MANAGEMENT SCIENCE
Vol. 38, No. 5, May 1992
Printed in U.S.A.

ASPIRATION LEVEL ADAPTATION: AN EMPIRICAL EXPLORATION*

THERESA K. LANT
Department of Management/Organizational Behavior, Stern School of Business, New York University, 90 *Trinity Place, New York, New York* 10006

Organizations have been modeled as goal directed systems which use simple decision rules to adapt behavior in response to performance feedback. This paper examines the formation of organizational goals, or aspiration levels, over time in groups of individuals representing top management teams of simulated organizations. The analysis compares the empirical validity of an adaptive attainment discrepancy model with models derived from rational and adaptive expectations theories. The results suggest that the attainment discrepancy model, which is based on a simple decision rule of adjustment to performance feedback, provides the most robust description of aspiration formation. They are also informative with regard to the application of expectation models to aspiration formation: There is a great deal of similarity between these results and those of prior studies on expectation formation. In addition, the study finds that there tends to be an optimistic bias in aspiration formation, that adaptation is not consistently incremental, and that adaptive learning may, over time, lead to behavioral outcomes that are consistent with rationality.
(GOALS; ADAPTIVE ASPIRATIONS; RATIONAL EXPECTATIONS; PERFORMANCE FEEDBACK; LEARNING)

1. Introduction

A basic assumption of many models of organizational behavior is that individuals and organizations learn and adjust their behavior in response to experience (March and Simon 1958). Specifically, the assumption is made that organizations set goals and adjust behavior in response to favorable and unfavorable feedback in accordance with simple decision rules (Cyert and March 1963). These assumptions are characteristic of models of organizational learning which posit that behavior in organizations is goal directed, history dependent, and rule based (Levitt and March 1988). The role of goals, or aspiration levels, is a critical part of these models. Satisficing models suggest that aspiration levels determine when alternatives are acceptable or unacceptable (March and Simon 1958). In the literature on managerial interpretations, aspirations determine whether past performance is framed as a success or failure, thus influencing interpretations and subsequent behavior (Milliken and Lant 1991). In behavioral simulations of organizations, aspirations are a critical variable that affects future behavior of the simulated organizations (Morecroft 1985; Sterman 1987; Lant and Mezias 1990, 1992).

Despite the importance of aspiration levels in many models of organizational behavior, there has been little empirical examination of the behavior of aspiration levels themselves. Most studies of aspiration levels have focused on individual level effects, such as the effect of goal setting on motivation (Locke 1968), satisfaction and individual job performance (House 1971), and feelings of success and failure (Lewin, Dembo, Festinger, and Sears 1944). As summarized above, however, aspirations are not only important at the individual level of analysis, but they are also a governing mechanism in organizational learning and decision making (March and Simon 1958). Thus, a key question remains: How do aspirations for organizational outcomes behave over time in response to experience? This paper explores the behavior of aspiration levels over time as they are set by groups of individuals representing the top management teams of simulated organizations.

* Accepted by Gregory W. Fischer; received May 1, 1989. This paper has been with the author 8 months for 2 revisions.

0025-1909/92/3805/0623$01.25

Although there is a lack of empirical evidence about the behavior of aspirations in strategic decision-making settings, models of organizational systems frequently assume that aspirations adapt to performance feedback (Cyert and March 1963; Morecroft 1985). The model developed by Levinthal and March (1981) posits that aspiration level adaptation follows a simple decision rule which updates aspirations based on a weighted average of prior aspiration level and actual performance. Thus, aspirations will adjust upward in response to favorable feedback, and downward in response to unfavorable feedback. A model of attainment discrepancy (Lewin et al. 1944) is very similar to the Levinthal and March (1981) model but with less restrictive assumptions. This model posits that adaptation of aspiration levels follows a simple decision rule which updates aspirations based on prior aspiration level and the discrepancy between prior aspiration level and actual performance, called the attainment discrepancy.

These models are consistent with the notion that decision makers are boundedly rational (Simon 1957). When the relationship between organizational actions and outcomes is not easily understood, the cognitive limitations of decision makers result in the use of simple decision rules (Kahneman, Slovic, and Tversky 1982). Examples include trial and error (March and Shapira 1982), incremental adjustment (Padgett 1980), anchoring (Sterman 1989), and dimensional rather than holistic comparisons (Payne 1976). In forming interpretations about how actions lead to outcomes, managers first determine whether the outcomes in question are favorable or unfavorable, and make strategic decisions based on this assessment (Milliken and Lant 1991). Performance relative to aspiration levels is used to make this assessment; this information is crucial because it provides a signal which is used to guide future behavior. Operational goals are set in organizations in order to provide a concrete link to specific actions, thus simplifying decision making (March and Simon 1958; Morecroft 1985).

Incremental adaptation models of aspiration formation have been developed specifically to aid in modeling organizational level learning processes, and are clearly in the behavioral tradition. However, models of this form have a long history in the economics literature as adaptive expectations (Sterman 1987) or adaptive learning (Jacobs and Jones 1980) models. A key difference between the behavioral and economic models is the conceptualization of goals versus expectations. Historically, economics has been interested in explaining how expectations, or forecasts, of future events are formed. A widely accepted model of expectation formation is Muth's (1961) rational expectations model, which defines expectations as anticipations of future events based on the optimal use of all available information. In expectation models, constructs that represent desires, such as aspirations, are subsumed in the concept of a preference function, and are not modeled explicitly. The organizational literature, on the other hand, has sought to explain how and why organizations set aspirations for levels of performance they seek to achieve, and how these goals affect behavior. Organizations act in order to enhance their degree of success in achieving their aspirations; the achievement of aspirations can be influenced by changes in the organization's behavior.

Although expectations and aspirations are conceptually distinct, it is worth asking whether aspirations behave in ways that are similar to expectations, since similar models have been used by economists to explain expectation formation and by organization theorists to explain aspiration formation. Such an investigation may discover that aspiration formation can also be modeled as either an adaptive or a rational process, depending, for instance, on the decision maker's level of experience in a system, the stability of the system, and the decision maker's ability to affect outcomes in the system. This paper addresses these issues in two ways. First, the paper explores whether aspirations behave in ways consistent with adaptive and rational expectations models. Second, the paper explores whether aspiration formation behavior is consistent with the empirical evidence of expectation formation (Lovell 1986; Frankel and Froot 1987; Mezias 1988).

This exploration will expand our knowledge of aspiration level formation, using models which have a long history in the literature on expectation formation. Further, in the spirit of work on dynamic decision making (Sterman 1989), this paper will explore decision making in a dynamic environment that simulates the complexity of decision making in organizations. This research offers a potential link between cross-sectional, individual level experiments (Payne, Laughhunn, and Crum 1980) and longitudinal, nonexperimental firm and market level studies (Lovell 1986). These issues are investigated by observing the decisions of groups representing the top management teams of simulated organizations over time. Predictions of adaptive models which correspond closely to adaptive expectations models will be examined first, followed by predictions corresponding to the rational expectations model.

2. Model Specification and Hypotheses

2.1. *Incremental Adaptation Models*

Both the Levinthal and March (1981) and attainment discrepancy models reflect the goal directed and incremental nature of organizational systems. Performance feedback governs the direction of aspiration level adaptation. Past aspiration level serves as an anchor from which incremental changes are made. Changes driven by deviations from goals are typically incremental, with both goals and activities changing in small steps (Padgett 1980). Decision makers anchor on their prior target as a starting point from which to make adjustments, and are unlikely to make a full adjustment in a single time period to the level of performance achieved. Incremental change is an example of a simple decision rule which economizes on the amount of information that needs to be processed in order for a decision to be made. Evidence of decision simplification through incremental change is found in studies of anchoring and adjustment (Tversky and Kahneman 1974), strategic decision making (Quinn 1980), budgetary allocations (Fischer and Kamlet 1984; Wildavsky and Hammond 1965), and dynamic decision making (Sterman 1989).

In the Levinthal and March (1981) model, organizations set performance aspirations, compare actual performance to these aspirations, and modify future aspirations based on this comparison. They predict that aspirations adapt to performance at a slower rate of change than change in performance. They model aspirations as an exponentially weighted moving average of past performance:

$$Y_t = [1 - \gamma_2] Y_{t-1} + \gamma_2 Z_{t-1} \qquad (1)$$

where Y_t is current aspiration level, Y_{t-1} is last period's aspiration level, Z_{t-1} is the actual performance achieved in the last period, and $0 \leq \gamma_2 \leq 1$.

The attainment discrepancy model focuses explicitly on the deviation between prior aspiration and actual performance. Attainment discrepancy is calculated by subtracting aspiration level from actual performance achieved. Thus, when performance exceeds aspiration level, attainment discrepancy is positive. When performance is below aspiration level, attainment discrepancy is negative. The model suggests that attainment discrepancy is a crucial piece of information which decision makers use to simplify the process of setting new goals. It assumes that decision makers consciously or unconsciously assess the difference between their aspired performance and their actual performance, and this information is used as a cue which determines the next aspiration level. The attainment discrepancy variable serves as the performance feedback which governs the direction of aspiration level adjustment. Past aspiration is an anchor from which incremental changes are made. The simplest version of this model is a linear process with a single-period lag. The specification of this model is given in equation (2):

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 X_{t-1} + \epsilon_t \qquad (2)$$

where Y_t is the aspiration level set in the current period, Y_{t-1} is the aspiration level set in the previous period, and X_{t-1} is the attainment discrepancy between aspiration level and performance in the last period.

The Levinthal and March (1981) and attainment discrepancy models are structurally equivalent, with the exception that the Levinthal and March (1981) model maintains several constraints. Equation (2) can be represented alternatively as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2[Z_{t-1} - Y_{t-1}] + \epsilon_t \quad (3)$$

where Y_t is current aspiration, Y_{t-1} is last period's aspiration, and Z_{t-1} is the actual performance achieved in the last period. Equation (3) can be rewritten as:

$$Y_t = \alpha_0 + [\alpha_1 - \alpha_2]Y_{t-1} + \alpha_2 Z_{t-1} + \epsilon_t. \quad (4)$$

The attainment discrepancy model would be equivalent to the Levinthal and March (1981) model in equation (1) if α_0 were constrained to be 0 and α_1 were constrained to be 1. Equation (4) shows that $\alpha_2 = \gamma_2$ from equation (1). The Levinthal and March (1981) model is a more parsimonious model, but achieves this through these constraints. The hypotheses suggested by these models are discussed below.

First, the attainment discrepancy model suggests that aspiration levels in the previous time period will have a positive effect on aspiration levels in the current time period. This hypothesis derives from the standard prediction in the literature that aspirations adjust to changes in performance, but at a slower rate than changes in performance (Cyert and March 1963; Levinthal and March 1981). Thus, there is some inertia in the adjustment of aspiration levels. Second, the attainment discrepancy model suggests that attainment discrepancy will have a positive effect on aspiration level. This hypothesis derives from the basic prediction that decision makers adapt their aspirations to performance. That is, if performance is above aspiration level, aspirations will adjust upward. If performance is below aspiration level, aspirations will adjust downward.[1]

The Levinthal and March (1981) model imposes constraints on several parameters of the attainment discrepancy model. These hypotheses can be tested by using a regression analysis on equation (3). First, the model predicts that the constant term will not be significantly different from zero. This implies that aspirations are set solely based on performance and past aspiration, with no constant term. In a world of stable performance at equilibrium, aspirations will approach the level of performance. This prediction can be evaluated by testing whether $\alpha_0 = 0$ in equation (3). A significant constant term would prevent the level of aspiration from adjusting completely to the level of performance in equilibrium. This would suggest that there is some force acting on aspiration levels which keeps them higher or lower than would be predicted by the Levinthal and March (1981) model. Second, the model predicts that the coefficient on past aspiration level will be equal to one minus the coefficient on past performance. According to equation (1), aspirations are a function of past aspiration and past performance. If the coefficient of past performance is less than one, then the coefficient of past aspiration level should be greater than zero; the sum of these two coefficients is defined by the model to equal 1. This implies that the change in aspirations from period to period will not be greater than the change in performance. As shown in equation (4), this constraint implies that α_1 in equation (3) will be equal to one. Finally, the model predicts that past performance will have a positive effect on current aspiration level, with a coefficient between 0 and 1. Current aspirations are partly a function of last period's performance. The coefficient of past performance indicates the weight of past performance in determining aspiration level. If this coefficient were equal to one, then aspiration level is set equal to last period's

[1] The attainment discrepancy model makes few assumptions, and thus does not make specific predictions about the constant term or the behavior of the error term.

performance, and the effect of last period's aspiration level should not be significant. The model states that the coefficient on past performance, γ_2 in equation (1), will not exceed 1; that is, aspiration levels do not adjust more rapidly than changes in performance. This prediction can be evaluated by testing for $\alpha_2 \leq 1$ in equation (3).

2.2. *Rational Expectations Model*

In modeling aspiration formation as discussed above, organization theorists have adopted models of adaptive expectations from the economics literature. In order to explore thoroughly the nature of aspiration formation, it makes sense to apply rational models of expectation formation as well. Proceeding in this way may provide a more complete understanding of the aspiration formation process.

The strong form of the rational expectations model assumes that expectations are formed by the optimal use of all available information. The weak form assumes that people will not systematically depart from behavior predicted by such a model. The basic specification of the rational expectations model is that of conditional expectations. Expectations about some future state, X_t, are conditional on the information that is available, I_{t-1}. The conditional expectation of this future state given available information is shown below:

$$E[Z_t | I_{t-1}] = \int_a^b Z_t f(Z_t | I_{t-1}) dZ_t. \tag{5}$$

In terms of expectations about future performance, for example, the expectation of future performance would equal the expected value of future performance. The rational expectations model of performance expectations can be represented as:

$$Y_t = Z_t + \epsilon_t \tag{6}$$

where Y_t is the expectation or forecast of current performance, Z_t is current performance, and ϵ_t is the forecast error. The forecast error is the difference between actual performance achieved and the forecasted performance. Its specification is given below:

$$\epsilon_t = Z_t - E[Z_t | I_{t-1}]. \tag{7}$$

The forecast error is assumed to exhibit two key properties. First, the expected value of the forecast error is zero. Second, forecast errors are uncorrelated over time. Each subsequent forecast error should be unpredictable and unrelated to any information available, such as previous forecast errors.

If the rational expectations model were used to study aspiration formation, it would predict that performance targets would be set equal to the expectation of future performance. Any information regarding past aspirations or past performance that was considered relevant would be contained in I_{t-1}, and thus would be used in evaluating $E[Z_t | I_{t-1}]$. Empirically, this means that aspiration formation would be a function only of the expectation of future performance; variables representing past aspirations and past performance would not add explanatory power if entered into the model along with Z_t. This model also would assume that there is no relationship between errors over time. This interpretation of the model can be represented by the following regression equation:

$$Y_t = \beta_0 + \beta_1 Z_t + \epsilon_t \tag{8}$$

where Y_t is the current aspiration level, and Z_t is current performance. Applying rational expectations to aspiration level formation yields the following predictions. First, because the model predicts that aspirations equal expectations of performance, the constant term in equation (8), β_0, should not be significantly different from zero. Second, there will be no serial correlation in the residuals. The model predicts that aspirations will track actual performance without systematic errors. While there may be random error in each period, this error is not systematically related across periods. Thus, there should be no evidence of serial correlation, with the coefficient of serial correlation, ρ, equal to zero. Third, current performance will have a positive effect on current aspiration level, with a coefficient equal to 1. The model predicts that aspiration levels are set equal to expected performance, and that aspirations are unbiased estimates of performance. Specifically, β_1 from equation (8) will be equal to one.

As discussed above, the rational expectations model assumes that all available current information is used in making forecasts, rather than a subset of information such as prior expectations. Applying this assumption to aspiration formation, it is predicted that aspirations from prior periods will not be a significant predictor of current aspirations, and that the coefficient on performance will remain equal to 1. These predictions can be tested by adding a lagged value of aspirations to equation (8), as seen in equation (9), and testing for $\beta_1 = 1$ and $\beta_2 = 0$:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 Y_{t-1} + \epsilon. \tag{9}$$

Although rational expectations has been considered a replacement and improvement over adaptive expectations models, some research suggests that expectations may be determined by historical or feedback data (Cyert and March 1963; Jacobs and Jones 1980). In fact, both may be applicable in different circumstances. Lucas (1986) argues that individuals must learn about the system whose behavior they are trying to predict before a rational expectations model will describe their expectation formation. That is, rational expectations is most applicable for actors who have experience with a system in equilibrium. This argument suggests that adaptive behavior is used by actors early in their experience with a system, when they are learning about the rules governing the system. Once the rules are learned, behavior is consistent with rational expectations. If the system moves from one configuration of rules to another, actors must once again use adaptive behavior to learn the new rules governing the system. Thus, it is predicted that rational expectations will be more descriptive of aspiration formation in later periods than in earlier periods. In contrast, the incremental adaptation models imply that adaptive behavior describes the behavior of actors in a system regardless of their level of experience in the system. Thus, these models predict that there will be no difference between the fit of adaptive aspirations models in later periods and earlier periods.

Models of expectation formation have been tested in a variety of nonexperimental domains. These studies suggest two additional hypotheses that could be applied to aspiration level formation in the present setting. Hirsch and Lovell (1969) found evidence that organizations were systematically biased in their formation of expectations. Their results indicate that some firms tended to be consistently optimistic while others were consistently pessimistic when forecasting sales volume. This finding is contrary to what would be predicted by rational expectations, where there should not be systematic biases. Thus, this paper tests the prediction that aspirations will not be systematically higher or lower than actual performance. The presence of biases in aspiration level formation will be investigated by testing for significant differences between average aspirations and average performance. If on average, over time, a firm's aspirations exceed their actual performance, they would be optimistic. If on average, over time, their aspirations are below their actual performance, they would be pessimistic.

Finally, the rational expectations model predicts that the variance of actual outcomes will exceed the variance of the forecasts of these outcomes (Lovell 1986). The adaptive models would suggest the same, since they model aspirations as weighted averages of past performance. Empirical tests have found mixed results (Hirsch and Lovell 1969), with the variance of forecasts sometimes being smaller and sometimes larger than the variance of actual outcomes. This prediction will be investigated by testing for significant differences between the variance of performance and the variance of aspirations.

3. The Research Setting

In order to test the hypotheses described above, it is necessary to track the aspirations and performance of decision makers over time. For reasons of external validity, the setting should be complex enough so that decisions that are made are similar to those that are made in actual organizations. The *Markstrat* marketing strategy game (Larreche and Gatignon 1977) provides such a setting. *Markstrat* was written as a comprehensive model of marketing dynamics that incorporated knowledge from prior marketing research and real-world experience. Its realism has led to its being adopted as a pedagogical and research tool. Discussions with managers from a variety of large, successful corporations who use *Markstrat* in their in-house management training revealed that they feel the game has a great deal of external validity (Dodgson 1987; Kinnear and Klammer 1987). *Markstrat* has also been used for research purposes (Cook and Page 1987; Glazer, Steckel, and Winer 1987) and specifically for research on decision making (Hogarth and Makridakis 1981; Walsh, Henderson, and Deighton 1988; Ross 1987; Lant and Montgomery 1987).

A typical play of *Markstrat* consists of five teams, each representing the top management team of an organization, who compete with each other in a single industry for up to ten periods. The five competitors can produce and sell two types of consumer products—Sonites and Vodites. The teams are responsible for setting performance objectives and making strategic and resource allocation decisions which they believe will lead to the achievement of these goals. Thus, this game offers the opportunity to observe teams of decision makers setting objectives, making strategic and resource allocation decisions, and receiving feedback, over several periods of time. The teams are also making a wide range of decisions in a complex environment. The *Markstrat* game is controlled by complicated algorithms that simulate a competitive market in a multidimensional, interdependent world; the relationships between organizational actions and outcomes are not easily understood because they are complex and nonlinear. The competitive structure of the industry evolves as the game is played and depends on the moves of teams. Thus, the complexity of the decisions facing the teams is similar to that faced by organizational decision makers. The teams are given the explicit role of making decisions which are designed to be similar to decision making in real organizations. The teams design their own structure for making these decisions and were asked to provide brief descriptions of the decision-making structure used in their group. These descriptions indicate that four designs were used: functional, product line, matrix, and consensus. Functional teams created vice-president roles such as production, R & D, and marketing. Product teams created product manager positions. Matrix teams divided responsibilities along both functional and product dimensions. Consensus teams did not divide responsibilities, but made all decisions as a group. These designs are fairly representative of the decision structures found in actual organizations; however, in this setting there is no real organization upon which the teams are dependent to implement their decisions.

3.1. *Operational Definitions*

Data were gathered from four *Markstrat* industries comprised of ten teams of managers in an executive education program and ten teams of MBA students enrolled in a marketing strategy course at the Stanford Graduate School of Business. Each industry will be treated as a separate sample for the purposes of initial analysis, and will be combined if there are no structural differences between the samples. Three data sources were used: the decision forms filled out by *Markstrat* players, the computer generated results, and questionnaires.[2] The teams played for seven periods, and data were collected for each period.

[2] All data are at the team, level. Decisions are made as a team, results are given for the team, and questionnaires are filled out by the team.

All decisions made by the teams are specific to each brand of Sonite or Vodite they are marketing. Brands are differentiated products with respect to characteristics such as power, size, price, and targeted market segment. Teams set their performance targets and monitor performance at the brand level. The causal mechanisms are posited to work primarily at the brand level, and it is important to tap the decision-making process at this level; thus, the unit of analysis used in this study is the brand.

Aspiration levels were measured using self-reports in each period of sales objectives from each team regarding each brand they were marketing. These objectives are reported by the teams in the questionnaire they filled out each week. The question regarding sales goals was worded as follows: *For each brand you are producing in the current period, please indicate your sales objective (# of units sold)*. The questionnaires were used to insure that a systematic record of these objectives was kept. However, the teams have an incentive to think about performance objectives independent of these questionnaires. The teams are graded based on how well they improve their company's performance from its initial position and the quality of the strategic plan they develop. They are taught that an important part of a good strategic plan is to set performance objectives. Thus, performance objectives become a natural part of strategic planning. There is also evidence that the teams pay attention to these goals in determining strategic actions. Lant and Montgomery (1987) found that performance relative to goals affected both the risk taking and search behavior of these teams. This setting is generalizable to actual managerial behavior to the extent that managers set performance objectives in the course of strategic planning. The strategic planning literature argues that setting goals and objectives is an essential part of strategic planning (Hofer and Schendel 1978). The actual performance achieved was measured as the corresponding number of units sold associated with each brand and was collected from the computer generated results each week. Then attainment discrepancy was calculated simply as performance minus aspiration.

It is important to discuss how these measures relate to the constructs in the theory and how they compare with measures used in previous research. This study differs from many others in that aspiration levels are reported by the decision makers themselves. This improves the relationship between the measure and the aspirations actually being used by the decision makers. This study assumes, however, that the aspirations as reported by a team of decision makers are the aspirations actually used by that team. Moving to the group level of analysis requires this assumption. However, it also makes the situation being studied more like that of a real organization, where organizational goals are most likely the result of bargaining processes between individuals within a subunit or between subunits. Prior work on aspirations has either focused on individual level achievement goals (Locke 1968), or has assumed that the value of aspirations was some reference point such as a zero level of return on a gamble (Payne, Laughhunn, and Crum 1980).

3.2. *Methodology*

The data are organized into a pooled, cross-sectional time series design, with each brand marketed by each team in each time period considered an observation. The pooling of cross-sectional and time-series data creates several estimation problems, including the possibility of autocorrelated disturbances across time periods and heteroscedastic disturbances across cross-sectional units. Further, the problem of autocorrelated disturbances is likely to be exacerbated in the Levinthal and March (1981) and attainment discrepancy models, which contain a lagged exogenous variable and a lagged endogenous variable. In addition, a lagged dependent variable will lead to inconsistent ordinary least squares estimates. For a model with a lagged dependent variable and autocorrelated disturbances, Johnston (1984) suggests using an iterative maximum likelihood technique, such as Cochrane-Orcutt, to produce consistent parameter estimates; thus, the regression analyses are conducted using the Cochrane-Orcutt procedure. For each model, an analysis of residual scatterplots was conducted to determine whether heteroscedasticity is a problem. The Durbin-Watson statistic was examined as an indicator of autocorrelation for each model. In models with lagged endogenous variables, the Durbin-Watson statistic is biased toward not indicating autocorrelation. The tests used here follow the suggestion of Kenkel (1974) in using the upper limit d_u as an accurate cut off point.

4. Results

For each hypothesis, the test results are discussed for each of the four industry samples separately. Ultimately, the results will be compared across samples, and differences between the samples and their potential causes will be discussed. Correlation matrices for the four industries are given in Table 1.

The results for the attainment discrepancy model are given in Table 2. The coefficients of past aspiration and attainment discrepancy are consistently positive and significant.

TABLE 1

Pearson Correlation Coefficients

Industry 1 (N = 105)	Aspiration$_t$	Aspiration$_{t-1}$	Attainment Discrepancy$_{t-1}$	Sales$_t$	Sales$_{t-1}$
Aspiration$_t$	1.000				
Aspiration$_{t-1}$	0.7717	1.000			
Attain. Discrep.$_{t-1}$	0.2900	−0.2419	1.000		
Sales$_t$	0.9058	0.7050	0.3408	1.000	
Sales$_{t-1}$	0.9143	0.8594	0.2883	0.8754	1.000

Industry 2 (N = 98)	Aspiration$_t$	Aspiration$_{t-1}$	Attainment Discrepancy$_{t-1}$	Sales$_t$	Sales$_{t-1}$
Aspiration$_t$	1.000				
Aspiration$_{t-1}$	0.4098	1.000			
Attain. Discrep.$_{t-1}$	0.3721	−0.4797	1.000		
Sales$_t$	0.7441	0.4652	0.3739	1.000	
Sales$_{t-1}$	0.7650	0.5916	0.4237	0.8238	1.000

Industry 3 (N = 90)	Aspiration$_t$	Aspiration$_{t-1}$	Attainment Discrepancy$_{t-1}$	Sales$_t$	Sales$_{t-1}$
Aspiration$_t$	1.000				
Aspiration$_{t-1}$	0.6671	1.000			
Attain. Discrep.$_{t-1}$	0.2186	−0.4228	1.000		
Sales$_t$	0.8414	0.6795	0.1483	1.000	
Sales$_{t-1}$	0.8660	0.7833	0.2322	0.8310	1.000

Industry 4 (N = 112)	Aspiration$_t$	Aspiration$_{t-1}$	Attainment Discrepancy$_{t-1}$	Sales$_t$	Sales$_{t-1}$
Aspiration$_t$	1.000				
Aspiration$_{t-1}$	0.7766	1.000			
Attain. Discrep.$_{t-1}$	0.1682	−0.2367	1.000		
Sales$_t$	0.8371	0.5902	0.2366	1.000	
Sales$_{t-1}$	0.8394	0.8026	0.3896	0.7047	1.000

TABLE 2

Incremental Adaptation Models

$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2[Z_{t-1} - Y_{t-1}] + \epsilon_t$ [equation (3)]

Industry 1 (N = 105)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
α_0 Constant	31140.6	13282.2	$\alpha_0 = 0$ $T = 2.345$†
α_1 Aspiration$_{t-1}$	1.0987	0.0502	$\alpha_1 > 0$ $T = 21.688$‡
α_2 Attain. Disc.$_{t-1}$	1.2571	0.0935	$\alpha_2 > 0$ $T = 13.439$‡
Adjusted R^2 = 0.8389, $F(2,102)$ = 271.72‡			$\alpha_1 = 1$ $T = 1.966$*
DW = 1.46‡, $\hat{\rho}$ = 0.300			$\alpha_2 \leq 1$ $T = -2.75$‡

Industry 2 (N = 98)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
α_0 Constant	70084.8	19311.6	$\alpha_0 = 0$ $T = 3.629$†
α_1 Aspiration$_{t-1}$	0.9070	0.0885	$\alpha_1 > 0$ $T = 10.247$‡
α_2 Attain. Disc.$_{t-1}$	0.9817	0.0998	$\alpha_2 > 0$ $T = 9.841$‡
Adjusted R^2 = 0.5811, $F(2,95)$ = 68.273‡			$\alpha_1 = 1$ $T = 1.05$
DW = 1.90, $\hat{\rho}$ = 0.048			$\alpha_2 \leq 1$ NS

Industry 3 (N = 90)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
α_0 Constant	19720.3	17738.8	$\alpha_0 = 0$ $T = 1.110$
α_1 Aspiration$_{t-1}$	1.1433	0.0727	$\alpha_1 > 0$ $T = 15.731$‡
α_2 Attain. Disc.$_{t-1}$	1.1739	0.1136	$\alpha_2 > 0$ $T = 10.331$‡
Adjusted R^2 = 0.7465, $F(2,87)$ = 132.02‡			$\alpha_1 = 1$ $T = -1.97$*
DW = 2.02, $\hat{\rho}$ = 0.017			$\alpha_2 \leq 1$ $T = -1.531$*

Industry 4 (N = 112)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
α_0 Constant	34362.6	14362.7	$\alpha_0 = 0$ $T = 2.360$†
α_1 Aspiration$_{t-1}$	0.9633	0.0570	$\alpha_1 > 0$ $T = 16.895$‡
α_2 Attain. Disc.$_{t-1}$	0.6438	0.0874	$\alpha_2 > 0$ $T = 7.365$‡
Adjusted R^2 = 0.7264, $F(2,109)$ = 148.39‡			$\alpha_1 = 1$ $T = 0.644$
DW = 1.94, $\hat{\rho}$ = 0.021			$\alpha_2 \leq 1$ NS

* $p < 0.10$.
† $p < 0.05$.
‡ $p < 0.01$.

Several specification checks were conducted to verify the validity of the aspiration level adaptation model given in equation (3). Standard tests indicated that multicollinearity was not a problem. The model was tested for nonlinearities and a two-period lag structure. Neither of these alternatives provided a better fit of the data in general, although there were some significant results.[3] Finally, there is significant autocorrelation only in industry 1.

The results for the Levinthal and March (1981) model are also given in Table 2. The hypothesis tests are conducted using the coefficients from equation (3). The prediction that the constant term will not be significantly different from zero is rejected in three of the four industries. The prediction that the coefficient on past aspiration will be equal to one minus the coefficient on past performance is evaluated by testing whether α_1 from equation (3) is equal to one. This hypothesis is rejected in two of the industries at the 0.10 level of significance.[4] The prediction that the coefficient on past performance would be less than 1 is not supported in 2 industries; the estimated coefficient is significantly greater than 1 in industry 1, and marginally greater than 1 in industry 3. Taken together, these results suggest that aspirations may actually adjust faster than changes in performance.

Table 3 gives the results of a regression on equation (8), the basic rational expectations model. The adjusted R^2's indicate that the model fits the data quite well. However, the prediction that the constant term will not be significantly different from zero is rejected in all four industries. The prediction that there will be no serial correlation in the residuals is rejected only in industry 1. The coefficient of current sales is significant in all industries. However, the prediction that the coefficient of current performance will be equal to one is rejected in three of the four industries. A regression on equation (9), where lagged aspirations are added to the rational expectations model, tested the predictions that the coefficient of lagged aspirations will not be significantly different from zero, and that the coefficient on sales will be equal to one even with the addition of lagged aspirations; these results are presented in Table 4. The coefficient on lagged aspirations is significant in industries 1 and 4, and marginally significant in industry 3. The coefficient on sales is significantly less than one in all four industries.[5]

The following results compare rational and adaptive models in terms of how well they describe the data in early and late periods of decision making. The hypotheses were tested by splitting the samples into early and late periods, and running regressions on these subsamples separately. Early periods were defined as periods 1–4 for the rational expectations model and periods 2–4 for the adaptation models;[6] late periods were defined as periods 5–7. In industries 2, 3, and 4 there are significant structural differences between early and late periods, as indicated by significant F statistics from Chow (1960) tests: $F = 18.19$, $F = 10.68$, $F = 14.61$,[7] respectively. These differences seem to be due to some improvement in the fit of the model in later periods. In three industries there is significant autocorrelation in early periods which disappears in later periods. In industries 2 and 3, the adjusted R^2 is better in the later periods: 0.3736 versus 0.7316 for industry 2, and 0.5594 versus 0.6226 in industry 3. Although the adjusted R^2 does not improve in industry 4, the assumptions of rational expectations are supported in later periods. In early periods the constant is greater than 0, $T = 5.68$, $p < 0.01$, and the coefficient on sales is not equal to 1, $T = 6.08$, $p < 0.01$; in later periods these predictions are not rejected.

[3] To test for nonlinearity, a squared term of attainment discrepancy was included. This variable was significant only in industry 4, $T = -7.73$, which was found to be driven by two outliers in the data. Prior aspiration level and attainment discrepancy lagged for two periods were included to test for a two-period lag structure. In industry 1, aspiration level at $t - 2$ was significant and negative, $T = -2.90$. In industry 3, both aspiration level and attainment discrepancy at $t - 2$ were significant and negative, $T = -2.64$ and $T = -2.05$, respectively.

[4] The cutoff for a two-sided test at the 0.05 level of significance is 1.98. The t-statistics for these industries are 1.966 and 1.972.

[5] It should be noted that a direct comparison between regressions on equations (8) and (9) is somewhat problematic since one observation must be dropped to estimate equation (9).

[6] The first period is dropped for the adaptation models because lagged variables are required.

[7] All are significant at $p < 0.01$.

TABLE 3

Rational Expectations Model

$Y_t = \beta_0 + \beta_1 Z_t + \epsilon_t$ [equation (8)]

Industry 1 (N = 119)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	28165.7	10873.2	$\beta_0 = 0$ $T = 2.59‡$
β_1 Sales_t	0.9790	0.0421	$\beta_1 = 1$ $T = -0.498$
$\hat{\rho} = 0.142$ Adjusted $R^2 = 0.8204$ $F(1,117) = 539.84‡$			$\rho = 0$ $DW = 1.72†$

Industry 2 (N = 116)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	86365.5	15074.2	$\beta_0 = 0$ $T = 5.729‡$
β_1 Sales_t	0.7007	0.0669	$\beta_1 = 1$ $T = 4.472‡$
$\hat{\rho} = -0.018$ Adjusted $R^2 = 0.4859$ $F(1,114) = 109.70‡$			$\rho = 0$ $DW = 2.04$

Industry 3 (N = 103)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	76728.2	17332.6	$\beta_0 = 0$ $T = 4.427‡$
β_1 Sales_t	0.7046	0.0664	$\beta_1 = 1$ $T = 4.446‡$
$\hat{\rho} = -0.031$ Adjusted $R^2 = 0.5222$ $F(1,101) = 112.48‡$			$\rho = 0$ $DW = 1.99$

Industry 4 (N = 126)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	59872.1	16419.6	$\beta_0 = 0$ $T = 3.646‡$
β_1 Sales_t	0.8013	0.0611	$\beta_1 = 1$ $T = 3.252‡$
$\hat{\rho} = -0.053$ Adjusted $R^2 = 0.5778$ $F(1,124) = 172.05‡$			$\rho = 0$ $DW = 2.10$

† $p < 0.05$.
‡ $p < 0.01$.

The test for structural equivalence of the adaptive aspirations model in early and late periods is rejected in industries 1, 2, and 4, although the difference is marginal in industry 2: $F = 4.55$, $p < 0.05$, $F = 2.96$, $p < 0.10$, $F = 14.79$, $p < 0.01$, respectively. In industries 1 and 4, there is some evidence that the predictions of Levinthal and March (1981) hold more often in later periods than earlier ones. In industries 1 and 4, the hypotheses that

TABLE 4

Rational Expectations Model plus Lagged Aspirations

$Y_t = \beta_0 + \beta_1 Z_t + \beta_2 Y_{t-1} + \epsilon_t$ [equation (9)]

Industry 1 (N = 105)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	2570.90	12280.6	$\beta_0 = 0$ $T = 0.209$
β_1 Sales$_t$	0.7781	0.0559	$\beta_1 = 1$ $T = 3.969\ddagger$
β_2 Aspiration$_{t-1}$	0.3283	0.0646	$\beta_2 = 0$ $T = 5.081\ddagger$
$\hat{\rho} = 0.189$			$\rho = 0$ $DW = 1.63\dagger$
Adjusted $R^2 = 0.8501$, $F(2,102) = 295.99\ddagger$			

Industry 2 (N = 98)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	69870.4	20260.2	$\beta_0 = 0$ $T = 3.449\ddagger$
β_1 Sales$_t$	0.7154	0.0737	$\beta_1 = 1$ $T = 3.861\ddagger$
β_2 Aspiration$_{t-1}$	0.0795	0.0890	$\beta_2 = 0$ $T = 0.894$
$\hat{\rho} = 0.191$			$\rho = 0$ $DW = 1.63\dagger$
Adjusted $R^2 = 0.5808$, $F(2,95) = 68.20\ddagger$			

Industry 3 (N = 90)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	33346.7	19321.4	$\beta_0 = 0$ $T = 1.726^*$
β_1 Sales$_t$	0.7952	0.0841	$\beta_1 = 1$ $T = 2.436\ddagger$
β_2 Aspiration$_{t-1}$	0.1859	0.0942	$\beta_2 = 0$ $T = 1.974^*$
$\hat{\rho} = 0.095$			$\rho = 0$ $DW = 1.79$
Adjusted $R^2 = 0.7112$, $F(2,87) = 110.60\ddagger$			

Industry 4 (N = 112)

Explanatory Variable	Estimated Coefficient	Standard Error	Hypothesis Test
β_0 Constant	7623.5	11620.4	$\beta_0 = 0$ $T = 0.656$
β_1 Sales$_t$	0.5495	0.0471	$\beta_1 = 1$ $T = 9.565\ddagger$
β_2 Aspiration$_{t-1}$	0.4812	0.0558	$\beta_2 = 0$ $T = 8.627\ddagger$
$\hat{\rho} = -0.058$			$\rho = 0$ $DW = 2.01$
Adjusted $R^2 = 0.8269$, $F(2,109) = 266.17\ddagger$			

* $p < 0.10$.
$\dagger$ $p < 0.05$.
$\ddagger$ $p < 0.01$.

$\alpha_1 = 1$ and $\alpha_2 \leq 1$ are rejected in earlier periods: $T = -2.46$, $p < 0.01$ and $T = -4.03$, $p < 0.01$, respectively, for industry 1; $T = -3.25$, $p < 0.01$ and $T = -3.24$, $p < 0.01$, respectively, for industry 4. These hypotheses are not rejected in later periods. Further, the adjusted R^2 improves in later periods for industry 1: 0.8274 versus 0.8582; industry 2: 0.4503 versus 0.6865; and industry 3: 0.6071 versus 0.8424.

TABLE 5

Paired T-tests: Mean Aspirations versus Mean Sales; F-tests: Variance of Aspirations versus Variance of Sales

Industry 1

Team	N	Mean Aspirations	Mean Sales	T-test $\bar{X}_D = 0$	Std. Dev. Aspirations	Std. Dev. Sales	F-test $\sigma_D^2 = 0$
1	23	224391	182384	3.67‡	83755	71976	1.35
2	20	147800	111049	2.56†	113019	74455	2.30†
3	26	314933	288441	1.60	217232	205857	1.11
4	24	155440	147853	0.48	110501	77951	2.01†
5	26	211385	199476	1.03	194540	194290	1.00

Industry 2

Team	N	Mean Aspirations	Mean Sales	T-test $\bar{X}_D = 0$	Std. Dev. Aspirations	Std. Dev. Sales	F-test $\sigma_D^2 = 0$
6	18	179722	122934	3.69‡	71032	37490	3.59‡
7	23	268826	281565	−1.02	142845	179789	1.58
8	25	229480	173598	1.87*	177890	125715	2.00†
9	19	194053	149168	1.33	150464	91716	2.69†
10	26	186004	172685	1.04	116348	155247	1.78

Industry 3

Team	N	Mean Aspirations	Mean Sales	T-test $\bar{X}_D = 0$	Std. Dev. Aspirations	Std. Dev. Sales	F-test $\sigma_D^2 = 0$
11	15	278727	246892	0.91	232644	223057	1.09
12	24	110583	74045	3.11‡	84145	52171	2.60‡
13	18	196761	142491	1.86*	135677	94047	2.08
14	21	245060	226760	1.39	171226	166183	1.06
15	25	268680	301130	−0.82	176493	198516	1.27

Industry 4

Team	N	Mean Aspirations	Mean Sales	T-test $\bar{X}_D = 0$	Std. Dev. Aspirations	Std. Dev. Sales	F-test $\sigma_D^2 = 0$
16	23	103739	100022	0.42	77294	80541	1.09
17	26	178538	143895	2.50†	96743	87415	1.22
18	20	273500	199385	1.17	261650	215550	1.47
19	27	112849	95508	1.61	94252	70981	1.76
20	30	382333	389966	−0.029	254939	241354	1.12

Units are the number of items sold.
* $p < 0.10$.
† $p < 0.05$.
‡ $p < 0.01$.

The results of testing the prediction that there should be no systematic optimism or pessimism in the formation of aspirations are given in Table 5. Paired T-tests compared the mean differences between aspirations and actual sales for each team across the 7 periods. In all but 3 teams, aspirations are higher than sales on average; these differences are significant for 7 out of 20 teams. Thus, these teams tend to be optimistic in setting their aspirations.

The results of testing the prediction that the variance of actual outcomes should exceed that of expectations or aspirations are also given in Table 5. These results indicate that in all but 4 teams the variance of aspirations is greater than that of sales. These differences are significant in 6 out of 20 teams.

5. Discussion

5.1. *Implications of Parameter Estimates*

A summary of parameter estimates is given in Table 6. This table indicates the predictions of each model with respect to each parameter, and gives the results of the hypothesis tests for each industry. The attainment discrepancy model provides a good description of aspiration level adaptation. In all four industries, the coefficients for both aspiration level and attainment discrepancy are greater than zero. The model is generally robust in the face of alternative models. However, the validity of a one-period lag structure may not hold in settings where information is unreliable, irregular, or is available at a different rate than decisions are made. In the *Markstrat* setting, error-free feedback is received at regular, equally spaced intervals at the same time as decisions are made. In contrast, an actual management team will receive sales reports from various divisions that are filtered, summarized, and subject to reporting and measurement error; they are likely to receive this information more frequently than they set strategic goals. In such a setting, managers may look at the trend in sales over some period of time, not just the last period's sales.

TABLE 6

Summary of Parameter Estimates

Equation (3): $Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2[Z_{t-1} - Y_{t-1}] + \epsilon_t$

Equation (8): $Y_t = \beta_0 + \beta_1 Z_t + \epsilon_t$

Equation (9): $Y_t = \beta_0 + \beta_1 Z_t + \beta_2 Y_{t-1} + \epsilon_t$

Variable	Eq. #	Rational Expect.	Weighted Average	Attain. Discrep.	Industry Results 1	2	3	4
Constant	[8]	$\beta_0 = 0$			$\beta_0 > 0$	$\beta_0 > 0$	$\beta_0 > 0$	$\beta_0 > 0$
Sales_t	[8]	$\beta_1 = 1$			$\beta_1 = 1$	$\beta_1 < 1$	$\beta_1 < 1$	$\beta_1 < 1$
ρ_t	[8]	$\rho_t = 0$			$\rho_t > 0$	$\rho_t = 0$	$\rho_t = 0$	$\rho_t = 0$
Aspiration_{t-1}	[9]	$\beta_2 = 0$			$\beta_2 > 0$	$\beta_2 = 0$	$\beta_2 > 0$	$\beta_2 > 0$
Constant	[3]		$\alpha_0 = 0$		$\alpha_0 > 0$	$\alpha_0 > 0$	$\alpha_0 = 0$	$\alpha_0 > 0$
Aspiration_{t-1}	[3]		$\alpha_1 = 1$	$\alpha_1 > 0$	$\alpha_1 > 1$	$\alpha_1 = 1$	$\alpha_1 > 1$	$\alpha_1 = 1$
Sales^*_{t-1}	[3]		$\alpha_2 \leq 1$	$\alpha_2 > 0$	$\alpha_2 > 1$	$\alpha_2 > 0$	$\alpha_2 > 1$	$\alpha_2 > 0$

The constraints imposed by the Levinthal and March (1981) model did not hold consistently across the four industries. The model predicted that α_0 from equation (3) would be equal to 0, that α_1 would be equal to 1, and that α_2 would not exceed 1. For 3 out of the 4 industries, the coefficient on α_0 was significantly greater than 0. In 2 of the 4 industries the estimated coefficient of α_1 was marginally different from 1 at the 0.10 level. In industry 1 the coefficient on α_2 was significantly greater than 1 at the 0.01 level, and in industry 3 was significantly greater than 1 at the 0.10 level. Of the 12 hypothesis tests conducted to test the Levinthal and March (1981) predictions, 7 were rejected.

The results of testing both the attainment discrepancy and Levinthal and March (1981) models suggest some interesting implications regarding the parameter estimates of adaptive models. First, the tendency for the constant term to be significantly greater than zero suggests that aspirations are affected by some force which keeps them higher than would be predicted by a model based solely on past performance. A positive constant implies that, even in a state of equilibrium and stable performance, aspirations will not adjust entirely to the level of performance, but will always remain higher than actual performance. This bias could be generated by forces such as optimism (Lovell 1986) or overconfidence (Fischhoff, Slovic, and Lichtenstein 1977). In addition to cognitive explanations, such as overconfidence, there may be motivational or strategic reasons for aspirations to consistently exceed performance. Organizations frequently set higher goals for profit and growth, rather than being satisfied with having met previous targets, in order to motivate managers to achieve these goals. This study cannot determine the cause of the bias, but it does suggest that models of aspiration level adaptation should include a bias term. These data have not provided a precise conclusion regarding the magnitude of the constant. The value of the constant will depend on the level of performance obtained, since it serves to push aspirations above this level of performance. Even as a percentage of performance, the estimated constant has quite a large range; from approximately 0% to 60% of average performance, using a 95% confidence interval.

Second, the coefficients of α_1 and α_2 are not consistent across industries. The coefficients on lagged aspiration and attainment discrepancy for industries 1 and 3 are a little greater than 1, while those for industries 2 and 4 are a little less than 1. These differences are of particular interest in those cases where the coefficient of α_1 is significantly different from 1, and the coefficient of α_2 is significantly greater than 1. Both occur in industries 1 and 3, but not in industries 2 and 4. $\alpha_1 > 1$ means that teams in industries 1 and 3 placed weights greater than 1 on past aspiration. This suggests an upward pressure on current aspiration level, independent of the effect of performance. $\alpha_2 > 1$ suggests that teams 1 and 3 were very sensitive to performance relative to aspiration. Each unit of discrepancy, positive or negative, resulted in an adjustment of aspirations greater than 1 unit. This implies that these teams adjusted their aspirations more quickly than their corresponding changes in performance. When performance exceeds aspirations, such rapid goal adjustment will prevent the accumulation of organizational slack (Cyert and March 1963). When performance is below aspirations, rapid adjustment can result in goal erosion (Forrester 1969). Adjusting behavior too quickly in response to feedback can be detrimental to organizational survival if it reduces the buffering effect of organizational slack and if the information has a large error component (Levitt and March 1988). The coefficients for industries 2 and 4 are more in keeping with what would be expected from a weighted average model, where both coefficients are between 0 and 1.[8] In these industries, past aspiration served as an anchor, and aspirations adjusted more slowly than changes

[8] Chow tests (Chow 1960) were conducted to determine if the data from separate industries could be pooled, despite the apparent differences in parameter estimates. Parameter estimates for industries 1 and 3 were statistically equivalent, but those for industries 2 and 4 were significantly different. The results for this pooled data are similar to those for industries 1 and 3 separately.

in performance. In summary, the data are inconclusive regarding precise estimates of the parameters. For these data, the range of α_1 is approximately between 0.75 and 1.25, based on a 95% confidence interval. This range includes the value 1; given no compelling evidence of a consistent value for α_1, the restriction that $\alpha_1 = 1$ may serve as a reasonable approximation. The range of α_2 is approximately between 0.5 and 1.5 based on a 95% confidence interval.

Applying a rational expectations model to aspiration formation yielded the predictions that $\beta_0 = 0$, $\beta_1 = 1$, and that the autocorrelation parameter, ρ, will equal zero. Although the overall model yielded acceptable R^2's, the assumptions of the model are not supported by the data. The prediction of no significant autocorrelation is rejected in 1 of the 4 industries. However, the prediction that $\beta_0 = 0$ was rejected in all four industries. The prediction that $\beta_1 = 1$ was rejected in 3 of the 4 industries. This prediction was also rejected consistently when a lagged value of aspirations is included in the model. In addition, the lagged value of aspirations was significantly different from zero in 3 of the 4 industries, suggesting that there is some history dependence in the formation of aspirations. Of the total of 20 hypothesis tests conducted for the rational expectations model, 15 of the null hypotheses were rejected.

A fairly consistent finding across the various analyses has been the optimistic bias, which suggests that aspirations tend to be set higher than would be expected by either the Levinthal and March (1981) or rational expectations models. This finding is corroborated by the presence in some teams of persistent optimism, which tended to have higher average aspirations than average performance. Finally, in contrast to the implication of both rational and adaptive models, the variance of aspirations tended to exceed that of actual performance. This suggests that the aspiration formation process may result in an overreaction to performance feedback; perhaps adjustment in aspirations is not as incremental as has been predicted. Such high variance in aspiration levels may also have been caused by noise introduced in the group decision-making process. Another possibility is extrapolative aspiration formation, where aspirations respond not only to past performance, but also to the trend in this performance (Sterman 1988).

The results of applying the rational expectations model to data on aspirations exhibit striking similarities to findings regarding expectation formation. For instance, a nonexperimental study of expectation formation found that the constant term was often significantly different from zero, although not consistently positive (Leonard 1982). Leonard (1982) and Gramlich (1983) have found that β_1 was frequently different from 1, though not consistently less than 1. Gramlich (1983) also found evidence of significant autocorrelation. Studies which have included lagged values of expectations have found evidence of history dependence similar to that found here (Hirsch and Lovell 1969). Thus, several studies in the economics literature have noted that expectation formation frequently violates the assumptions of the rational expectations model; in particular, expectations tend to adapt to feedback. These studies also have suggested that decision makers may be biased systematically in the formation of their expectations (Hirsch and Lovell 1969; Leonard 1982); that is, they tend to be consistently pessimistic or optimistic. There is also evidence which suggests that while decision makers attend to feedback, learning is hindered because feedback is misperceived (Sterman 1989).

The extent to which aspiration formation is consistent with rational expectations is likely to depend on whether the decision-making context is conducive to accurate learning. For instance, this study found that aspiration formation was more consistent with rational expectations in later periods than in early ones. There are significant structural differences between early and late periods in 3 of the 4 industries. For instance, autocorrelation that is significant in early periods is not significant in later periods. Thus, rational expectation's prediction that $\rho = 0$ is supported in later periods. In industry 4, the other parameter predictions are also supported in later periods. In industries 2 and 3, the fit of the model seems to improve. Overall, only 5 of the 12 null hypotheses for rational expectations are rejected in later periods, compared to 9 in early periods. These results may suggest that rational expectations describe aspiration formation better in later periods than in earlier periods, when decision makers have little experience with the system. Such a conclusion is consistent with an argument (Lucas 1986) which states that rational expectations models will be more descriptive of expectation formation after decision makers have had experience in the system about which they are trying to make predictions. The idea that individuals learn about a system over time, resulting in better, more rational decisions, is supported by Camerer and Weigelt (1988). However, the results may also suggest that, in this setting, an adaptive aspiration process simply yielded results that are consistent with rational expectations in later periods. Since this study does not provide process data, it cannot distinguish between a rational process of aspiration formation and an adaptive process that yields rational results.

Interestingly, there are also significant differences between early and late periods for 3 industries using the attainment discrepancy model. These differences are driven, in part, by the improved fit of the model in these industries. In industry 4, the predictions of the Levinthal and March (1981) model are supported in later periods but not in earlier ones. This is not a general finding, however. Of the 12 hypothesis tests associated with Levinthal and March (1981), 5 null hypotheses are rejected in both early and later periods. For both adaptive and rational models, the comparison between early and late periods reveals that there is some learning occurring over time. Still, it is apparent that learning is not easy in a complex environment, even one that is simulated (Sterman 1989). While decisions were more consistent with rationality in later periods, they are not entirely consistent with the rational expectations model. It is likely that learning is even more difficult in systems that change periodically, produce ambiguous feedback, or tend not to reach equilibrium (March and Olsen 1976; Camerer 1987; Lant and Mezias 1990; Glynn, Lant, and Mezias 1991).

5.2. *Explaining Parameter Differences*

Given the differences in parameter estimates across the industries, it is important to explore possible explanations for the differences, and their implications. The differences may be the result of random variation or a function of the particular individuals involved. It may also be the case, however, that there is a more systematic explanation for the differences. Several possible explanations were investigated.

Since the decisions that were analyzed had been made by groups, differences in group process or structure may explain the lack of consistency in parameter estimates. In anticipation of such an effect, questionnaire data about group process were collected for all four industries. These questions asked about attributional tendencies, levels of agreement in the group on various strategies, the frequency of use of various decision-making techniques, and group structure. Overall, the industries look quite similar in terms of their questionnaire responses. There is no pattern which would explain the differences in parameter estimates, including whether the group was made up of MBA's or executives. Significant differences between teams on group process tended to be a function of performance outcomes, rather than industry membership.

Another area where the industries might differ is the pattern of their experience in the game. An important aspect of their experience may be their pattern of performance, particularly with respect to the variation in this performance. The variation of performance variables, such as profit, budget allocations, or sales may have an effect on feelings of uncertainty regarding cause and effect relationships between the organization and the environment. If performance is fairly stable, decision makers may have more confidence in their ability to understand and manage the relationship between their organization and the environment. An increased level of confidence or predictability may make decision makers more willing to rely on specific signals to guide their behavior, such as attainment discrepancy. Feeling more confident in this signal may result in greater responsiveness to performance signals. While there are differences in performance variation between some of the industries, there is no pattern which clearly distinguishes industries 1 and 3, which had adjustment parameters greater than one, from industries 2 and 4, which had adjustment parameters less than one.

It was also speculated that early experiences in the game may anchor the teams on certain beliefs about the certainty of cause and effect relationship in the game. There is evidence that initial judgments are resistant to new information (Nisbett and Ross 1980). Thus, impressions formed early in the game may have a lasting effect on team decisions. In order to test this idea, the relative variation of performance was examined for the first two periods of the game. There was some tendency for industries 2 and 4 to have higher performance variation than industries 1 and 3. While these findings are far from conclusive, there is some evidence consistent with the argument that lower variation creates more confidence in performance signals, and thus higher levels of adjustment, while higher variation leads to lower levels of adjustment. The findings indicate that this effect occurs early in a decision maker's experience.

6. Conclusions and Implications

The results of the analyses presented in this paper have significant implications for models of aspiration level adaptation and decision making. They suggest that models originally applied to expectation formation are also useful models for describing aspiration formation. The aspiration formation process seems to be best described as a process of adjustment in response to past aspirations and past performance, suggesting that adaptive, history dependent models are more accurate descriptors of aspiration formation than a rational model of expectation formation. This result is highlighted by the significant effect of past aspiration in conjunction with the rational expectations model, as well as the fit of the adaptive model. However, decision makers appear to learn over time; the rational expectations model does better in later periods than early ones. Further, contrary to the typical prediction of adaptive models, the adjustment process is not always incremental; rather, aspirations sometimes adjust faster than changes in performance. In contrast to both adaptive and rational models with constraints, there is also evidence of systematic bias in the aspiration formation process, with a tendency toward optimism. This tendency to set aspirations consistently higher than actual performance was indicated by the prevalence of a positive constant term and the tendency for average aspirations to exceed average performance.

The results of this study also suggest that, given the applicability of expectation models to aspiration level formation, there may be a close relationship between expectations and aspirations. The findings for expectation based models, adaptive expectations and rational expectations are not wildly different from those of an aspiration based model, the attainment discrepancy model. As noted above, the only consistent empirical distinction is the presence of an optimistic bias which keeps aspirations higher than would be predicted by models which do not include a constant term. Arguments have been made which suggest possible relationships between expectations and aspirations. Cyert and March (1963), for instance, argue that organizations aspire to what they think is possible, and their perceptions of what is possible are influenced by their desires. March and Shapira (1987) found that managers believe they have post-decision control. That is, they believe they can influence outcomes toward their desires. This suggests that expectations would tend to move toward aspirations and vice-versa. Thus, in situations where managers believe they can affect outcomes, such as their organization's performance outcomes, their expectations of what will happen may be very close to their aspirations. In situations where they do not believe they have any control, such as the performance of stocks in their investment portfolio, their expectations of the value of these stocks may be quite different from their aspirations.

The results presented in this paper should be interpreted in light of the context in which the decisions were made. For instance, decisions were made for only seven periods. It would be interesting to determine if decision makers continue to learn over longer periods of time, perhaps becoming increasingly more consistent with rational expectations predictions. It would also be useful to study decision making in contexts that change over time or are characterized by ambiguity. Decision makers may learn about a system given enough time, enough stability in the system, and unambiguous information. However, if the system frequently moves out of equilibrium, or is characterized by ambiguity, such learning may be difficult (March and Olsen 1976; Lant and Mezias 1990, 1992). Such a decision-making context may result in more dependence on adaptive behavior.

In summary, this paper has provided exploratory evidence on several issues surrounding aspiration formation. Such evidence is important because aspiration levels, or goals, are frequently key variables in more general models of organizational behavior. The results also have direct implications for our understanding of organizational learning and decision making. First, the results suggest that aspiration level formation is well described by a history-dependent process. That is, decision makers learning about a system appear to be guided more by examining past experience than by their predictions of the future. Second, this study provides some evidence that such adaptive learning may, over time, lead to behavioral outcomes that are consistent with rationality. This evidence must be interpreted in light of the specific decision-making context, where the system is complex but the rules are stable, feedback is not ambiguous, and subjects had a limited number of periods in which to learn. Third, aspirations, like behavior, appear to be responsive to discrepancies between goals and performance. Fourth, the process of goal formation can be described by fairly simple decision rules. This paper has argued that attainment discrepancy serves as a simple, clear signal which decision makers use to guide their behavior. The results indicate that it serves this purpose for goal adaptation. An interesting next step would be to explore the role of attainment discrepancy in guiding other types of behavior, such as the degree of risk taking in strategic choices (Lant and Montgomery 1987). Fifth, adjustments to behavior do not always occur incrementally. While behavior responds to simple signals, this response may be substantial. Finally, there is an overall optimistic bias in aspiration formation. These findings and their implications may aid attempts to model the behavior of organizational systems by improving the specification of aspiration formation, a key variable in such models. These findings also suggest that an interesting avenue for future research is exploring the relationship between expectations and aspirations in different decision-making contexts.[9]

[9] This paper has evolved from my dissertation research. I would like to thank Jim March, my dissertation chairperson, and the members of the committee, Jay Bourgeois and Dave Montgomery, for their guidance. I would also like to thank Steve Mezias, Zur Shapira, and three anonymous reviewers for their valuable insights with regard to this project, and Greg Fischer for his excellent editorial guidance.

References

CAMERER, COLIN, "Do Biases in Probability Judgment Matter in Markets? Experimental Evidence, *Amer. Economic Rev*., 77 (1987), 981–997.

——— AND KEITH WEIGELT, "Experimental Tests of A Sequential Equilibrium Reputation Model," *Econometrica*, 56 (1988), 1–36.

CHOW, GREGORY C., "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," *Econometrica*, 28 (1960), 591–605.

COOK, VICTOR J. AND JOHN R. PAGE, "Assessing Marketing Risk," *J. Business Res.*, 15 (December 1987), 519–530.

CYERT, RICHARD M. AND JAMES G. MARCH, *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ, 1963.

DODGSON, HARVEY, "Management Learning in Markstrat: The ICL Experience," *J. Business Res.*, 15 (December 1987), 481–489.

FISCHER, GREGORY W. AND MARK S. KAMLET, "Explaining Presidential Priorities: The Competing Aspiration Levels Model of Macrobudgetary Decision Making," *Amer. Political Sci. Rev.*, 78 (1984), 356–371.

FISCHHOFF, B., P. SLOVIC AND S. LICHTENSTEIN, "Knowing with Certainty: The Appropriateness of Extreme Overconfidence," *J. Experimental Psychology: Human Perception and Performance*, 3 (1977), 552–564.

FORRESTER, JAY W., *Industrial Dynamics*, The MIT Press, Cambridge, MA, 1961.

———, *Urban Dynamics*, The MIT Press, Cambridge, MA, 1969.

FRANKEL, JEFFREY A. AND KENNETH A. FROOT, "Using Survey Data to Test Standard Predictions Regarding Exchange Rate Expectations," *Amer. Economic Rev.*, 77 (March 1987), 133–153.

GLAZER, RASHI, JOEL H. STECKEL AND RUSSELL S. WINER, "Group Process and Decision Performance in a Simulated Marketing Environment," *J. Business Res.*, 15 (December 1987), 545–557.

GLYNN, MARY ANN, THERESA K. LANT AND STEPHEN J. MEZIAS, "Incrementalism, Learning, and Ambiguity: An Experimental Study of Aspiration Level Adaptation," In J. L. Wall and L. R. Jauch (Eds.), *Acad. Management Best Paper Proc.*, Omnipress, Inc., Madison, WI, 1991, 384–388.

GRAMLICH, EDWARD M., "Models of Inflation Expectations Formation," *J. Money, Credit, and Banking*, 15 (May 1983), 155–173.

HIRSCH, ALBERT AND MICHAEL LOVELL, *Sales Anticipations and Inventory Behavior*, Wiley and Sons, New York, 1969.

HOFER, CHARLES W. AND DAN SCHENDEL, *Strategy Formulation: Analytical Concepts*, West Publishing Company, New York, 1978.

HOGARTH, ROBIN M. AND SPYROS MAKRIDAKIS, "The Value of Decision Making in a Complex Environment: An Experimental Approach," *Management Sci.*, 27 (1981), 93–107.

HOUSE, ROBERT J., "A Path Goal Theory of Leadership Effectiveness," *Admin. Sci. Quart.*, 16 (1971), 321–338.

JACOBS, RODNEY L. AND ROBERT A. JONES, "Price Expectations in the United States: 1947–75," *Amer. Economic Rev.*, 70 (June 1980), 269–277.

JOHNSTON, J., *Econometric Methods*, (Third Ed.), McGraw Hill Book Company, New York, 1984.

KAHNEMAN, DANIEL, PAUL SLOVIC AND AMOS TVERSKY, *Judgment Under Uncertainty: Heuristics and Biases*, Cambridge University Press, Cambridge, 1982.

KENKEL, JAMES L., "Some Small Sample Properties of Durbin's Tests for Serial Correlation in Regression Models Containing Lagged Dependent Variables," *Econometrica*, 42 (1974), 763–769.

KINNEAR, THOMAS G. AND SHARON K. KLAMMER, "Management Perspectives: The GE Experience and Beyond," *J. Business Res.*, 15 (December 1987), 491–501.

LANT, THERESA K. AND STEPHEN J. MEZIAS, "Managing Discontinuous Change: A Simulation Study of Organizational Learning and Entrepreneurial Strategies," *Strategic Management J.*, 11 (1990), 147–179.

——— AND ———, "An Organizational Learning Model of Convergence and Reorientation," *Organization Sci.*, 3 (1992), 47–71.

——— AND DAVID B. MONTGOMERY, "Learning from Strategic Success and Failure," *J. Business Res.*, 15 (1987), 503–518.

LARRECHE, JEAN-CLAUDE AND HUBERT GATIGNON, *Markstrat: A Marketing Strategy Game*, The Scientific Press, Palo Alto, CA, 1977.

LEONARD, JONATHAN S., "Wage Expectations in the Labor Market: Survey Evidence on Rationality," *Rev. Economics and Statist.*, 64 (February 1982), 157–161.

LEVINTHAL, DANIEL AND JAMES G. MARCH, "A Model of Adaptive Organizational Search," *J. Economic Behavior and Organization*, 2 (1981), 307–333.

LEVITT, BARBARA AND JAMES G. MARCH, "Organizational Learning," *Ann. Rev. Sociology*, 14 (1988), 319–340.

LEWIN, KURT, TAMARA DEMBO, LEON FESTINGER AND PAULINE SNEDDEN SEARS, "Level of Aspiration," In *Personality and the Behavior Disorders*, J. McV. Hunt (Ed.), The Ronald Press Company, New York, 1944.

LOCKE, EDWIN A., "Toward a Theory of Task Motivation and Incentives," *Organizational Behavior and Human Performance*, 3 (1968), 157–189.

LOVELL, MICHAEL C., "Tests of the Rational Expectations Hypothesis," *Amer. Economic Rev.*, 76 (1986), 110–124.

LUCAS, ROBERT E., "Adaptive Behavior and Economic Theory," *J. Business*, 59 (1986), S401–S426.

MARCH, JAMES G. AND JOHAN P. OLSEN, *Ambiguity and Choice in Organizations*, Universitetsforlaget, Bergen, 1976.

——— AND ZUR SHAPIRA, "Management Perspectives on Risk and Risk Taking," *Management Sci.*, 33 (1987), 1404–1418.

——— AND HERBERT SIMON, *Organizations*, Wiley, New York, 1958.

MEZIAS, STEPHEN J., "Aspiration Level Effects: An Empirical Investigation," *J. Economic Behavior and Organization*, 10 (1988), 389–400.

MILLIKEN, FRANCES J. AND THERESA K. LANT, "The Effect of an Organization's Recent Performance History on Strategic Persistence and Change: The Role of Managerial Interpretations," In P. Shrivastava, J. Dutton and A. Huff (Eds.), *Advances in Strategic Management*. JAI Press, Greenwich, CT, 7 (1991), 129–156.

MORECROFT, JOHN D., "Rationality in the Analysis of Behavioral Simulation Models," *Management Sci.*, 31 (1985), 900–916.

MUTH, JOHN F., "Rational Expectation and the Theory of Price Movements," *Econometrica*, 29 (1961), 315–335.

NISBETT, T. RICHARD AND LEE ROSS, *Human Inference: Strategies and Shortcomings of Social Judgment*, Prentice-Hall, Englewood Cliffs, NJ, 1980.

PADGETT, JOHN F., "Bounded Rationality in Budgetary Research," *Amer. Political Sci. Rev.*, 74 (1980), 354–372.

PAYNE, JOHN W., "Task Complexity and Contingent Processing in Decision Making: An Information Search and Protocol Analysis," *Organizational Behavior and Human Performance*, 16 (1976), 366–387.

———, DAN J. LAUGHHUNN AND ROY CRUM, "Translation of Gambles and Aspiration Level Effects on Risky Choice Behavior," *Management Sci.*, 26 (1980), 1039–1060.

QUINN, JAMES BRIAN, *Strategies for Change: Logical Incrementalism*, Richard Irwin, Homewood, IL, 1980.

ROSS, WILLIAM T., "A Re-examination of the Results of Hogarth and Makridakis 'The Value of Decision Making in a Complex Environment: An Experimental Approach'," *Management Sci.*, 33 (February 1987), 288–296.

SIMON, HERBERT A., "A Behavioral Model of Rational Choice," In *Models of Man*, Herbert A. Simon (Ed.), John Wiley, New York, 1957.

STERMAN, JOHN D., "Expectation Formation in Behavioral Simulation Models," *Behavioral Sci.*, 32 (1987), 190–211.

———, "Modeling the Formation of Expectations: The History of Energy Demand Forecasts," *Internat. J. Forecasting*, 4 (1988), 243–259.

———, "Modeling Managerial Behavior: Misperceptions of Feedback in a Dynamic Decision Making Experiment," *Management Sci.*, 35 (March 1989), 321–339.

TVERSKY, AMOS AND DANIEL KAHNEMAN, "Judgment Under Uncertainty: Heuristics and Biases," *Science*, 185 (1974), 1124–1131.

WALSH, JAMES P., CAROLINE M. HENDERSON AND JOHN DEIGHTON, "Negotiated Belief Structures and Decision Performance: An Empirical Investigation," *Organizational Behavior and Human Decision Processes*, 42 (1988), 194–216.

WILDAVSKY, AARON AND ARTHUR HAMMOND, "Comprehensive Versus Incremental Budgeting in the Department of Agriculture," *Admin. Sci. Quart.*, (1965), 321–346.