

An Experimental Study of Overconfidence in Accounting Numbers Predictions

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ABSTRACT

This paper analyzes experimentally investors' overconfidence when making predictions of financial and accounting numbers and explores which factors drive this bias. In particular we analyze the extent to which familiarity with the variable predicted, the complexity of the forecasting task, and the amount of information available for the investors affect their overconfidence. We also compare the extent to which professional analysts differ from other investors in that respect. For this we conducted three experiments. Two experiments with advanced accounting students as subjects, where the experiments differed in the firm the subjects analyzed and the third with professional financial analysts. In each experiment we provided the subjects with past accounting reports and other financial data of a firm. Based on these data the subjects were asked to forecast Net Income, EPS, and Share Price.

In all the experiments we found that the subjects exhibited a considerable degree of overconfidence. The professional analysts were slightly more overconfident than the students. Subjects showed more overconfidence in predicting share prices than when forecasting other lesser familiar variables. However we could not detect correlation between the amount of information and overconfidence, neither between success and overconfidence, nor between the complexity of the task and overconfidence.

Keywords: Accounting, Prediction of Accounting Numbers, Experimental Economics, Overconfidence, Behavioral Finance, Analysts.

JEL Classification: G02, G17, M40

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Citation Sasson Bar-Yosef, Itzhak Venezia (2014). An Experimental Study of Overconfidence in Accounting Numbers Predictions. *International Journal of Economic Sciences*, Vol. III, No. 1/2014, pp. 78-89.

Introduction

The theory that decision makers in general and investors in particular are overconfident is central in behavioral finance and accounting. This is an important bias since it may lead to costly erroneous decisions. This bias however also has important benefits since overconfidence provides impetus for bold and innovative ideas and endeavors.

There are several ways to define or measure overconfidence. Definitions such as those of Alpert and Raiffa, 1982 concentrated on the calibration (or precision) of probabilities. According to this school of thought, people are considered overconfident if the precision of their estimate is too high, or put differently if they attach too low a probability to the event that they may be wrong. This type of bias which has been observed for many types of people and in many professions is said to exist if the decision makers provide for unknown parameters confidence intervals which are "too narrow".ⁱ

Overconfidence shows up in other ways as well. Researchers find that people overestimate their ability to do well on tasks (Frank, 1935), they are unrealistically optimistic about future events, they expect good things to happen to them more often than to their peers (Weinstein, 1980, Kunda 1987), and they are even unrealistically optimistic about pure chance events (Marks, 1951, Irwin, 1953, Langer and Roth 1975). Most individuals see themselves as better than the average person and most individuals see themselves better than others see them (Taylor and Brown, 1988). They rate their abilities and their prospects higher than those of their peers.ⁱⁱ New business owners thought their business had a 70 percent or better chance succeeding but only 39 percent thought that any business like theirs would be this likely to succeed (Cooper, Woo, and Dunkelberg, 1988).

In recent years and in the context of financial decision, Odean, 1998, and Barber and Odean, 1999, measured overconfidence by "excessive" trading. They showed for a large sample of individual traders that overconfident investors trade more than is rational and that doing so lowers their expected utilities. They argued that the returns on the individuals' portfolio did not justify the high transaction costs. Moreover they suggested that returns on stocks the individuals purchased were lower than those they sold to make those purchases.

This paper extends the literature in the following respects. First, it tests experimentally the overconfidence of investors from the "pure" precision definition of overconfidence of Alpert and Raiffa, 1982. This has an advantage over measures of overconfidence based on "excessive" trading since the latter measures, whereas indicative of overconfidence could be symptoms of other biases. Moreover, the definition of "excessive" trading is somewhat nebulous.ⁱⁱⁱ Second, we explore which factors drive overconfidence, and in particular we analyze the extent to which familiarity with the variable predicted, the complexity of the forecasting task, and the amount of information available for the investors affect their overconfidence.^{iv} Third, our paper provides a comparison between the overconfidence of analysts and that of the less experienced subjects. Whereas it has been demonstrated before that professionals tend to exhibit higher degrees of overconfidence than amateurs, the advantage of this paper is that it investigates this question directly in the context of predicting accounting and financial numbers setting, and it uses the calibration definition of overconfidence. Last, we explore whether overconfidence is "justified" in the sense that the more overconfident investors are also the more successful.

The remainder of the paper is constructed as follows: in Section II we present our method of analysis. The subjects are described in Section III, and in Section IV we describe the procedure used to conduct the experiments. In Section V we present and discuss the results, and Section VI concludes.

1. Method

Subjects were required to play the roles of investors who had to provide prediction of key accounting numbers of a firm (see Appendix A for the exact description of their task).^v To help them in their forecasts we supplied the subjects with all the relevant public data that would normally be available to investors. The variables they were asked to forecast were: Net Income (NI),

Earnings Per-Share (EPS), and Share Price (yearly average). We tried to lead the subjects to believe that their assignment was a run-of-the-mill forecasting task, so they will not pay special attention to overconfidence issues. We employed actual firms and financial reports so as to mimic real life as much as possible. In order to disguise the identity of the firm and prevent the subjects from finding the actual figures they had to predict, we scaled down all volume and numbers, accounting and others, by a suitable factor, retaining ratios intact.

To test for overconfidence, the subjects were asked to give 95% confidence intervals for the variables forecasted. We then calculated the number of intervals that covered the true values. Since 95% confidence intervals are supposed to cover the true values in 95% of the cases, then, if the provided intervals cover the true values in less than 95% of the cases this may be a sign of overconfidence (see Alpert and Raiffa, 1982). To examine to what extent the subjects understood the meaning of a confidence interval (which was explained in class) they were asked to answer the question: "what is the chance the EPS will exceed the upper bound of the 95% confidence interval you suggested for this variable?" We then compared their responses to the correct answer which is 2.5%. We also contrasted the average width of the subjects spreads (difference between upper and lower bounds of the confidence intervals) with the theoretical "objective" spread. Assuming that the variables predicted are Normally distributed with a standard deviation of σ , then in order to get a confidence interval of 95%, the "objective" spread should be approximately 4σ (2σ above average and 2σ below average); a lower spread is then consistent with overconfidence.

Three experiments were conducted. In Experiments I and III the subjects differed in their background and occupation but they made predictions for the same firm ("Guess"). In Experiment II the subjects are similar to those of Experiment I, but they made predictions for a different firm ("Sony"), for which the internal structure and operations were more complex than those of "Guess".^{vi}

Comparisons between Experiment I and II were used to analyze the effects of the complexity of the firm for which the predictions were made, and its financial reports (and thus the complexity of the forecasting task) on overconfidence.^{vii} Contrasting the results of experiments I and III provide some evidence on the effect of experience on overconfidence.

Whether or not familiarity affects overconfidence can be inferred from differences in overconfidence exhibited in the predictions of different variables. Whereas Share Price is a very familiar term, EPS and NI are less familiar, even for accounting students and analysts. We therefore compared the overconfidence shown in the predictions of share prices to that exhibited in predicting the other two variables.

In order to test for the effect of the amount of information (detail) on overconfidence we divided the subjects (in all the experiments) into two subgroups and supplied each subgroup with the same data but with slightly different detail. One subgroup, MDI (More Detailed Information) received the more detailed accounting information, presented according to SFAS 131, and the other LDI (Less Detailed Information) received the less detailed accounting information presented according to SFAS 14. We then compared the extent to which they exhibited overconfidence.

One may also wonder whether overconfidence can be attributed to (or correlated with) success. We therefore examined the correlations between the accuracy of predictions of the subjects and their overconfidence.

2. Subjects

Experiment I

Fifty-six fourth year accounting students at the Hebrew University of Jerusalem, aged 24 years or older, participated in the study. The subjects were grouped into teams of two, providing us with 28 teams.^{viii} During their fourth year all accounting students at the university (and hence all subjects) prepare for the CPA exams, having graduated and having taken all of the required accounting and finance classes including Financial Statement Analysis course. The subjects were therefore one semester away from becoming CPAs with a background and formal education quite close to that of

real financial analysts. This locates them at the middle to upper level of the spectrum of capital market sophistication.

Experiment II

Sixty two third year accounting students at the Hebrew University of Jerusalem participated in the study. This experiment was conducted in a different year than the previous experiment and the subjects predicted variables for a different firm (Sony). As in Experiment I the subjects were required to work in teams of 2, thus giving us 31 teams.

Experiment III

Ten analysts, 27 years or older, employed by four different accounting firms or brokerage houses participated in the experiment. They were all experienced analysts, mostly CPA's with MBA degree, majoring in Finance, with work experience of at least three years.^{ix}

3. Procedure

In all experiments the data were provided in the form of a questionnaire which detailed the task the subjects had to perform and the incentives to perform well (see Appendix A). We also provided them with accounting and market data that should assist them in their forecasts. We supplied the subjects with previous income statements, balance sheets, and relevant excerpts from the 10K disclosures. We also provided them with share price history, beta, and some industry highlights.

In Experiment I, an independent instructor who is neither the class instructor nor a coauthor of this paper randomly distributed the questionnaires in class and explained the nature of the task at hand. It was promised that the top 1st, 2nd, and 3rd teams within each group, in terms of closeness of their results to the true results, will receive cash prizes of \$300, \$200, and \$100, respectively, and that their superior performance will be announced. In addition to the monetary gain, the competitive nature of the students led us to believe that the subjects will make hard efforts to do well. Because of the considerable effort and time required to fulfill the task the subjects were permitted to take the data home and were allowed a week to hand in their results. They were told that collusion is forbidden, and violators will be harshly disciplined.^x Experiment II was handled likewise except that we changed the nature of the rewards, providing the top 3 teams extra points towards their course grade. These rewards generated similar interest in the experiment as those given in Experiment I.^{xi}

For Experiment III, where analysts were used for subjects, the following slight differences were made: First, the questionnaires were sent to the supervisors of the analysts in their work place who in turn explained the task to the subjects. Second, the subjects in this experiment worked individually rather than in teams as this is their typical work setting. They were promised prizes of \$500 for the top three performers in each group, and they were also told that their forecasts accuracy ranking will be disclosed. These two incentives were deemed sufficient to motivate the analysts to do their best.^{xii}

To provide some validation checks and ascertain that the subjects understood the task, we asked them to report the values of the estimated variables for the last two years for which they had data. Since this information appeared in the footnotes and in the auxiliary reports that we provided the subjects, they should have answered these questions correctly if the material was studied carefully. Their answers were generally correct or very close to the actual ones so that we could conclude that the subjects indeed thoroughly read and comprehended the material and understood what their required task was.^{xiii}

4. Results and Discussion

In this section we present the results of the experiments. The presentation is made according to the hypotheses tested: First we test in Subsection V.1 whether the subjects exhibited overconfidence. We then tested for the effects of familiarity on overconfidence in subsection V.2, The effect of task complexity of the task on overconfidence in Subsection V.3, The effect of detail on overconfidence in Subsection V.4, and the correlation between success and overconfidence in Subsection V.5.

4.1. Existence of Overconfidence

Experiment I

The predictions and the confidence intervals provided by the subjects for Net Income, EPS, and Share Price are presented in Tables 1. In the last column of this table we record the subjects' answer to the question: "what is the chance the Net Income will exceed the upper bound of the 5% confidence interval you suggested for this variable?" a question intended to verify the extent to which subjects understood the meaning of a confidence interval. As can be observed from this column, only few subjects gave the exact right answer (which is 2.5%). However, it seems from Table 1 that the subjects understood that there should only be a small chance that the confidence interval will not cover the actual number.

One notes from Table 1 tables that only about 7% (6 out of 84) of the confidence intervals (marked in bold) cover the true values. Since 95% confidence intervals are supposed to cover the true values 95% of the time, the much smaller percentage of the provided intervals that do so is indicative of the subjects' overconfidence.^{xiv} The average of the spreads the subjects chose for Net Income, EPS, and Share Price, and were: 12,821, 0.18, and 1.83, respectively. The values of 4σ (i.e., the "objective" spreads) of these variables were however substantially higher^{xv}: 20,428 ($p < 0.13$), 0.64 ($p < 0.00$), and 13.12 ($p < 0.00$), than their parallel observed spreads, pointing to overconfidence.

Experiment II

The results of this experiment are presented in Table 2 in the same format as in the former experiment. One observes that also in this experiment the subjects showed great amount of overconfidence. Only about 20% of the confidence intervals provided covered the true values of the predicted variables, indicating overconfidence. Also comparisons of the spreads provided with the "objective" spreads led to the same conclusion. The average spreads chosen by the subjects for Net Income EPS, and Share Price: 1687, 1.92, and 19.20, respectively, are significantly lower than the parallel "objective" spreads of 3700 ($p < 0.05$), 8.90 ($p < 0.00$), and 110.2 ($p < 0.00$). This reinforces our conclusion that the subjects exhibited overconfidence.

Experiment III

In Table 3 we present the results of this experiment. The analysts participating in the current experiment exhibited overconfidence and in about the same degree as that found for the younger less experienced participants of Experiment I.^{xvi} One observes from Table 3 that only two confidence interval out of 30 (7.14%) covered the actual variable, quite close to the analogous percentage in the first experiment. In this experiment as well as in the former ones the average spreads this group gave for Net Income, EPS, and Share Price: 8529, 0.24, and 3.06, respectively were narrower than the "objective" spreads supporting the evidence for overconfidence.^{xvii}

4.2. Effect of Familiarity on Overconfidence

To compare between the overconfidence shown for different variables we had to scale the spreads to a common denominator. For this we calculated for each spread provided by the subjects a variable called the "relative spread" defined by the ratio of the spread to the "objective" spread. In Experiment I, the average "relative spread" obtained for Share Price, about 14% ($1.83/13.12$), is significantly lower ($p < 0.01$) than the average of 0.18 ($0.12/0.64$) and 0.24 ($5000/20428$) found for Net income and EPS respectively (see Table 4). The greater familiarity of Share Price possibly led to the higher overconfidence in its prediction.^{xviii} In Experiment II, the relative spreads are 0.17 for price as compared with 0.22 and 0.46 for EPS and NI, and in Experiment III the relative spread for price is 0.23 compared with 0.38 and 0.42 (see Table 4). For the analysts, as well as for the students the greatest overconfidence is exhibited for the more familiar variable.

4.3. Effect of task complexity on overconfidence

The higher percentage of coverage of the spreads by the subjects in Experiment II (20%) as compared with Experiment I (7%) may signify lower overconfidence. As the subjects in this experiment were similar in nature to those of Experiment I, but the firm they had to analyze was much more complicated, the lower overconfidence exhibited in this experiment may be attributed to the higher complexity of the task.

4.4. Effect of detail on overconfidence

We also split the samples into two groups, the one of those receiving more (less) detailed information is entitled MDI (LDI). The average spreads the MDI group chose for Net Income, EPS, and Share Price were 5256, 0.18, and 2, respectively, compared with 18494, 0.17, and 4.40, chosen by the LDI group. The higher detail the MDI group has received might have increased their overconfidence.^{xix}

The average spreads the MDI group provided for Net Income, EPS, and Share Price were 526, 1.40, and 11.13, are considerably lower than the respective spreads of 2925, 2.48, and 27.82, respectively provided by the LDI group. As in the former experiment, the higher detailed data and information the MDI group has received might have contributed to their higher overconfidence.

The average spreads the MDI group gave for Net Income, EPS, and Share Price were: 4660, 0.12, and 1.15, respectively compared with 12397, 0.36, and 4.98, provided by the LDI group. As in the former experiments the higher detail the MDI group has received might have increased their overconfidence.

4.5. Correlation between success and overconfidence

We also calculated the correlation between success and overconfidence. To measure success we calculated for each subject, i , his/her RMSE _{i} (Root Mean Squared Error, a measure of the average forecasting error the subject made in forecasting the three variables; see Appendix 2 for the exact definition), and his/her total relative spread, S_i , (sum of the relative spreads he/she provided for these variables). We then regressed S_i on RMSE _{i} and found that consistent with the hypothesis that success is correlated with overconfidence, the slope of this regression is negative.

5. Conclusions

In this paper we have tested experimentally the extent to which investors tend to show overconfidence in their predictions of financial and accounting numbers. We also examined how familiarity, the complexity of the forecasting task, and the amount of detail provided for the task affect overconfidence. We have demonstrated that both analysts and advanced accounting students display a great amount of overconfidence in their estimates, and that this bias is about the same for analysts and student subjects. We have also shown that the complexity of the prediction task reduced the subjects' overconfidence, but familiarity with the variable predicted and the more detailed information given to them to assist in their forecasts increased the subjects' overconfidence.

Notes

ⁱ See Lichtenstein, Fischhoff, and Phillips, 1982, for a review of the calibration literature. Such overconfidence has been observed in many professional fields. Physicians and nurses, Christensen-Szalanski and Bushyhead, 1981, Baumann, Deber, and Thompson 1991, investment bankers, Staël von Holstein, 1972, engineers, Kidd, 1970, entrepreneurs, Cooper, Woo, and Dunkelberg, 1988, lawyers, Wagenaar and Keren, 1986, negotiators, Neale and Bazerman, 1990, and managers, Russo and Schoemaker, 1992, have all been observed to exhibit overconfidence in their judgments.

ⁱⁱ For example, when a sample of U.S. students assessed their own driving safety, 82 percent judged themselves to be in the top 30 percent of the group (Svenson, 1981).

ⁱⁱⁱ Odean, 1998, and Barber and Odean, 2000, argue that if speculative traders are informed, but overestimate the precision of their information, the securities they buy will, on average, outperform those they sell, but possibly not by enough to cover trading costs. Whereas this type of behavior is consistent with overconfidence it may also indicate ignorance or hubris.

^{iv} See Huberman, 2001 for a discussion of the effect of familiarity on investors' behavior.

^v This was a part of a large experiment on the effect on predictions of the introduction of rule SFAS 131 for segment disclosures, which usually requires more detailed information than the rule it replaced, SFAS 14 (see Bar-Yosef and Venezia, 2002, 2003).

^{vi} "Sony" has more divisions, more types of products, its operations span more countries, its financial reports are much complex, and raising much more complicated issues than "Guess".

^{vii} In addition using two studies with different firms analyzed and with different subjects increased the validity of the overconfidence tests.

^{viii} The subjects were grouped into teams in order to ease the burden of the quite complicated and time consuming task.

^{ix} It should be noted that the nature of the experiment is demanding in terms of both effort and time. Therefore, firms employing analysts were not always cooperative, as the required input needed to be committed by each analyst to perform the required tasks were not trivial. This explains the small number of subjects we managed to obtain.

^x The type of the reward was such that teams had little incentive to cooperate, and in retrospect, as shown in Bar-Yosef and Venezia, 2003, the results point to little or no collusion.

^{xi} Since the task was closely related to the students' studies, the School of Accounting at The Hebrew University of Jerusalem approved of this type of reward.

^{xii} Indeed, the supervisors of these analysts informed us, when the filled questionnaires were turned-in, that each analyst worked for several hours on performing the required tasks.

^{xiii} For example, out of 28 groups, 19 provided the correct answers for EPS, 4 groups were within .1 of the correct answer, 3 were within .2 and only one group that eventually provided the worst estimates gave a significantly incorrect answer.

^{xiv} In all tables the results of the MDI and LDI groups are aggregated.

^{xv} After adjusting for the scaling factor, 1.3, for share price and net income.

^{xvi} We do not compare this experiment to Experiment II because of the higher intricacy of the task in the latter experiment

^{xvii} No t-tests are presented because of the small number of observations in this experiment.

^{xviii} Also for Experiment III we observed lower relative spreads for share prices compared with the "other variables". However due to the different nature of the subjects in this experiment, and the small number of observations we preferred not to include this experiment in the aggregate.

^{xix} See Bar-Yosef and Venezia, 2004.

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Table 1

Experiment I: Summary: of true values of variables, average predictions, average spreads of predictions (upper bound minus lower bound), theoretical spreads, and number and percentage of intervals covering the true values.

	Variable Predicted			
	Net Income	EPS	Share Price	Total
Actual Values	39900	0.93	9.00	
Mean prediction	15794	0.38	5.50	
Mean Spread	12821	0.18	1.83	
Theoretical Spread	20428	0.64	13.12	
Number of Intervals Provided	28	28	28	84
Number of Intervals Covering the True Values	1	1	4	6
Percentage of Intervals Covering the True Values	1.19%	1.19%	4.76%	7.14%

Table 2

Experiment II: Summary: of true values of variables, average predictions, average spreads of predictions (upper bound minus lower bound), theoretical spreads, and number and percentage of intervals covering the true values.

	Variable Predicted			
	Net Income	EPS	Share Price	Total
Actual Values	1708	4.20	87.45	
Mean prediction	1364	2.69	70.16	
Mean Spread	1687	1.92	10.00	
Theoretical Spread	3700	8.90	19.20	
Number of Intervals Provided	31	31	31	93
Number of Intervals Covering the True Values	9	5	5	19
Percentage of Intervals Covering the True Values	29.03%	16.13%	16.13%	20.43%

Table 3

Experiment III: Summary: of true values of variables, average predictions, average spreads of predictions (upper bound minus lower bound), theoretical spreads, and number and percentage of intervals covering the true values.

	Variable Predicted			
	Net Income	EPS	Share Price	Total
Actual Values	39900	0.93	9.00	
Mean prediction	19702	0.20	6.00	
Mean Spread	8529	0.24	3.06	
Theoretical Spread	20428	0.64	13.12	
Number of Intervals Provided	10	10	10	30
Number of Intervals Covering the True Values	0	1	1	2
Percentage of Intervals Covering the True Values	0.00%	10.00%	10.00%	6.67%

Table 4

Relative Spreads (theoretical spread/mean actual spread) in all three experiments

	Expreiment I	Expreiment II	Expreiment III
NI Theoretical spread	20428	3700	20428
NI chosen mean spread	12821	1687	8529
NI relative spread	0.63	0.46	0.42
EPS Theoretical spread	0.64	8.9	0.64
EPS chosen mean spread	0.18	1.9	0.24
EPS relative spread	0.28	0.22	0.38
Price Theoretical spread	13.12	110.02	13.12
Price chosen mean spread	1.83	19.2	3.06
Price relative spread	0.14	0.17	0.23

Appendix A

Questionnaire

The date is April 1, 1999.^{xix} Assume you are an analyst in the big investment bank “Investronics” and you were assigned to analyze the firm “NRG”, specifically, your supervisor asked you to provide forecasts of the financial performance of NRG for 1999. These forecasts usually go to the trading department of Investronics, where they use the forecasts either for trade or for recommendations to clients.

To help you in the task you will receive the following documents:

1. Select qualitative data from the annual reports of NRG for 1997, 1998.
2. Select quantitative reports from Negus's annual reports from 1997, 1998
3. Relevant Industry and macroeconomic data.

You are supposed to use the auxiliary documents to perform the forecasts.

It is extremely important to provide accurate forecasts. Your forecasts will be compared to the actual variables, when these will become known. Your accuracy will then be compared to that of other teams who have been assigned a similar task. Each team that will fill the questionnaire will receive a nominal amount of cash for its work. In addition the six teams whose forecasts will be closest to the actual variables will receive a \$100 prize.

The forecasts should be handed in to the simulation coordinator within a week from today.

The following describe your task in detail:

- a. Based on the supplements you were given, please answer the following:
 1. What was the gross profit per share in 1997 and 1998? (In \$)
 2. What was the Return on Equity (ROE) in 1997, and 1998? (in %)
 3. What was the Return on Assets (ROA) in 1997, and 1998? (In %)

4. Which segment has been most profitable in 1997? In 1998? Explain
- b. Provide the following forecasts (please use the enclosed Tables):
1. Total after tax earnings for 1999 (in \$1000)
 2. Per share earnings for 1999 (in \$)
 3. Average Stock Price in 1999 (in \$)
 4. Ratio of Sales/Assets (in %, 1999 average)
 5. Profits/Sales (in %, 1999 average)
 6. A confidence interval for the total net earnings of the firm (that is a range of profits such that there are 95% chances that actual profits will fall in this range)
 7. A confidence interval for firm's EPS.
 8. A confidence interval for firm's average stock price.
- c. Explain shortly how you got your forecasts;
1. Which statistical methods did you use?
 2. Which economic models did you use?
 3. Which variables did you use in your calculations (please list all)
 4. Which variables were the most important? (select 4)
 5. What is the chance that the actual profit will exceed the upper bound supplied for b-6 above?

Appendix B

The definition of RMSE

Accuracy in prediction of each subject was measured by RMSE (Root Mean Squared Error) defined by $RMSE_t = [(1/N) \sum_i e_{it}^2]^{(1/2)}$, where N denotes the number of prediction and e_{it}^2 measures the relative error of forecast X_{it} made by subject i, $i=1, \dots, N$, in predicting variable P_t , $t=1,2,3$. That is: $e_{it} = (X_{it} - P_t) / P_t$. The RMSE's of NI, EPS, and Share Prices were 62%, 61%, and 59%, respectively.