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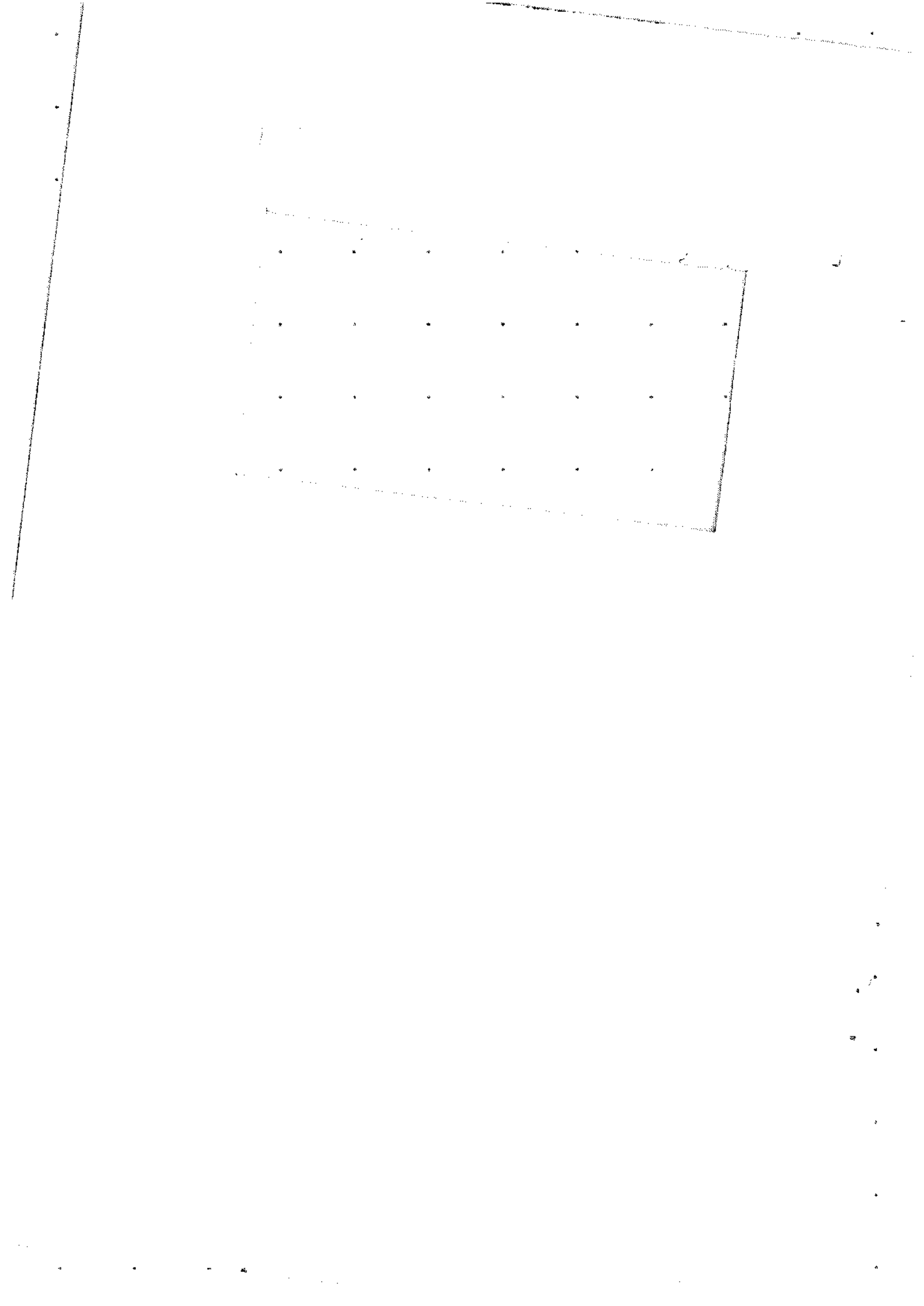

Forecasting Corporate Revenue and Profit:

Models versus Management and Analysts

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The predictability of corporate profits has attracted considerable research the last decade or so. While early work focussed on the performance of forecast models, corporate managements and financial analysts per se, later studies have increasingly endeavored to determine the comparative accuracy of the forecasts generated by these sources.[1] One reason for this shift in emphasis has obviously been the search for an external benchmark against which to evaluate forecast accuracy. The need for such a benchmark may have become more apparent because of the trend toward profit forecast disclosure by firms in several countries, both on a voluntary basis and as a result of policy shifts by accounting rulemaking bodies.[2] The question then arises whether these corporate forecasts are useful for outsiders, to improve their investment decisions, for example. Financial analysts have served as a knowledgeable group of outsiders in this context, while forecasting models have served as tools potentially available to any outsider. As to the latter it is, of course, an empirical question which forecast model could best serve as an external standard for evaluating management's forecast accuracy.

This paper tries to shed some more light on this question. It reports primarily on the forecast accuracy of nine models which have been used to describe the time-series of corporate revenues and profits and compares the performance of these models with that of management and analysts.[3] Our research provides several extensions to and replications of previous studies:

- whereas earlier research focussed almost exclusively on profits, we give results for both revenues and profits;
- the comparisons are based on internal data confidentially obtained from corporate management and financial analysts rather than on published data;
- while most research has used samples from the U.S. or U. K., our results

pertain to a sample of Dutch companies, thus providing opportunities for international comparisons;

- we have used not only point estimates but also prediction intervals for all three groups of forecasts in this study; and
- following some leads in the literature we have tried to improve model forecast accuracy by selecting a specific model for each time-series instead of assuming the same model for all time-series.

The remainder of this paper is divided into five sections. In the first section we review the major findings from the related literature. Next, we sketch our research design. In the third section, we describe the nine models and analyze their performance. The model forecasts are compared with those of management and the analysts in the fourth section and we conclude with a summary of our main results.

1. Related research

As our study deals with annual data, we shall summarize only the literature concerning such data, omitting, for example, the research on quarterly forecasts.[4] In conformity with the presentation of our own results, we shall first concentrate on the model forecasts per se and then on the comparison of these forecasts with management and analyst predictions.

1.1 Model forecasts

The literature on modeling corporate financial data has focussed almost entirely on profit forecasts (an exception is Foster, 1977, who considers sales forecasts as well). Of the two general approaches to forecasting, causal modeling and time-series modeling, the latter has been used almost exclusively, no doubt because causal models for this purpose are difficult to specify accurately and tend to be very firm-specific.

Time-series models, however, have become very popular, especially after the introduction of the Box-Jenkins (1970) ARIMA-framework in the accounting literature. Autoregressive integrated moving average models may be expected to perform well when applied to long time-series without any structural changes. Indeed, they have been shown to outperform more restricted time-series models on a quarterly basis [see, e.g., Watts (1975), Lorek et al. (1976), Foster (1977), Griffin (1977) and Brown and Rozeff (1978)]. For profits on a yearly basis, however, Watts and Leftwich (1977) found that the random-walk model showed a better performance. Similar results were obtained by Beaver (1970), Ball and Watts (1972), Lookabill(1976) and Albrecht et al. (1977).[5]

ARIMA-models are very flexible and contain many simple time-series models as specific cases. However, if only few data are available, or when the time-series contains structural changes [cf. Watts (1970)], ARIMA-models are probably not very appropriate. The question then arises which simple time-series model yields optimal prediction results. This question has been examined by McEnally (1971),

Elton and Gruber (1972) and Nichols and Groomer (1979). Since the number and nature of models used, the time periods, and the samples, etc., vary among these studies, it is difficult to compare their results. The main finding of the latter two studies, however, was that an "exponentially weighted moving average with no trend in trend" performed best. We will later refer to this model as the Elton and Gruber-model. McEnally also reports good results with moving average models.

All the above studies assumed that every time-series could be described appropriately by the same model. This assumption is not very plausible. An increase in forecast accuracy may be expected if it can be relaxed. Albrecht et al. (1977) lend supportive evidence to this expectation in that they found industry-specific effects in applying their ARIMA-models. They did not succeed in improving forecast accuracy, however. Neither did Ruland (1980) who reported a rather robust dominance of the ramdon-walk model.

Summing up: For the purpose of forecasting yearly profits, the pure random-walk model seems hard to beat, although in some studies moving-average models perform better. Moving beyond such relatively simple models to more complex frameworks seems as yet to yield no improvement in forecast accuracy.

1.2 Model forecasts versus management and analysts

From an a priori point of view management and analysts should be able to obtain better prediction results than time-series models, simply because they can use all available time-series data and any other source of relevant information. The literature, however, does not generally bear out this expectation. Comparisons between model and management forecasts were carried out by Green and Segall (1966, 1967), Copeland and Marioni (1972), Ruland (1978), Nichols and Groomer (1979) and Hagerman and Ruland (1979). Again, because of differences in the models used, performance criteria, etc., these studies are difficult to compare. In general, however, they show a confusing pattern of results. In their replication of Green and Segall's study, for instance, Copeland and Marioni got quite the opposite results, a

phenomenon they attributed to Green and Segall's sample selection design. Ruland (1978) concludes that management significantly outperforms his models, whereas Nichols and Groomer (1979) find that the Elton and Gruber-model forecasts significantly more accurately than management.

Similar confusion arises from the research on model versus analyst forecasts. Such studies have been performed by Cragg and Malkiel (1968), Elton and Gruber (1972), Barefield and Comiskey (1975), Richards et al, (1977), Ruland (1978) and Brown and Rozeff (1978). All in all, and despite more recent studies, the conclusions from the earlier survey by Abdel-khalik and Thompson (1977/1978) remain valid:

- "Researchers disagree as to whether earnings forecasts made by management and/or analysts are more accurate than forecasts which rely on mechanical forecasting models...
- The evidence to date does not show that information available to management and analysts (beyond that required by historically based time series models) is particularly valuable for making more accurate forecasts."

2 Research design

Looking at the state-of-the-art as it emerges from the literature summarized above and given that no prior research existed with respect to Dutch samples, we decided to set up this study in an exploratory way. A major difficulty in obtaining data for this type of study in the Dutch environment, however, is that almost no quantitative management of analysts' forecasts are published. We therefore devised a research design geared to internal forecasts. Using a notary as an intermediary, we obtained management forecasts from 53 out of the 193 companies listed on the Amsterdam Stock Exchange. We also arranged for 124 analysts' forecasts prepared by at least 30 analysts working for 14 different organizations. The management forecasts were submitted in the beginning of 1980 and pertained to the expected 1980 revenues and profits. The analysts' forecasts were deposited with the notary at about the same time and referred largely to the same companies. Further information on this part of the overall research project is provided in Schreuder and Klaassen (1982, 1983).[6]

To insure comparability, our model predictions were also for 1980. In selecting these models we were guided by (1) an examination of the properties of the time-series to be used, (2) the results of prior research as summarized above and (3) the exploratory nature of this research -for which a broad representation of the different types of time-series models was desirable. As a result of (1) we omitted ARIMA-models from further analysis. There were too many structural changes (especially mergers and major takeovers) in the time-series to permit the application of these models. Our second consideration led us to include the random-walk model (with and without drift), a simple exponentially weighted moving-average and the Elton and Gruber-model. Our third consideration led, for example, to the addition of two trend models. The actual models used will be described in the next section.

Participating management and analysts were not only asked their "best guess" point extimates of 1980 revenue and profit but also their 50 percent and 100 percent prediction intervals. Accordingly, we also computed the 50 percent and 95 percent

Table 5

Revenue Forecasts of Management, Analysts, and Models

	Management	Analysts	Model 1	Model 3	Model 4	Model 6	Model 9
Management	--	-1.061	1.372*	-0.686	0.343	-1.029	0.000
Analysts	1.061	--	1.715**	0.343	-0.343	0.000	0.343
Percentage of negative forecast errors	41.2	38.2	41.2	50.0	58.8	58.8	55.9
Percentage of revenues within 50% interval	44.1	44.1	47.1	47.1	55.9	50.0	51.6
Percentage of revenues within 100/95% interval	65.5	64.7	79.4	85.3	91.2	85.3	96.8

N.B. See Table 2 for Legenda

Table 4

Criteria for Selecting Firm-Specific Models

1	Mean prediction error (PE)	$\left\lvert \frac{1}{4} \sum_{t=1976}^{1979} (Y_{j,t} - \hat{Y}_{j,t}) \right\rvert$
2	Mean relative PE	$\left\lvert \frac{1}{4} \sum_{t=1976}^{1979} \left(\frac{Y_{j,t} - \hat{Y}_{j,t}}{Y_{j,t}} \right) \right\rvert$
3	Mean absolute PE	$\frac{1}{4} \sum_{t=1976}^{1979} \lvert Y_{j,t} - \hat{Y}_{j,t} \rvert$
4	Mean absolute relative PE	$\frac{1}{4} \sum_{t=1976}^{1979} \left\lvert \frac{Y_{j,t} - \hat{Y}_{j,t}}{Y_{j,t}} \right\rvert$
5	Mean squared PE	$\frac{1}{4} \sum_{t=1976}^{1979} (Y_{j,t} - \hat{Y}_{j,t})^2$
6	Mean squared relative PE	$\frac{1}{4} \sum_{t=1976}^{1979} \left(\frac{Y_{j,t} - \hat{Y}_{j,t}}{Y_{j,t}} \right)^2$

Table 3

The Model Forecasts of Profit

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Model 2	2.142**								
Model 3	0.630	-0.882							
Model 4	2.832**	1.043	0.447						
Model 5	2.534**	1.640*	0.745	1.640*					
Model 6	0.149	-0.745	2.412**	-0.745	-0.745				
Model 7	-1.890**	-2.394**	-2.286**	-1.938**	-2.534**	-1.206			
Model 8	-1.638*	-1.386*	-2.394**	-1.938**	-2.534**	-1.043	1.569*		
Model 9	1.016	-0.882	0.420	-1.640*	-1.043	-0.149	1.134	1.270	
Percentage of negative forecast errors	60.3	61.9*	62.9**	75.6**	71.1**	71.1**	55.6	54.0	69.8**
Percentage of profits within 50% prediction intervals.	31.7**	25.4**	30.2**	33.3**	33.3**	28.9**	34.9**	39.7*	37.5**
Percentage of profits within 95% prediction intervals.	74.6	66.7	82.5	75.6	60.0	84.4	81.0	88.9	94.6

N.B. See Table 2 for legenda.

Table 2

The Model Forecasts of Revenue

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Model 2	3.054**								
Model 3	0.122	-1.588*							
Model 4	0.246	-1.588*	1.100						
Model 5	3.299**	0.611	1.588*	3.299**					
Model 6	1.100	-0.122	1.364*	-0.367	-1.344*				
Model 7	2.462**	1.833**	2.810**	0.492	0.122	2.566**			
Model 8	2.810**	2.321**	3.054**	0.855	0.611	2.810**	1.000		
Model 9	1.100	-0.855	0.137	-0.855	-1.833**	-1.231	-1.477*	-1.723**	
Percentage of negative forecast-errors	43.3	35.8**	55.2	58.2	58.2	59.7	19.4**	16.4**	55.2
Percentage of revenues within 50% prediction interval.	47.8	37.3**	53.7	53.7	37.3**	56.7	35.8**	43.3	54.1
Percentage of revenues within 95% prediction interval.	85.1	77.6	91.0	92.5	85.1	89.6	95.5	98.5	98.4

N.B. The model comparisons have been carried out using the normal approximation of the sign test. A positive value denotes a superior performance by the model indicated in the column heading. A * or ** shows significance levels of 10% and 5%, respectively (one-tailed sign test). For the 95% level this test is not appropriate, and we have refrained from applying it. The forecast error is defined as: $y - \hat{y}$.

Table 1

Forecasting Models Used

NUMBER	NAME	FORMULA
1	RANDOM WALK PLUS CONSTANT	$\hat{Y}_{j,t+1} = Y_{j,t} + a$
2	LINEAR TREND	$\hat{Y}_{j,t+1} = a + b(t+1)$
3	IDENTICAL CHANGE	$\hat{Y}_{j,t+1} = Y_{j,t} + (Y_{j,t} - Y_{j,t-1})$
4	RANDOM WALK MULTIPLIED BY CONSTANT	$\hat{Y}_{j,t+1} = Y_{j,t}\, e^{a}$
5	MULTIPLICATIVE TREND	$\hat{Y}_{j,t+1} = e^{a+b(t+1)}$
6	IDENTICAL PERCENTAGE CHANGE	$\hat{Y}_{j,t+1} = Y_{j,t}\, \frac{Y_{j,t}}{Y_{j,t-1}}$
7	RANDOM WALK	$\hat{Y}_{j,t+1} = Y_{j,t}$
8	EXPONENTIALLY WEIGHTED MOVING AVERAGE	$\hat{Y}_{j,t+1} = a\, Y_{j,t} + (1-a)\, \hat{Y}_{j,t}$
9	ELTON AND GRUBER MODEL: EXPONENTIALLY WEIGHTED MOVING AVERAGE WITH NO TREND IN TREND	$\bar{Y}_{j,t} = \bar{Y}_{j,t-1} + r_{j,t-1} + a[Y_{j,t} - (\bar{Y}_{j,t-1} + r_{j,t-1})]$ $r_{j,t} = r_{j,t-1} + b[\bar{Y}_{j,t} - (\bar{Y}_{j,t-1} + r_{j,t-1})]$ $\hat{Y}_{j,t+1} = \bar{Y}_{j,t} + r_{j,t}$

N.B.

$Y_{j,t}$ = revenue or profit for company j in year t

$\hat{Y}_{j,t}$ = forecast of revenue or profit for company j in year t

The major limitation of this study is, of course, that it is restricted to only one year.[11] The research design necessary to obtain forecasts from management and analysts in the Dutch environment imposed practical restrictions on extending the analysis to additional years. As regards profit forecasting, however, our study can be evaluated in light of the already sizeable literature. As such, it has reconfirmed the superiority of the random-walk model over other forecasting techniques and its nearly identical performance vis-à-vis management and analysts' forecasts. Our findings with respect to revenue forecasting await the results of replication in further research.

5 Summary and conclusions

This paper has provided further evidence on the forecast accuracy of simple time-series models with respect to corporate financial data. Revenues were predicted relatively well by (1) the random-walk with additive drift, (2) the identical change model and (3) the Elton and Gruber-model. There are no previous studies we know of with which to compare these results. For profit forecasting, the pure random-walk model dominated all other forecasting techniques, as could be expected from earlier research findings.

In addition, we tried to improve forecast accuracy by selecting firm-specific models. This attempt failed just as had earlier research directed at establishing superior selection techniques [Watts (1975); Ruland (1980)]. To us this finding provides one of the most intriguing clues for further research to come out of our study.

Finally, we compared model forecasts with internal forecasts confidentially obtained from corporate management and financial analysts. Both groups were significantly outperformed by the random-walk with additive drift model in forecasting revenues. Hardly any differences existed between management, the analysts and the pure random-walk model with respect to profit forecasting. The simple exponentially weighted moving average showed about the same comparative results. The Elton and Gruber-model, which performed well in some prior studies, was here significantly outperformed by management, although not by the analysts.

All comparisons were also carried out on the basis of the forecasting bias involved and the specification of uncertainty. The latter was accomplished by asking management and analysts for their prediction intervals and by calculating similar ranges for the models. We feel that such procedures lend important additional weight to the comparisons made in this paper.

4.2 Profit forecasts

The random-walk model, which clearly dominated all other forecasting techniques in this study, is only barely outperformed by management and the analysts in profit forecasting, both doing better in only 20 of the 38 comparisons. Needless to say, this difference is far from significant. The exponentially weighted moving average shows about the same comparative results. The Elton and Gruber-model is significantly inferior to management but not to the analysts. The random-walk model shows no bias, whereas both management and the analysts were too optimistic. Again, the models deal far better with the uncertainty of the forecasts. Both management and the analysts were completely surprised by the actual profits in about 60 percent of the cases.

Table 6 about here

4 Models versus management and analysts

There were 34 companies for which we received both a management forecast and at least one analyst forecast of revenue. For profit forecasts this total is 38. In order to enable a complete comparison among the three groups of forecasts, all analyses in this section will be based on these samples.[9] As space is limited, we shall not present the comparative results for all nine models. For revenue forecasting, some models, such as the trend models and the "no growth" models, were found to be inappropriate. These will be eliminated from further consideration. For profit forecasting we shall use the models which would also have been selected on the basis of previous research. These are the pure random-walk, the exponentially weighted moving average and the Elton and Gruber-model.[10]

4.1 Revenue forecasts

Table 5 presents comparative data on the revenue forecasts of management, analysts and five forecasting models. Model 1, the random-walk with additive drift, outperforms management at a significance level of ten percent and the analysts at a significance level of five percent. It generates a more accurate prediction 21 out of the 34 times as compared with management and 22 out of 34 as compared with analysts. None of these five models is significantly outperformed by management or the analysts. Two of the five models have a better balance between under- and over-estimates than management, none a worse; all models perform better than the analysts in this respect. Similarly, the models better take into account the uncertainty inherent in these forecasts. The percentages of actual revenues within both prediction intervals conform more closely to the specified levels. All in all, neither management nor the analysts outperform our five simple models. In fact, model 1 appears to be the best forecaster.

Table 5 about here

Thus, we obtained six series of firm-specific forecasts generated by models which had historically performed best according to our six criteria. Our expectation that this procedure would improve forecast accuracy was, however, not borne out by the results. As compared with the optimal revenue forecasting model, model 1, five of the six criteria yield less accurate predictions. Only criterion 5, the mean square prediction error, fares some better than model 1, generating 29 more accurate predictions versus 27 less accurate (and 11 draws). For profit forecasting, the picture is even clearer. The pure random-walk significantly outperforms all six criteria. Apparently, the increased flexibility allowed by the criterion selection does not lead to improved accuracy. Similar findings were reported by Watts (1975), Albrecht et al. (1977) and Ruland (1980). This rather puzzling outcome may well be explained by the tendency of the more flexible procedures to misinterpret unsystematic factors in the historical series as systematic. This is, however, an ex post and ad hoc rationalization. Further research will have to address this issue more satisfactorily.

better than all other models and significantly outperforms all but models 6 and 9. Its dominance is, however, perfectly clear.

Table 3 about here

All percentages of negative forecast errors are above 50 percent, indicating that 1980 profit levels were lower than expected on the basis of historical information. However, for models 1, 7, and 8, which show relatively good forecasting accuracy and may thus be regarded as perhaps most appropriate, the hypothesis of an equal number of over- and under-predictions cannot be rejected. All proportions of actual profits within the specified prediction intervals are smaller than expected--for the 50 percent interval even significantly so in all cases. These results imply that profits varied more in 1980 than was to be expected from historical data only.

3.4 Firm-specific forecast models

Finally, we tried to improve overall forecast accuracy by selecting firm-specific models from among our nine alternatives. We did so by evaluating the past performance of each model for each particular firm-specific time-series. For each given time series, we first computed the nine model forecasts for 1976 based on the 1974 and 1975 data. We then computed the 1977 forecast using the 1974 - 1976 observations. This procedure was repeated until all years were included. Next, a measure of historical forecast accuracy had to be selected which could be applied to the 1976 - 1979 forecasts and actual values. As we saw no *a priori* justification of any particular measure, we used the six criteria listed in Table 4. Each criterion was used in turn to select a model which showed the greatest accuracy in forecasting the 1976 - 1979 revenues and profits.

Table 4 about here

were also obtained by models 3 and 9, the identical change-model and the Elton and Gruber-model. The trend models did not perform well. Given the inflation effects on sales revenues, it is not surprising that the random-walk model and the exponentially weighted moving average perform worst. Both models cannot cope with the growth inherent in the revenue series.

Table 2 about here

It is desirable to select a forecasting method which not only produces small forecast errors but is also free from systematic bias. Table 2, therefore, shows the percentage of negative forecast errors ($y-\hat{y} < 0$) denoting the frequency of overestimates. Except for models 2, 7 and 8, we cannot reject the hypothesis that there is no systematic over- or under-prediction at a significance level of ten percent. Models 3 and 9 performed best in this respect, followed by model 1.

Finally, the last two rows of Table 2 show the percentages of actual 1980 revenues contained in the 50 percent and 95 percent prediction intervals of the models. Naturally, we want these percentages to be as close to 50 percent and 95 percent as possible. For most models the actual proportions within the small interval conform well to expectation. Only the trend models and the random-walk generate significantly different percentages. The proportions of actual revenues within the 95 percent interval range from 77,6 to 98,5; for most models it is quite close to the expected level of 95 percent.

3.3 Profit forecasts

The 63 profit forecasts were analyzed in the same way as the revenue forecasts above. Table 3 presents the equivalent information. From the values of the sign test statistic, it is evident that profits are predicted best on the basis of information about last year's profits only. The pure random-walk model predicts

3 An analysis of the model forecasts

In this section we shall first examine which forecast model performs best when applied to all firms. Next, we shall describe our efforts to increase the overall accuracy by selecting firm-specific forecast models from among the available alternatives. Management and analysts predicted the 1980 revenue of 67 companies and the profit of 63 companies. For these firms the corresponding historical data were gathered. In view of the numerous structural changes in the series, we restricted ourselves to the 1974-1979 data, thus using a maximum of six observations.[8]

3.1 Models and test statistics used

The nine models used in this study, which together cover a wide range of simple time-series models, are listed in Table 1. The forecast accuracy of these models was evaluated by means of the sign test and the Wilcoxon matched-pairs signed-ranks test (see Siegel, 1956, for a description of these statistics and Brown and Rozeff, 1978, for a discussion of their applicability in this case). The sign test is invariant under transformations of the metric; for the Wilcoxon test this has to be investigated. As it turns out, both tests lead to similar results. Therefore, only the values of the sign test will be presented below.

Table 1 about here

3.2 Revenue forecasts

Table 2 presents the values of the sign statistic computed on a model-by-model basis for 67 revenue forecasts. A positive value of the statistic denotes a better performance of the model shown in the column heading; a negative value denotes a greater number of accurate predictions by the model shown as the row designation. Model 1, the random-walk with additive drift, predicted better than all other models but only significantly so as compared to models 2,5,7 and 8. Relatively good results

prediction intervals of the models.[7] In this way, the accuracy of our three groups of forecasts could be evaluated not only on the basis of the prediction errors but also by means of these intervals.

Table 6

Profit Forecasts of Management, Analysts, and Models

	Management	Analysts	Model 7	Model 8	Model 9
Management	--	-0.324	-0.324	-0.649	-1.947**
Analysts	0.324	--	-0.324	-0.324	-0.649
Percentage of negative forecast errors	65.8*	57.9	50.0	52.6	68.4**
Percentage of profits within 50% interval	29.7**	26.3**	39.5	39.5	37.1
Percentage of profits within 100/95% interval	40.6	36.8	84.2	89.5	97.1

N.B. See Table 2 for legenda

NOTES

1. For reviews of this literature see Abdel-Khalik and Thompson (1978), Foster (1978), Richards and Fraser (1978) and Westwick (1982).
2. In The Netherlands, for example, the provision in the EEC Fourth Directive requiring companies to disclose information on their likely future developments has led to draft legislation covering forecasts of employment, investment and financing as well as the circumstances affecting sales revenue and profitability.
3. An earlier paper by Schreuder and Klaassen (1982, 1983) has dealt extensively with the comparisons between management and analysts' forecasts. The reader is referred to that paper for details on these comparisons and the related literature and for more information on our research design and its implications.
4. See Foster (1978) as well as Hopwood and Newbold (1980) for these studies.
5. Early work by Little (1962), Little and Rayner (1966) and Brealey (1969) had already documented the apparently random behavior of corporate profits.
6. Schreuder and Klaassen (1982) give the results of tests which show that the sample of participating companies may be regarded as representative for the total population of companies listed on the Amsterdam Stock Exchange. It further shows that 1980 may be regarded as a representative year for revenue forecasting purposes. The direction of profit changes in 1980 does not significantly differ from what would be expected on the basis of historical data, while the volatility of profits is significantly higher. Other relevant background information is contained in both the 1982 and the 1983 papers. These also discuss some implications of the differences between this study and previous research.
7. Whether a 100% prediction interval is meaningful for the forecast models depends on the distrubution of the forecast errors.
8. Despite this restriction we had to use an even shorter series in eight cases due to structural changes within the 1974-1979 period.
9. Included are 98 analysts' forecasts of revenue and 113 profit forecasts. Eleven companies were forecasted by one analyst. In the remaining cases the average analyst prediction is used in all computations.
10. Note that in section 4 our aim was to include as wide a range of time series models as possible. Here we search for appropriate benchmarks for evaluating management and analysts performance. Ex post bias is mitigated by eliminating only those models which are obviously inappropriate from the revenue comparisons and by using the models which received earlier empirical support for profit comparisons.
11. See note 6 for some information on the representativeness of 1980 in a forecasting context.

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