrapolative forecasts.

Acknowledgements

Robert Magee, Timothy R. Crichfield, Robert L. Hagerman and others commented on drafts of this paper. Eugene E. Comiskey, Kenneth S. Lorek and William Ruland provided additional data. Much of the work on this paper was done while the author was a Visiting Professor at IMEDE, Lausanne, Switzerland.

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