ECONOMIC AND PSYCHOLOGICAL THEORIES OF FORECAST BIAS AND LEARNING: EVIDENCE FROM U.S. BUSINESS MANAGERS' FORECASTS

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INTRODUCTION

Economists and psychologists each have puzzled over the nature of decision making and the formation of expectations. Economists employ rationality as a paradigm, a commonly agreed upon way of modeling decision making. This paradigm suggests that decision makers use all relevant information to form unbiased predictions of the future. While this does not reject the existence of mistakes, or even adaptive behavior, it does imply that decision rules are under constant evaluation, and older rules are being supplanted by newer, more successful, forms [Lucas, 1987, 217]. When agents do make mistakes, this theory predicts learning, hence improved forecast accuracy over time.

For psychologists, rationality is one of a large number of competing theories of human behavior. Lacking an agreed-upon paradigm, the focus instead is on empirical tests of decision making. The result has been a large and growing literature that suggests frequent departures from rationality. This literature suggests, for example, that humans have a limited ability to process information and a limited access to information, and may be influenced by the context, or framework, in which a decision is presented [Simon, 1987; 1979; Tversky and Kahnamen, 1987]. Psychologists are more comfortable with the notion of "irrationality" than economists, and are more willing to suggest that humans may not learn from past mistakes.

Recently, economists and psychologists have begun a conversation on whether the rationality paradigm in economics can profit from empirical evaluation. This evaluation would include both the paradigm's *prediction* of unbiased forecasts and its *assumption* of learning. The purpose of this paper is to examine the forecasts of business managers for evidence of bias and learning. Are managers' forecasts consistent with the economist's notion of rationality, or do they instead support the psychology literature's doubts about rationality?

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To study decision making economists and psychologists have relied on different data sources. Economists have typically studied either professional forecasters or the lay public; psychologists have used experimental subjects of opportunity.[1] The data analyzed in this paper are drawn from the Conference Board Survey of Business Managers. Our subjects are those people who make the production, pricing, and employment decisions in the economy. Because of the importance of these decisions to the economy, we regard the nature of business managers' predictions to be worthy of investigation.

Our analysis reveals systematically biased decision making by business executives in nearly every industry studied. When biased, managers proved to be overly optimistic. In addition, we find evidence of learning predicted by economists. However, this learning while often statistically significant is of little consequence to the accuracy of managerial forecasts. We analyze these outcomes using both the economics and cognitive psychology literature.

EXPECTATIONS AND LEARNING

The Economics Literature

Managers form expectations of the future *adaptively* when their predictions are revised using only historical data. Economists once commonly assumed that such simple models described managers' forecasts. For example, Cagan [1956] used past values of the money supply to explain inflationary expectations. Muth [1961] observed, however, that adaptive expectations had little resemblance to how decisions are made. Instead, Muth argued that economic decision makers form their expectations of the future by using all currently available information. Citing Muth, Lucas [1973] demonstrated how an announced policy change could influence the formation of predictions, an insight lacking in adaptive models. The resulting theory, awkwardly named *rational expectations*, has largely replaced adaptive expectations in economic models. Indeed, Blinder [1988] notes that the theory of rational expectations has played a defining role in the education of young economists, leading Gordon [1990, 1115] to reflect on "... the dominance of new-classical macroeconomics among the younger generation...". This commonly accepted paradigm recognizes that forecasters make errors. But by using all currently available information forecasters avoid making *systematic* errors — instead their errors will be randomly distributed about the actual outcome. The absence of systematic error is the economist's definition of being unbiased. Thus, if decision makers form forecasts rationally, their predictions will be unbiased.

Economists have examined the behavior of decision makers to see if they forecast with rational expectations. Lovell's [1986] survey evaluated the large and growing literature on empirical tests of rationality. He finds that forecasters frequently fail to predict unbiased estimates.

Bias alone, however, is not a sufficient indictment of rational expectations to suggest its rejection. Economists contend that people will learn over time more

accurately to adapt to the economy's shocks and to understand its structure better. Lovell [1986, 121] notes the importance of this possibility in the face of evidence seeming to reject rationality. He states, "... departures from rationality may be a transient phenomenon arising because economic actors are learning to adapt to a shift in regimes...". This learning, economists predict, will continue as long as the marginal gains from the learning exceed the marginal costs of improving the forecasts. Learning, then, should reduce the size of any bias over time, leading to an outcome consistent with rational expectations.

The Psychology Literature

Psychologists have developed an extensive literature that suggests that people are *not* rational in the economist's sense. Rather they see people adopting "stereotypic schemas and simple heuristics," rules of thumb, to guide decision making. Nobel prize winning economist and psychologist Simon argues that Muth's theory of rationality places unrealistic "demands on the knowledge and computational abilities of the human agents..." [1979, 496]. In addition, he believes that even if agents possess the necessary skills, the cost inherent in forming forward-looking, unbiased, forecasts leads people to adopt cheaper decision rules. In his view, individuals simply aspire to a certain level of accuracy in their decisions and are satisfied by decisions that meet their criterion. This behavior he has labeled "satisficing." A business manager that satisfices, for example, may be able to achieve an acceptable level of profits without the expense necessary to forecast accurately the future values of marginal revenue and cost. In contrast to Muth, Simon sets out a theory of decision making called "bounded rationality" where agents facing cognitive, financial, and informational constraints seek acceptable solutions.[2]

Other psychologists, however, suggest that the heuristics typically adopted lead to decisions that are not rational, even in Simon's bounded sense. They suggest that the adoption of certain heuristics will lead to errors in judgment. Rachlin [1989], for example, describes how a "representative heuristic," a rule for judgment that extrapolates from limited information to arrive at general conclusions, leads to biased decision making. Marriage after a brief courtship, the purchase of a car after a short test drive, or plant expansion based on recent orders may be the result of adopting such a heuristic. Instead, use of such limited information may enhance the likelihood of biased forecasts resulting in failed marriages, ownership of automotive lemons, and idle capacity.[3]

The psychology literature not only suggests that people are biased, but also posits that people are unlikely to learn from their mistakes. One important reason for this position is the experimental evidence provided by Wason [1969] regarding the "difficulty people have in making use of disconfirming information." This experimental evidence suggests that the inability to learn stems from the unwillingness to examine information that would disprove the held position. Interestingly, Einhorn and Hogarth's [1978] experiment extended Wason by using professional statisticians as their subjects. Although trained to consider

disconfirming evidence when testing a hypothesis, only 5 of the 23 subjects sought such evidence.[4]

Alternatively, the lack of learning may stem not from a lack of evidence, but from an unwillingness to alter a failed policy. Staw and Ross discuss escalation, a situation in which a course of action has resulted in initial losses, but where action can be taken to modify and possibly reverse the original outcome. They observe that "individuals as well as organizations can become locked into the existing course of action, throwing good money or effort after bad" [1989, 216].

THE DATA

In 1976 the Conference Board began collecting quarterly data on business executives' expectations. The Conference Board asked executives two questions. First, what are your "expectations for your own industry six months ahead?" Second, what is your evaluation of "current conditions in your own industry versus six months ago?" In each case executives used a 100 point scale in which 50 meant no change. Thus, if she answered 55 to the first question, she meant that her industry would improve over the next six months.

The Conference Board administered the survey to about 1200 corporate executives covering each of 26 two-digit SIC industries. The Board surveyed executives who had attended their conferences, subscribed to its publications, or were otherwise known to members of the Board. It did stratify across small and large firms, manufacturing and nonmanufacturing, and durable and nondurable goods within manufacturing. Responses to the survey were anonymous and only industry averages for those responding were reported.

A principal concern was that the data were not necessarily derived from a random, matched sample. The Conference Board used targets of opportunity. In addition, while the same set of executives in each industry were polled each quarter, the actual respondents may have changed, affecting the average response.[5] This selection bias problem will be small if there is little change in the respondents and if those who do respond do not have systematically different views from the industry population.

The data subject to this proviso provide a direct measure of business managers' expectations for their own industries. In the next section we construct a measure of forecast accuracy. The unique feature of these data is that managers' forecasts can be evaluated from their own perspective. Since they forecast the future and evaluate the past using the same subjective scale, they determine, themselves, whether their forecasts are accurate. Surprisingly, economists have yet to examine expectations using such data.

METHODOLOGY

Bias

In each of 26 industries we compare business executives' subjective forecasts of future conditions against their own subjective evaluation of whether that forecast was realized. We define the error to be

$$ERROR_t = Evaluation_t - Prediction_{t-2}. \tag{1}$$

For example, if managers respond to the first question (future conditions compared to today) with a 55, then six months later respond to the second question (current conditions compared to six months ago) with a 50, then we find their prediction to be in error by a minus five "points." Optimistically, they predicted an improvement that, in their own evaluation, was not achieved. We calculate the mean of these errors over time to examine whether there is evidence of bias. Bias would be evident if the mean of the errors differed significantly from zero.

Learning

We construct an *Error-Learning Model* to test whether managers use disconfirming information, in the form of past errors, to learn and hence update their next forecast of future conditions. If such learning occurs, we would expect that past errors will significantly influence the current forecast. If the manager was overly *optimistic* in the last prediction, this error should lead to a *reduction*, *ceteris paribus*, in next period's forecast. Conversely, excessive *pessimism* should lead to an *increase* in the next forecast. Since optimistic errors have a different predicted effect on future forecasts than pessimistic errors, the equation estimated allows each type of error to affect the forecast independently.

Because the Conference Board asks for predictions of the future, *relative to current conditions*, we include GNP to account for the level of current conditions. What is the predicted relationship between real gross national product and the managers' forecast (*BEF*)? Consider two situations. Suppose that in each case the manager has the same absolute vision of future conditions. In the first case, however, current conditions, as measured by GNP, exceed those in the second case. When asked to predict the future relative to the present, the manager will answer with a smaller number in the first case when base period conditions (*GNP*) are relatively good. Stated differently, the same absolute conception of a brighter future will look like a more dramatic improvement to managers in industries mired in the trough of a business cycle. Hence, we expect a negative relationship between the level of *GNP* and *BEF*. We estimate equation (2) for all industries.

$$BEF_t = \beta_0 + \beta_1 |OPT|_t + \beta_2 PES_t + \beta_3 GNP_t + \epsilon_t, \tag{2}$$

where

BEF_t = the Business Executives' Forecast in period t of future conditions in period t + 2

$|OPT|_t$ = the absolute value of the forecast error from equation (1) if optimistic; 0 if the error was pessimistic.

PES_t = the value of the forecast error from equation (1) if pessimistic; 0 if the error was optimistic.

GNP_t = Gross National Product in period t measured in 1982 dollars.

Equation (2) asks whether the most recently realized error affects the next forecast of future conditions. We use the absolute value of the negative (optimistic) errors to simplify the interpretation of the coefficients. As specified the expected sign on $\hat{\beta}_1$ is negative; optimistic errors should lead the manager to reduce the forecast for the next period. The expected sign on $\hat{\beta}_2$ is positive; pessimistic errors should lead the manager to increase the prediction for the next period. The expected sign on $\hat{\beta}_3$ is negative.[6]

RESULTS

Bias

Figure 1 presents typical time profiles of the errors made by the managers in the industries studied. It reveals that the managers more often made optimistic, rather than pessimistic, errors about the future of their industry.

Table 1 presents the mean errors for the industries studied.[7] In all of the 26 industries, the mean of the difference between the evaluation and the forecast is a negative number, indicating errors of optimism. The mean value is significantly different from zero in 22 of the 26 industries. The values range from -1.56 for Finance to -7.23 for Mining. These mean errors represent 2.6 percent and 12.3 percent of the mean forecasts for these industries. Manufacturing, which includes 15 of the industries in the study, has a mean error that is 9.9 percent of the mean forecast. In industries as different as Primary Metals and Insurance, managers seem possessed by a view of the future that exceeds reality.[8]

It is difficult, however, to determine the economic importance of these mean errors. The survey is unanchored. Only a value of 50 has a defined meaning. Numbers above 50 merely reflect the degree of expected improvement in industry conditions. Obviously, an error of 10 is more important given a forecast of 40 than for a forecast of 80, an error of 25 percent of the forecast versus 12.5 percent. But at what threshold do these errors become economically important? Our approach is to allow the managers to define whether the forecast errors they make are meaningful. We examine the relationship between previous forecast errors and subsequent predictions to address this issue. If managers substantially alter their forecasts, we assume they are acting as if their prediction errors matter.

FIGURE 1
Forecast Errors: Manufacturing, 1978III - 1989III

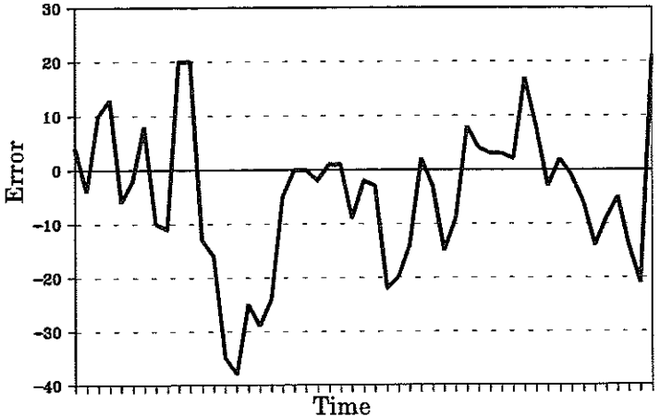

TABLE 1
Forecast Errors: Means and Tests for Bias

	X: Mean Forecast Errors	Absolute Value of X/S_x	Number of Observations
Manufacturing	-5.59[a]	(3.09)	51
Primary Metals	-6.80[b]	(2.09)	40
Fabricated Metals	-6.03[b]	(2.52)	38
Non-electric Machinery	-5.95[b]	(2.32)	38
Electric Machinery	-6.89[a]	(2.85)	38
Transportation Equipment	-5.53[b]	(2.26)	40
Food	-7.00[a]	(6.31)	40
Paper	-3.95	(1.45)	40
Chemicals	-4.95[b]	(2.21)	40
Mining	-7.23[a]	(3.08)	40
Utility	-3.41[a]	(3.13)	51
Wholesale Trade	-4.62[b]	(2.21)	40
Transportation	-6.80[a]	(2.98)	40
Textiles	-7.10[b]	(2.32)	38
Apparel	-5.13[b]	(2.09)	38
Printing and Publishing	-5.12[a]	(3.07)	40
Rubber	-6.62[b]	(2.11)	26
Lumber	-3.88	(1.26)	26
Stone, Clay and Glass	-2.46	(0.98)	26
Instruments	-8.35[a]	(3.27)	26
Construction	-4.30[b]	(2.53)	40
Retail Trade	-7.15[a]	(4.23)	40
Banking	-2.30[b]	(1.70)	40
Finance	-1.56	(0.53)	32
Business Services	-5.00[a]	(2.94)	42
Insurance	-3.27[a]	(2.97)	51

a, b c: Statistically different from zero at the 1, 5 and 10 percent confidence levels, respectively.

Learning

Error-Learning Model. Because we found bias in forecasts, our analysis turned to an examination of whether learning occurs. Recall that a forecast of future conditions made in period $t-2$ is evaluated in period t. If learning occurs, the resulting period t's error, pessimistic or optimistic, should influence period t's forecast of future conditions if learning occurs. Therefore, we estimated equation (2) using OLS for each industry. Serial correlation was filtered using the Cochrane-Orcutt procedure. Table 2 presents the results.

The coefficients estimated on *OPT*, the absolute value of an optimistic forecast error, had the expected negative sign in 24 of the 26 cases. In all of the 19 cases in which the coefficient was significant it had a negative sign. The coefficients estimated on *PES* had the expected positive sign in 22 of the 26 cases. The coefficient was significantly different from zero in 11 cases. In each of these cases, it had a positive sign.

The economic significance of the coefficient values depends upon the elasticity of the forecast with respect to the error. Table 3 presents the "error elasticities" of managers' forecasts. For each type of error, in each industry, we calculated a very inelastic response of the forecast to the most recent error realized. For instance, the largest elasticity calculated was -0.09 for Finance. Managers are learning, as suggested by economic theory, but the error elasticities reveal that this learning has little economic importance. The most responsive managers, those in the financial services industry, would merely reduce their next forecast of business conditions by 9 percent if their most recent optimistic error doubled.[9]

The coefficients on *GNP* had a negative sign in 24 of the 26 cases. In all of the ten cases where significant the coefficient had the expected negative sign.[10]

The goodness of fit measure, R^2, indicates that this simple Error-Learning Model is able to explain a substantial amount of the variance for forecasts in certain industries. For four industries the model explains at least 68 percent of the variance in *BEF*, yet for six industries the R^2 falls below 10 percent. In the 26 regressions the median R^2 reveals that the variance in past errors accounts for 18.8 percent of the variance in forecasts. The "Regression F" was significant in 15 of the 26 cases.

INTERPRETATIONS AND CONCLUSIONS

The finding of bias contradicts the economist's notion of rationality. No manager would be well served by a persistently rosy view of the future; nevertheless, optimism characterizes managers in nearly every industry studied. In industries as disparate as Retail Trade and Fabricated Metals managers anticipate outcomes that are only partially realized.

Our finding of a bias toward optimism is consistent with Ito [1990], Carlson and Dunkelberg [1989], and Leonard [1982]. These researchers found optimism in managers' perceptions of exchange rates, output prices, and starting salaries respectively.[11] While this evidence against rationality disputes the view held by most

TABLE 2
Error Learning Model: Regression of Conditions Forecast (BEF)

	Constant	OPT	PES	GNP	N	R^2	F
Manufacturing	22.3[a]	-.28[b]	.40[b]	-.01	50	27.9	5.93[a]
	(2.94)	(2.18)	(2.37)	(1.18)			
Primary Metals	44.2[a]	-.26[b]	.23[c]	-.02[c]	37	28.2	4.32[b]
	(3.09)	(2.20)	(1.58)	(1.79)			
Fabricated Metals	24.9[b]	-.12	.32[c]	-.01	37	10.6	1.31
	(1.90)	(0.72)	(1.32)	(0.48)			
Electric Machinery	35.2[b]	-.27[b]	.07	-.01	37	11.5	1.43
	(2.22)	(1.75)	(0.38)	(0.83)			
Non-electric Machinery	39.5[a]	-.20[c]	.25	-.01	37	12.5	1.57
	(2.57)	(1.37)	(1.09)	(1.07)			
Transportation Equipment	49.4[a]	-.31[b]	.22[c]	-.02[b]	38	27.7	4.35[b]
	(3.73)	(2.29)	(1.39)	(2.06)			
Food	29.0[b]	-.27[c]	-.53	0.00	39	7.7	.97
	(2.35)	(1.51)	(-1.03)	(.27)			
Paper	18.9	.01	.07	.00	39	0.4	.05
	(1.15)	(.06)	(.32)	(.18)			
Chemicals	18.6[c]	.04	.25[c]	-.00	39	6.0	.74
	(1.33)	(.24)	(1.43)	(.11)			
Mining	78.2[a]	-.17[c]	.44[b]	-.01[a]	39	33.0	5.74[a]
	(6.43)	(1.56)	(2.44)	(2.97)			
Utility	19.2[a]	-.18	.43[b]	-.01	50	18.8	3.54[b]
	(2.94)	(1.12)	(2.06)	(1.06)			
Wholesale Trade	33.8[b]	-.21	.20	-.01	39	10.4	1.35
	(2.26)	(1.25)	(1.0)	(.53)			
Transportation	30.9[b]	-.29[b]	.06	-.01	39	17.1	2.41[c]
	(2.24)	(2.16)	(.29)	(.77)			
Textiles	112.8[a]	-.31[b]	-.03	-.04[a]	36	35.6	5.39[a]
	(5.83)	(2.08)	(.13)	(4.06)			
Apparel	34.2[b]	-.20	.02	-.01	37	5.4	.63
	(1.94)	(1.25)	(.07)	(.62)			
Printing and Publishing	18.4[c]	-.17	.13	-.00	39	6.1	.76
	(1.34)	(.98)	(.47)	(.01)			
Rubber	127.5[a]	-.23[c]	.06	-.04[a]	25	41.0	4.87[b]
	(5.48)	(1.36)	(.21)	(3.70)			
Lumber	160.6[a]	-.34[a]	.37[b]	-.03[a]	26	68.2	15.71[a]
	(10.45)	(3.03)	(1.80)	(6.59)			
Stone, Clay and Glass	179.8[a]	-.48[a]	.67[a]	-.03[a]	26	76.4	23.71[a]
	(11.47)	(3.42)	(3.38)	(7.94)			
Instruments	136.8[a]	-.27[b]	.53	-.02[a]	26	39.1	4.71[b]
	(6.44)	(1.90)	(1.12)	(3.59)			
Construction	34.7[b]	-.37[c]	-.18	-.00	39	7.6	.96
	(2.05)	(1.63)	(.56)	(.31)			
Retail Trade	31.9[a]	-.31[a]	-.06	-.01	38	18.0	2.49[b]
	(3.02)	(2.52)	(.22)	(1.15)			
Banking	14.8[b]	-.31[b]	.07	-.01	39	12.5	1.66
	(1.73)	(1.83)	(.37)	(.55)			
Finance	110.1[a]	-.67[a]	.10	-.01[a]	32	78.1	33.25[a]
	(9.57)	(6.63)	(.72)	(4.31)			
Business Services	133.8[a]	-.36[a]	.30[c]	.02[a]	42	71.9	32.34[a]
	(16.76)	(3.56)	(1.44)	(9.35)			
Insurance	23.1[a]	-.33[b]	.33[c]	-.01	49	26.2	5.31[a]
	(3.54)	(2.17)	(1.33)	(1.16)			

a,b,c denotes significance at the 1, 5, and 10 percent levels respectively. Two-tailed test on *GNP*.

TABLE 3
Elasticity of Managers' Forecasts with Respect to their most Recently Realized Error

	η_{OPT}	η_{PES}
Manufacturing	-.0404	.0180
Primary Metals	-.0570	.0215
Fabricated Metals	-.0192	.0174
Electric Machinery	-.0424	.0028
Non-electric Machinery	-.0333	.0150
Transportation Equipment	-.0494	.0139
Food	-.0353	-.0046
Paper	.0015	.0059
Chemicals	.0054	.0127
Mining	-.0295	.0217
Utility	-.0170	.0138
Wholesale Trade	-.0283	.0109
Transportation	-.0444	.0023
Textiles	-.0679	-.0026
Apparel	-.0311	.0013
Printing and Publishing	-.0217	.0051
Rubber	-.0341	.0023
Lumber	-.0488	.0288
Stone, Clay and Glass	-.0532	.0448
Instruments	-.0440	.0132
Construction	-.0442	-.0073
Retail Trade	-.0444	-.0013
Banking	-.0253	.0029
Finance	-.0888	.0106
Business Services	-.0433	.0110
Insurance	-.0305	.0108

The elasticity is constructed as follows: $\eta = \%\Delta BEF/\%\Delta|OPT|$, where $\%\Delta BEF$ = Change in *BEF* associated with a 1 unit increase in *OPT*, given by the estimated coefficient, divided by the mean *BEF* for the industry. $\%\Delta|OPT|$ = an assumed 1 unit change in *OPT* divided by mean optimistic error for the industry. Consider the following example: compared to the mean optimistic error in Finance, (see Table A.2), a 1 unit increase in the optimistic error represents a 13 percent increase in this error. Yet this 13 percent increase in error yields only a small change in next period's forecast. Compared to the industry's mean *BEF* (see Appendix Table A.1), the decrease in the prediction of 0.67 points represents only a 1 percent decline. Thus, -1 percent divided by 13 percent yields an elasticity of -0.09. For the other coefficients noted in the text the elasticities are: -.03 for Mining's *BEF* with respect to *OPT* and .01 for Transportation Equipment's *BEF* with respect to *PES*.

mainstream economists, psychologists might anticipate some of these results. For instance, Weinstein identified a bias toward optimism and investigated its source. He notes:

> Various data suggest that people do tend to be unrealistically optimistic about the future. Surveys concerning automobile accidents... crime... and disease... find many people who say their risk is less than average, but few who say their risk is greater than average. [1980, 806]

Weinstein attempted to determine the conditions that foster optimistic bias in a study of undergraduates' perceptions of future events. His results support the hypothesis that the greater the perceived controllability of an event, the greater the tendency for individuals to believe that their own chances are greater than average (to avoid a negative outcome).

This finding on the source of optimism among students may help explain why business managers are overly optimistic. If managers regard future conditions as under their control, they may be biased toward believing that they will avoid negative outcomes. The consequence of such bias would be optimistic forecast error.

Models that incorporate the empirical results of cognitive psychology are capable of predicting systematic optimism. Our results, then, support those economists [Akerlof, 1991; Simon, 1979] who call for richer behavioral assumptions in economic models. These assumptions would not be derived from axiomatic dicta, but rather "from publicly repeatable observations that are obtained and analyzed objectively" [Simon, 1987, 28].

In addition to unbiasedness, we tested another behavioral assumption embedded in the traditional model of the decision maker: the ability to learn. The results from the Error-Learning Model support those economists and psychologists that argue that people attempt to learn from past mistakes. Past errors influenced current predictions in the direction expected by a theory of learning. Interestingly, however, the response to the error was insufficient to remove the bias. While the direction of change was consistent with learning, there was no substantial alteration in the forecast. Managers showed themselves to be willing to consider past errors when making a forecast, but unwilling to apply much weight to such information.

This weak learning response may be explained by the work of Oscamp [1965], and Einhorn and Hogarth [1978]. Oscamp argues that as people make more decisions they experience increased confidence in the accuracy of their judgments. This increased confidence follows from the experience of repeated decisions and is largely independent of the accuracy of those decisions.[12] Einhorn and Hogarth point out that once people acquire confidence in their judgments, even negative evidence "will not quickly extinguish the concept." They conclude, "When confidence in judgment is unwarranted, the illusion of validity can be maintained in the face of contradictory evidence" [ibid., 402]. Thus, managers may be holding on to their perceptions of the future, despite the evidence of bias, because of confidence in their judgments.

The managers studied in this paper bear a close, but not perfect, resemblance to the rational actors of economic models. Although they exhibited bias, they attempted to learn. The surprising findings are, first, that managers were biased in one direction only, toward optimism. Second, the managers studied moved only tentatively toward reforming their expectations. These results, then, add to the growing literature that notes the limited empirical validity of certain assumptions of the rationality paradigm.

APPENDIX: TABLE A.1
Mean Forecast Errors by Industry
(standard errors in parentheses)

	BEF	OPT	PES
Manufacturing	56.2	-8.1	2.5
	(1.33)	(1.41)	(0.72)
Primary Metals	57.9	-12.7	5.4
	(1.58)	(2.37)	(1.52)
Fabricated Metals	56.9	-9.1	3.1
	(1.55)	(1.83)	(0.90)
Non-electric Machinery	56.5	-9.4	3.4
	(1.54)	(1.97)	(0.99)
Electric Machinery	59.2	-9.3	2.4
	(1.68)	(1.88)	(1.04)
Transportation Equipment	57.1	-9.1	3.6
	(1.54)	(1.76)	(1.14)
Food	57.3	-7.5	0.5
	(0.92)	(0.97)	(0.29)
Paper	58.5	-8.8	4.9
	(1.78)	(1.96)	(1.16)
Chemicals	59.0	-8.0	3.0
	(1.49)	(1.67)	(1.01)
Mining	58.8	-10.2	2.9
	(1.01)	(1.78)	(0.92)
Utility	56.2	-5.3	1.8
	(1.05)	(0.78)	(0.45)
Wholesale Trade	57.1	-7.7	3.1
	(1.30)	(1.52)	(0.92)
Transportation	59.5	-9.1	2.3
	(1.41)	(1.85)	(-.83)
Textiles	53.4	-11.7	4.6
	(1.97)	(2.24)	(1.17)
Apparel	55.9	-8.7	3.6
	(1.85)	(1.83)	(1.00)
Printing and Publishing	58.1	-7.4	2.3
	(1.43)	(1.20)	(0.71)
Rubber	60.0	-8.9	2.3
	(2.17)	(2.61)	(1.16)
Lumber	59.2	-8.5	4.6
	(1.56)	(2.24)	(1.18)
Stone, Clay and Glass	56.8	-6.3	3.8
	(1.85)	(1.74)	(1.15)
Instruments	60.1	-9.8	1.5
	(1.55)	(2.22)	(0.65)
Construction	54.4	-6.5	2.2
	(1.32)	(1.31)	(0.66)
Retail Trade	58.7	-8.4	1.3
	(1.46)	(1.43)	(0.54)
Banking	56.3	-4.6	2.3
	(1.45)	(0.92)	(0.67)
Finance	59.6	-7.9	6.3
	(1.41)	(1.90)	(1.34)
Business Services	59.8	-7.2	2.2
	(1.28)	(1.31)	(0.61)
Insurance	55.2	-5.1	1.8
	(1.29)	(0.82)	(0.43)

NOTES

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1. Economists have relied primarily on the Livingston data [Pesando, 1975; Carlson, 1977; Mullineaux, 1978; Figlewski and Wachtel, 1981] and the Carlson-Parkin data [Evans and Gulamani, 1984; Carlson and Parkin, 1975], to study rationality.

   Psychologists have conducted experiments using a variety of subjects including: shoppers [Nisbett and Wilson [1977]], the elderly [Langer, Beck, Janoff-Bulman, and Timko [1984]], undergraduates [Wason [1969], Kahneman and Tversky [1973]], and faculty members [Einhorn and Hogarth [1978]].
2. Not all psychologists have abandoned the economist's model of rationality. Staddon [1992, 141] concludes that "...it makes no sense to pit economic models against mechanistic ones..." because all of the models of choice examined "...behave optimally under some conditions...".
3. Milgram [1963], Kahneman, and Tversky [1972; 1973], Grice [1975], Rachlin [1989], and Nisbett and Wilson [1977] have evaluated the consequences of adopting heuristic decision rules. Milgram [1963] discovered the existence of irrational obedience to authority by having participants administer "shocks" that increased in magnitude in a fictitious learning experiment. Kahneman and Tversky [1973] found that decision makers gave too little weight to previous information and gave disproportionate weight to new evidence. Grice [1975] notes that people may give undue weight to information of questionable relevance. Nisbett and Wilson [1977] found that people are often unaware of the true determinants of their behavior. Finally, Langer [1989] claims that people may be acting on the basis of mindsets formed in childhood, without considering alternative actions. Langer calls the resulting routinized behavior "mindlessness."
4. Similarly, experiments by Ward and Jenkins [1965], and Smedslund [1963], reveal that people judge the strength of a relationship solely by the frequency of outcomes consistent with their prediction. Thus, learning is unlikely since the subjects failed to recognize any errors in judgment.
5. The Conference Board only reports that the average number of respondents in each industry was approximately 25. If those response rates could not be maintained the Conference Board dropped that industry from the survey.
6. A referee suggested an alternative specification of equation (2) with forecast revisions as the dependent variable. This would reflect an assumption that managers update their most recent forecast. We modified text equation (2) by adding a lagged dependent variable to test whether managers update a previous forecast, rather than forming an independent forecast based upon new information.

   A coefficient on the lagged dependent variable that was not statistically significantly different from unity would favor a model with forecast revisions as the dependent variable. We *reject* the null hypotheses that the coefficient on the lagged dependent variable equals 1 in 21 of the 26 cases. We conclude, therefore, that text equation (2) is the more appropriate specification.
7. Mean errors of optimism (*OPT*) and pessimism (*PES*), as well as mean forecasts (*BEF*), are presented in Appendix Table A.1.
8. It is important to determine whether our finding of bias is merely the result of the business cycle. It is possible, however, that managers are unbiased and forward looking but are surprised during the estimation period by shocks that make their predictions appear optimistic. To test this hypothesis we estimated the following equation for every industry: $ERROR_t = \beta_0 \Delta GNP_t + \epsilon_t$ where: $\Delta GNP_t = (GNP_t - GNP_{t-2})/GNP_{t-2}$.

   We found a statistically significant relationship between managers' forecast errors and the change in the level of *GNP*. However, it rarely explained a substantial amount of the variance in the forecast error. Thus, while the business cycle accounts for some of the bias, not all of the optimism can be traced to the business cycle.
9. A referee suggested that the extent of managerial learning may be sensitive to industry competitiveness. We conducted a simple test of this hypothesis by examining the relation between the

eight firm two-digit industry concentration ratio and the number of significant learning coefficients for an industry. We found virtually no support for the notion that competition forces managers of firms in competitive industries to learn.

10. To test for robustness across a different measure of current conditions we also estimated equation (2) using industry-specific production indices instead of real *GNP*. The results were similar to those regressions using *GNP*. Only *OPT* shows a substantive difference between the two models. *OPT* was negative and significant in 47 percent of the industries examined using *GNP*, while negative and significant in 73 percent of the cases using the production indices. However, in all but one case where the coefficient on *OPT* was significant, it was also significant in the *GNP* model. Results are available from the authors.
11. Ito [1990] found evidence of "wishful thinking" amongst importers and exporters in Japan in the prediction of exchange rate movements. Each predicted changes favorable to their interests. Carlson and Dunkelberg [1989] report that firms are consistently more optimistic about price changes over the next six months than warranted by subsequent reports of actual price changes. Leonard [1982] studied inexperienced college graduates to compare expected and realized starting salaries. He found that employers systematically underestimate actual starting salaries in all eight occupational classes studied.

    Hirsch and Lovell [1969] looked for evidence of bias using data on firms' sales forecasts. In contrast to the above results, however, they conclude that not all bias stems from optimism.
12. Detmer, Fryback, and Gassner [1978] find that highly educated people are just as susceptible to overconfidence as are less educated individuals.

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