

**PERFORMANCE, FIRM SIZE, AND FACTORY EXPANSION IN THE  
SHIPBUILDING INDUSTRY**

**PINO G. AUDIA**

London Business School

Regent's Park

London NW1 4SA

United Kingdom

[paudia@london.edu](mailto:paudia@london.edu)

Tel: +44-(0)20-7706-6934

Fax: +44-(0)20-7724-7875

**HENRICH R. GREVE**

Norwegian School of Management BI

Elias Smiths vei 15, box 580

1302 Sandvika NORWAY

[henrich.greve@bi.no](mailto:henrich.greve@bi.no)

Tel: +47-6755-7213

Fax: +47-6755-7250

MAY 2002

Earlier versions of this paper benefited from the suggestions of Hayagreeva Rao, Harry Sapienza, Freek Vermeulen, and seminar participants at the University of Michigan and the University of Washington. Research support from Japan's Ministry of Education and London Business School is gratefully acknowledged. As of July 2002, please send correspondence to: Pino G. Audia, Walter A. Haas School of Business - University of California, 545 Student Services Bldg. #1900 – Berkeley, CA 94720-1900

**PERFORMANCE, FIRM SIZE, AND FACTORY EXPANSION IN THE  
SHIPBUILDING INDUSTRY**

**ABSTRACT**

Behavioral risk theory predicts that low performing firms will take greater risks, but threat rigidity theory predicts that low performing firms will be risk averse. We seek to resolve these conflicting predictions by extending the March-Shapira shifting-focus model of risk taking. Specifically, we predict that large firms will follow risk theory and small firms will follow threat rigidity theory because small firms are more focused on the threat of failure.

Using data on the risky strategic action of factory expansion in Japanese shipbuilding firms, we find that when performance falls below the aspiration level, performance decreases induce risk aversion in small firms but not in large firms.

Keywords: behavioral theory of the firm, threat-rigidity, firm size, organizational performance, risk taking, shipbuilding industry

## **INTRODUCTION**

The behavioral perspective has guided much recent research on risky organizational changes. Its central argument is that decision makers use an aspiration level to evaluate performance on a goal variable, and the performance relative to the aspiration level influences their inclination to take risks and make changes (Bromiley, 1991; Cyert and March, 1963; March and Shapira, 1987, 1992; Shapira, 1986). The theory is based on psychological processes of risk perception and preference (Kahneman and Tversky, 1979) and organizational processes of search (Cyert and March, 1963), but contains few propositions on the influence of the organizational context in which decisions are made. Some studies have made predictions that are sensitive to variations in the organizational context, but they are still rare (e.g., Kahneman and Lovallo, 1993; McNamara and Bromiley, 1997; Wiseman and Gomes-Meja, 1998). This study seeks to extend such efforts by exploring the basic, yet unanswered, question of how small and large firms differ in their risk behavior. Specifically, we focus on the risk behavior of small and large firms when performance is below the aspiration level.

The evidence supports the view that when performance is above an aspiration level increases in performance make managers less willing to take risks (Bromiley, Miller, and

Rau, 2001; Nickel and Rodriguez, 2002). In contrast, the effect of changes in performance when performance falls below the aspiration level remains an active subject of debate (March and Shapira, 1987, 1992; Milliken and Lant, 1991; Mone, McKinley, and Barker, 1998; Ocasio, 1995; Sitkin and Pablo, 1992). Researchers have focused on two competing predictions: one proposes that decision makers respond to decreases in performance by taking more risk, whereas the other suggests that decision makers respond to decreases in performance by becoming more risk averse. In spite of the continued attention given to these conflicting predictions, only a few studies have directly examined firm risk behavior when performance is low and the evidence is still inconclusive. Some studies show greater risk taking (e.g., Greve, 1998; Gooding, Goel, and Wiseman, 1996) whereas others suggest risk aversion (e.g., Laughunn, Payne, and Crum, 1980; Miller and Bromiley, 1990; Shapira, 1986; Wiseman and Bromiley, 1996).

Building on the shifting-focus model of risk taking (March and Shapira, 1992), we derive conditions that can help clarify when risk aversion or risk taking prevails. In particular, we propose that when performance falls below the aspiration level, decision makers in small and large firms diverge in their responses to changes in performance because firm size influences perceptions of threat. Decision makers in small firms feel

threatened by decreases in performance and react by taking less risk because they see the low performance as a step toward organizational failure. Decision makers in large firms seek to mend the performance shortfall by taking risks because the size of the organization buffers them from the threat of failure.

The risk behavior we analyze is factory expansion among Japanese shipbuilders. Upgrading factories is a risky decision because the consequences are uncertain and include the possibility of losses (March and Shapira, 1987; Palmer and Wiseman, 1999; Ruefli, Collins, and Lacugna, 1999). By upgrading production assets or adding employees to a factory, a firm can overcome productivity gaps, knowledge deficiencies or capacity constraints. Additional investments, however, can make the situation worse if the implementation of the changes is not successful or if unpredictable environmental changes worsen the market served by the factory. Shipbuilding was chosen because factories are important strategic assets in that industry, and it has strong demand fluctuations that make high fixed assets risky. The Japanese shipbuilding industry constitutes an important sub-population of firms (in recent years having thirty percent of the global market) within a single national context, making the firms comparable.

## **THEORY AND HYPOTHESES**

### **Performance Effects on Firm Risk Behavior**

Decision makers are thought to be risk averse when performance is above an aspiration level and risk taking when performance falls below it. Prospect theory (Kahneman and Tversky, 1979) and the behavioral theory of the firm (Cyert and March, 1963) make this prediction based on three components. First, the decision maker focuses attention on an aspiration level for performance. In prospect theory this aspiration level is the status quo or a value of zero, whereas in the behavioral theory of the firm the aspiration level is determined by social or historical comparison. Second, the decision maker uses this aspiration level to code outcomes into failures (losses) when the performance is below the aspiration level, and successes (gains) when the performance exceeds it. Third, this interpretation guides the reaction to performance feedback. Both theories posit that the desire to mend a performance shortfall (or avoid losses) is stronger than the desire to extend success (or increase gains). Thus the desire to reach the target makes decision makers below the aspiration level willing to take risks and decision makers above the aspiration level risk averse.

This prediction has guided much research on organizational risk taking, but it has also been subject to debate (March and Shapira, 1987, 1992; Ocasio, 1995; Sitkin and Pablo, 1992). Although the idea of risk aversion when performance is above the aspiration level is widely accepted, there is an alternative view that questions the notion of risk seeking when performance is below the aspiration level. This view is held by theories of threat rigidity which suggest that decision makers performing below the aspiration level become rigid and risk averse because of their inability to generate and consider risky alternatives (Staw, Sundelands, and Dutton, 1981). The explanation for this rigidity is that a threat to the vital interest of individuals leads to psychological stress and anxiety. This mental state then restricts information processing and makes them less able to generate and consider new solutions, including risky alternatives. In some cases, threatened individuals may even experience a paralysis of action. The source of the threat, in this perspective, is any event that has potentially harmful consequences, including low performance. In fact, much evidence cited as suggestive of the threat-rigidity thesis derives from experimental studies that induce perceptions of anxiety and stress by administering performance-failure feedback (Staw et al., 1981: p. 503-504).

The debate regarding the conflicting predictions of risk seeking and risk aversion when performance is below the aspiration level, however, rests on very limited empirical evidence. Studies of threat-rigidity focus primarily on risk behavior in response to organizational decline, conceived as a reduction in financial resources (Cameron, Kim, and Whetten, 1987; Greenhalg, 1983; Mone et al., 1998), and give less attention to risk behavior in response to low performance. Most research on organizational risk taking examines the effect of performance on risk behavior but makes the assumption that this relationship is constant above and below the aspiration level (Bromiley, 1991; Singh, 1986; Wiseman and Catanach, 1999). As a result, the majority of risk taking research provides evidence regarding the average effect of performance on risk behavior across the performance range, not differentiating between risk behavior in response to low performance and risk behavior in response to high performance.

We found only four studies that examine the risk behavior of firms below and above the aspiration level separately. Greve (1998) found that decreases in performance increased the risk propensity of firms both above and below the aspiration level, though the slope was less steep below the aspiration level. Gooding et al. (1996) examined whether firms with performance in the lowest quintile were risk averse but showed that this group of firms took

more risks in response to performance declines. Miller and Bromiley (1990) found that deterioration in performance increased risk for high performers but decreased risk for low performers. Wiseman and Bromiley (1996) found that lower performance caused less risk taking in a sample of declining firms. Thus, the first two studies suggest risk taking below the aspiration level whereas the latter two studies provide some evidence of risk aversion below the aspiration level<sup>1</sup>. Interestingly, the evidence in favor of the threat-rigidity hypothesis was in both studies against the authors' predictions and led to calls for more research.

The conclusions that can be drawn from this limited number of studies must be tempered also by the fact that the latter three studies use corporate-level measures of risk such as variation on corporate financial outcome data. A growing body of work suggests that such aggregate measures of risk are quite distant from the actual decisions made by managers and are inadequate to study risky decisions (March and Shapira, 1987; Ruefli,

---

<sup>1</sup> Additional evidence of threat-rigidity comes from two studies at the individual level. Laughhumm, Payne, and Crum (1980) in an experimental study of 237 managers found that managers tended to choose a risky alternative when responding to an experimental stimulus presenting losses but selected a less risky alternative when presented with a situation involving unacceptable losses. Shapira (1986) in a descriptive study of 50 executives reports that over 90% of the managers would not take risks when a failure could jeopardize the survival of the firm.

Collins, and Lacugna, 1999; but see also McNamara and Bromiley, 1997, 1999).

To contribute toward a resolution of this long-standing debate and correct the imbalance between theoretical and empirical work, we begin by testing the two competing predictions. The first is proposed by the behavioral theory of the firm and prospect theory, while the second derives from threat rigidity theory.

H1: When performance on an organizational goal is below the aspiration level, performance decreases result in more risk taking.

H2: When performance on an organizational goal is below the aspiration level, performance decreases result in less risk taking.

### **The Moderating Effect of Firm Size on Risk Behavior**

The conflicting findings regarding risk seeking under conditions of adversity may be due to unobserved heterogeneity. Several researchers have proposed contingencies that may explain when risk aversion or risk seeking prevail (Ocasio, 1995; Mone et al., 1998; Sitkin and Pablo, 1992), but few studies have addressed this issue empirically (but see Chattopadhyay et al., 2001). March and Shapira (1987, 1992) made an important contribution to this literature by proposing the shifting-focus model of risk taking. Drawing

on extensive studies of how managers perceive risk (MacCrimmon and Wehrung, 1986; Shapira, 1986), they noted that decision makers do not direct their attention to a single reference point, as prospect theory and the behavioral theory of the firm assume. Rather, decision makers switch the focus between two reference points, attending to either one or the other. One reference point is the aspiration level for performance and the other is the survival point, the point at which performance is so low that the organization fails.

Two assumptions of this model must be made explicit to clarify our analysis. First, the aspiration level is higher than the survival point. This is because the aspiration level is a psychologically neutral point that defines the lowest satisfactory performance for a satisficing decision maker (Kameda and Davis, 1990; March and Simon, 1958).

Organizational failure is a psychologically negative outcome, not a neutral one (e.g., Sutton, 1990). Second, performance below the survival point leads to failure. Given our interest in understanding how decision makers respond to low performance, these assumptions restrict our attention to cases in which the performance is below the aspiration level and above the survival point.

In such cases, the shifting-focus model of risk taking suggests two risk behavior scenarios. The first is when decision makers focus on the survival point. Under this

scenario, decreases in performance are interpreted as a step closer to failure and a serious threat. Consistent with the threat-rigidity hypothesis, this interpretation of poor performance induces anxiety and hinders the formulation of new courses of action that could potentially resolve the crisis. The result is risk aversion in reaction to low performance, and the risk taken increases monotonically with distance above the survival point. The second scenario is when decision makers focus on the aspiration level.

Performance decreases are now interpreted as repairable gaps and the risk taken increases monotonically with distance below the aspiration level. The important implication then is that performance decreases below the aspiration level lead to risk taking if the focus is on the aspiration level but risk aversion if the focus is on the survival point.

Managers can shift attention between these reference points according to various rules. Building on March and Shapira (1992), we propose a rule that depends on the proximity of the performance to the two reference points and on firm size. According to the proximity rule, the probability of attending to the survival point and the aspiration level is inversely proportional to their relative distance from the current position of the risk taker. When the performance is closer to the survival point, the decision maker focuses on the survival point, whereas when the performance is closer to the aspiration level, the decision

maker focuses on the aspiration level. Here we add that firm size may shift the focus of attention between these two reference points by influencing the position of the survival point both in reality and cognitively.

Organizational theorists note that firm size provides a cushion against failure (Levinthal, 1991; Pfeffer and Salancik, 1978). Large firms are endowed with extensive financial assets, manufacturing infrastructures, and technological capabilities, and can endure many periods of poor financial performance with little threat of failure (Barron, West, and Hannan, 1994; Hannan, 1998; Meyer and Zucker, 1989; Levinthal, 1991). Small firms, in contrast, have more limited resource endowments and are more vulnerable to a single event such as the loss of an important client (Levinthal, 1991).

For managers of large firms, the buffering effect of firm size makes the survival point more distant from the aspiration level by lowering the performance level at which decision makers perceive the organization to be in danger. In contrast, for managers of small firms, the survival point is closer to the aspiration level because small firms are vulnerable to levels of negative performance that do not normally threaten the survival of large firms. By virtue of the proximity rule, this difference in the position of the survival point then influences the probability of focusing on the aspiration level or on the survival

point. When the performance falls below the aspiration level, the greater distance between the survival point and the aspiration level makes managers of large firms more likely to remain focused on the aspiration level than managers of small firms. As a result, managers of large firms will tend to interpret low performance as a gap that can be closed by taking risks whereas managers of small firms will interpret low performance as a step closer to a serious crisis that calls for risk aversion. Thus, drawing on the shifting-focus model of risk taking we propose a moderating effect of firm size on the direction of risk taking under conditions of low performance:

H3: When performance on an organizational goal is below the aspiration level, performance decreases result in less risk taking among small firms but greater risk taking among large firms.

### **Firm Size and Inertia**

A prediction that differs from our hypotheses bears mention. Inertia theory holds that firms are generally unable to make timely adaptations to changes in the environment and that this relative inertia is stronger for older and larger firms (Hannan and Freeman, 1977, 1984). It identifies several internal and external constraints on change, and argues that these are stronger in larger firms. This argument suggests that large firms fail to respond or respond

weakly to changes in performance in some situations where small firms respond more decisively. Thus, the expectation would be that large firms are either insensitive or less sensitive than small firms to changes in performance, both below and above the aspiration level. We do not adopt this hypothesis, but our study design allows testing for it.

## **DATA AND METHODS**

Most organizational risk taking research either examines aggregate, firm level measures of risk behavior (e.g., Gooding et al., 1996; Palmer & Wiseman, 1999) or data regarding specific decisions (e.g., McNamara and Bromiley, 1997, 1999). The advantage of focusing on specific decisions is that they more directly correspond to the actual risk behavior of managers (March and Shapira, 1987). In this study we take the latter approach by examining the risky strategic decisions of factory expansion made by Japanese shipbuilders. As we previously noted, high investments in production assets expose a firm to risk since demand variations strongly affect firms with a large asset base. If the factory contains highly specialized assets, as in the shipbuilding industry, factory expansion cannot be reversed without losing much of the investment.

The study uses data on the shipbuilders on the primary list of the Tokyo stock exchange from 1974 to 1995. The firm data come from the Nikkei Annual Directory of Corporations, and industry data were taken from various volumes of the Ministry of Transportation's Annual Report of Shipbuilding. There were 8 Japanese shipbuilders with complete records, nearly all having multiple factories. The number of factories in a given year varied between 47 and 65. All factories had multiple years of data (the average was 17.9 years) and the total sample included 1235 observations. The unit of analysis was the factory-year, with each observation capturing the decision to expand a certain factory in a given year. Because key resource allocations such as factory expansion are not made at the factory level but rather involve managers higher in the hierarchy (Bower, 1970; Maritan, 2001), our primary focus was to examine the influence of firm size and performance on factory expansion.

The data have a panel structure with multiple factories and a time series for each factory. In preliminary analysis, we tested for autocorrelated error structures, firm and plant effects, and heteroskedastic standard errors. The models did not suggest actor differences at

factory nor at the firm level<sup>2</sup>, but weakly suggested autocorrelation within factories and strongly suggested heteroskedasticity across factories. This means that firms and factories did not differ in the average expansion rate—there were no fast-growers or slow-growers in the data except as predicted by our covariates. They did differ in the variance, with some factories experiencing greater fluctuations in the expansion rate than others. Scatterplots of the factory expansion rate relative to firm and factory size did not reveal a systematic basis for this heteroskedasticity. Based on these findings, we estimated feasible general least squares (FGLS) models with a separate autocorrelation coefficient and covariance term computed for each factory. The estimates were made by the xtgl procedure of the Stata software.

## Measures

### *Dependent variable*

A factory can be expanded by adding workers, machines, other assets, or functions. These are economic substitutes at a given level of expansion, so studying any one alone will not

---

<sup>2</sup> To conduct an additional check of whether the multiple observations per firm influenced the results, we run the models with only 1 plant per firm (N=160) and found that the pattern of results did not differ from that obtained used all 1235 observations.

capture the complete growth. For this reason, we construct a summary measure of factory expansion based on five variables. The first three are the logged ratio of the year-end and year-start value of the (1) value of the machinery, (2) value of non-machinery real assets, and (3) number of workers in the factory. All these are long-term investments that cannot easily be disposed of if they turn out not to be needed. The machinery and other real assets of shipbuilders are highly specialized and immobile, and the firms honored lifetime employment guarantees during the study period.<sup>3</sup> The final two variables are indicators of whether the firm added functions to the factory and whether the firm dropped any function from the factory. The function add and drop variables were based on the following classification: new ships, ship repairs, engines, accessories, steel, and unrelated business.

The five variables were factor analyzed to extract a measure of overall expansion. The factor analysis was done with varimax rotation using Stata's factor routine and the principal component factor option, and yielded two factors with eigenvalues greater than one. The rotated coefficients showed that the first factor captured factory expansion and the second factor function change. In the first factor, the three expansion variables get similar

---

<sup>3</sup> The traditional stigma associated with downsizing in Japan has lessened in recent years. One study showed that downsizing had been done in less than 10% of the sampled firms until 1994, but accelerated thereafter (Ahmadjian and Robertson, 2002). This is near the end of our sample period, so it is unlikely to affect the results.

loadings, which are greater than those of the function add and drop variables. The function drop indicator variable has a negative loading, as expected. The second factor consisted mainly of function add and drop, both with positive loadings. The score of the first factor was used as the dependent variable in the analysis. In addition to this measure, we examined a simpler measure that just summed the expansion of machinery, workers, and assets, and found that this measure gave the same conclusions. We also examined alternative methods of finding and rotating factors, and discovered that these were not consequential for the factor scores.

### *Performance measures*

We used multiple goal variables to test whether the top executives of these firms oriented their behavior toward a single goal, and if so, which, or whether they had multiple goals. One class of goals is the traditional accounting measures of returns, that is, return on equity (ROE), return on assets (ROA) and return on sales (ROS). A second is goals related to size or growth, of which we used sales. Sales have been argued to influence the behavior of Japanese firms in particular (Johansson and Yip, 1994).

Performance measures are evaluated against aspiration levels that indicate what performance levels are possible and desirable (Cyert and March, 1963). An oft-used model

generates the aspiration level by taking an exponentially weighted average of past values on the performance variable (Greve, 1998; Lant, 1992; Levinthal and March, 1981). The formula for the exponentially weighted rule is:

$$A_t = aA_{t-1} + (1-a)P_{t-1}$$

Here,  $A$  is aspiration level,  $P$  is the performance,  $t$  is a time subscript, and  $a$  is the weight given to the most recent aspiration level. When  $a$  is high, the aspiration level changes slowly in response to new performance feedback; when it is low the aspiration level changes rapidly. We used preliminary analysis to establish that the best exponential rule gave the following weights to the each measure: ROE had  $a=0.1$ , ROA had 0.3, ROS had 0.2, and sales had 0.4. All these weights suggest fairly rapid updating of the aspiration level.

We hypothesized that the effect of performance on factory expansion differs depending on whether the performance is above or below the aspiration level, and also differs depending on the size of the firm. We tested the hypotheses by interacting performance with indicator variables for whether it is above or below the aspiration level and with firm size. The interaction with the aspiration-level indicator is the same as a spline specification in which a variable is allowed to have slopes that differ depending on whether it is above or below a given point (Greene, 2000: 322-324).

*Firm size*

We used the logged number of employees, which is a good measure of overall firm size in a given industry. In these data it correlates highly with another standard size measure, the accounting value of assets. We log the number of employees because we think that this specification better captures the effect of size on risk taking—it means that a given percentage increase in firm size has the same effect regardless of firm size, whereas an unlogged measure would mean that a given number of workers added has the same effect regardless of firm size. Going from 600 workers to 1200 workers ought to affect risk taking more than going from 50,000 to 50,600. The logging also gives the size variable an approximately normal distribution, with most observations in the center and fewer at the edges, though with thicker tails than the normal distribution. This absence of skew and outliers eliminates the possibility of lever effects where the results are driven by a few observations with extreme values.

Because the firm size measure is used in interaction variables with performance, we normalized it between zero and one using the lowest and highest values in the data. Thus, the largest firm (Mitsubishi with 78,104 employees), had a score of one, and the smallest (Naikai with 538 employees), had a value of zero. This allows direct computation of the

effects of the performance coefficients in the table for the minimum and maximum values in the data—the effect for the smallest firm in the data is just the main effect, and the effect for the largest firm in the data is the sum of the main effect and the interaction effect. All others are in between. Firm size is time varying, so Mitsubishi has a score of one only in its largest year (but values close to one in other years). An alternative approach of taking the interactions as deviations from the mean is often used when the researcher wants to display the effect of an average firm along with the interaction, but our approach is easier to interpret when testing hypotheses that contrast the extremes in the size distribution. The two approaches give results that are mathematically equivalent.

### *Control variables*

Control variables are entered to describe firm and factory characteristics and the economic conditions in the previous year. The firm's product diversification is entered by computing the entropy index of product line shares given in the Nikkei directory of firms. An indicator for whether the firm added a factory in the preceding year was included to control for capital scarcity in other factories when a new factory is built up. To capture the effect of the size and complexity of a given factory on its expansion rate, its number of functions is entered. This variable uses the same list of functions as the variables for adding or dropping

functions. We considered adding indicator variables for the functions of the factories but found that these did not affect factory expansion. To control for the size of the factory relative to the firm, the factory's production assets were entered as a proportion of all production assets held by the firm in the variable asset proportion. Large factories may have powerful managers who can demand a greater share of the investment funds. Each firm's end-of-year order reserve was included. The order reserve represents nearly certain future income, so a high reserve reduces the risk of factory expansion. Orders can be cancelled if a predetermined fine is paid to the shipbuilder, so the order reserve is not entirely secure.

In preliminary analyses, we tested whether organizational slack affected the factory expansion, as it would if firms take greater risks when they have slack resources (Singh, 1986). We entered measures of absorbed slack (high administrative costs), unabsorbed slack (cash reserves), and potential slack (lending reserves) (Bromiley, 1991, Singh, 1986). Somewhat surprisingly, none of these measures affected factory expansion. These findings are discussed in a separate paper (cite to author), and the variables are not included in these models.

We controlled for important factors in the industry environment. To take the effect

of the 1973 oil shock into account, an indicator variable was set to one for the years 1974-1976. In addition, we controlled for the following industry-level variables: Ship production is the annual finished tonnage (scale: Million G/T) completed by the Japanese shipbuilders in the previous year, and the worldwide shipping revenue (scale: 100 trillion Yen) is the revenue of the shipping industry. Descriptive statistics of the variables and correlations are reported in table 1.

=== Insert Table 1 About Here ===

## **RESULTS**

Table 2 shows the results of analyzing the factory expansion with returns on equity (ROE), returns on assets (ROA), and sales interacted with the number of employees of the firm. We do not display results for return on sales in the table, but found that they were intermediate to those of return on assets and return on equity. The table shows standard errors and significance tests of each coefficient, and significance tests for sums of coefficients are given in the text. The latter are done as Wald tests, which are distributed as a chi-square with one degree of freedom.

Model 1 contains only the control variables. Large firms grow more slowly, which is consistent with past research on how firm size affects firm growth (Barron et al., 1994). Factories with more functions grow more slowly whereas factories with a high proportion of the firm's assets grow faster. Finally, the firm's end of year order reserve, industry previous-year production, and shipping revenues positively affect factory expansion.

=== Insert Table 2 about here ===

### **Return on Equity**

Model 2 shows the effect of return on equity without interactions with the firm size. Return on equity has a negative effect on the factory expansion above the aspiration level and a positive below, consistent with threat-rigidity. Both effects are highly significant. Model 2 thus supports hypothesis 2, and contradicts hypothesis 1.

Model 3 adds interactions with the firm size. As noted before, the firm size is scaled between zero (smallest firms) and one (largest firms), so the main effect equals the effect on the smallest firm in the sample, and the sum of the main effect and the interaction equals the effect on the largest firm in the sample. For small firms, ROE has a negative effect on factory expansion above the aspiration level and a positive effect below the aspiration level, consistent with threat rigidity and highly significant. Both interaction variables are

significant and have the opposite sign of the main effect. By summing the main effect and the interaction, we find that the largest firm in the sample shows insignificant relations between ROE and factory expansion both above (.01, ns) and below (2.29, ns) the aspiration level. Thus, hypothesis 3, which posited the reverse effect of performance below the aspiration level for small and large firms is only partly supported. Small firms are risk averse but large firms are inert. These results indicate that hypothesis 2 was supported in model 2 because these data have more firms in the size range where the threat-rigidity relation holds.

### **Return on Assets**

Model 4 shows the effect of return of assets without interactions with the firm size. Return on assets has a negative effect on the factory expansion above the aspiration level and a positive below, consistent with threat rigidity. Both effects are highly significant. These results support hypothesis 2 and contradict hypothesis 1.

Model 5 adds interactions with the firm size. For small firms, ROA has a positive effect on factory expansion below the aspiration level and a negative but not significant effect above the aspiration level. Thus they are threat rigid below the aspiration level and inert above it. Both interaction variables are negative for this outcome. The largest firm in

the sample shows an insignificant relation between ROA and factory expansion below the aspiration level (.01, ns) and a significant negative relation between ROA and factory expansion above the aspiration level (5.09,  $p < .05$ ). Hypothesis 3 is only partly supported since below the aspiration level, small firms show threat-rigidity but large firms are insensitive to changes in performance. Large firms, however, are risk averse above the aspiration level, a finding more consistent with risk theory than with inertia theory. This evidence also reveals that the results of model 4 supporting hypothesis 2 are due to the small firms in the sample.

### **Sales**

Model 6 indicates that firms overall show a threat-rigidity response to sales. Sales have a positive relation to factory expansion below the aspiration level and a negative above it, and both coefficients are significant. The decline above the aspiration level is rather small, however, and only significant at the 10% level. Thus, hypothesis 2 is supported and hypothesis 1 is contradicted.

Model 7 adds the interactions and shows that for small firms, sales now have a positive effect on factory expansion both above and below the aspiration level. The results suggest threat rigidity below the aspiration level. Both firm size interaction variables are

negative and highly significant, so the link between sales and factory expansion is weaker for large firms. For the largest firms in the sample, there is a negative and significant (11.34,  $p < .01$ ) relation between sales and factory expansion above the aspiration level and a negative and insignificant (1.59, ns) relation below the aspiration level. Again, this evidence partly supports hypothesis 3 in that below the aspiration level small firms are risk averse but large firms show inertia. Large firms, however, behave consistently with risk theory above the aspiration level since they show risk aversion.

### **Graphical analysis**

Figure 1 illustrates the effects of ROA graphically using the estimates of model 5 to graph ROA and firm size against factory expansion. The axis of ROA is set to the mean plus/minus two standard deviations from the aspiration level to indicate the response range for a typical firm, and the axis of firm size retains the original zero-to-one normalization. The vertical axis is set so that a small firm with ROA equal to the aspiration level has zero expansion (in reality this expansion rate depends on the control variables and intercept). The figure shows substantial differences in the reaction of small and large firms to low performance. Small firms sharply reduce the factory expansion, but large firms keep it constant. There are also differences between small and large firms in the inclination of the

curve above and below the aspiration level. Above the aspiration level, both large and small firms reduce the factory expansion, but the reduction is somewhat greater for large firms. Finally, large firms generally have lower factory expansion, as seen in the decline in the curve as the number of employees increases. The curve for sales and ROE are similar, but ROE shows a flatter curve for large firms. The curves clearly show that the threat rigidity finding is driven by small firms, while large firms are less responsive overall and have responses that are more consistent with behavioral risk theory.

=== Insert Figure 1 About Here ===

## **CONCLUSION**

This study examined how the risk behavior of the small firms in an industry differed from that of large firms. Models ignoring firm size showed that: 1) performance decreases below the aspiration level made organizational decision makers more risk averse, against the prediction of prospect theory and the behavioral theory of the firm but consistent with the threat-rigidity hypothesis; and, 2) performance decreases above the aspiration level made decision makers more willing to take risks, consistent with prospect theory and the behavioral theory of the firm. Models considering firm size showed that those findings

masked an important difference between small and large firms, as low performance made small firms more risk averse but had no effect on large firms.

Although the results show a clear difference in the risk behavior of small and large firms when performance is below the aspiration level, they do not precisely conform to our predictions. We predicted risk seeking below the aspiration level for large firms, but surprisingly large firms appear to be insensitive to changes in performance. This finding could be interpreted as indication of the greater inertia of large firms (Hannan and Freeman, 1984) but the problem with this account is that above the aspiration level large firms behave consistently with behavioral predictions by showing risk aversion. Two post-hoc explanations may account for this finding. The first is that this partial inertia is caused by internal political dynamics triggered by low performance. Increased political frictions arising from proposals of reallocation of scarce resources and the inability of a dominant coalition weakened by low performance to resolve internal divergences (Ocasio, 1994) could stall decision-making. The second possible explanation is that in large firms with long communication channels, negative news such as those regarding poor organizational performance travel at a much slower speed than positive news. These accounts are

speculative and obviously more work is needed to verify their validity and whether this unexpected finding applies to other industries.

Perhaps the most important contribution of this research is to previous studies that seek to explain when risk aversion or risk seeking prevails. First, our findings provide much-needed evidence in support of risk aversion when performance is low. Prior risk taking research (e.g., March and Shapira, 1992) has typically inferred the importance of the hypothesis of risk aversion when performance is low from studies of organizational decline (e.g., Greenhalgh, 1983; Cameron, Kim, and Whetten, 1987). But since those studies focus primarily on organizations close to extinction, it has been unclear whether decision makers would show risk aversion when experiencing low but not near-fatal performance. Except for two studies that, against the authors' predictions, showed risk aversion when performance was low (Miller and Bromiley, 1990; Wiseman and Bromiley, 1996), we have not seen evidence of threat-rigidity in firm risk behavior. More research is certainly needed, and the results of our study should encourage such additional efforts.

Second, although there have been theoretical analyses suggesting moderating factors that may explain when risk aversion or risk seeking prevails (Ocasio, 1995; Mone et al., 1998), the paucity of empirical work has retarded progress toward the resolution of this

puzzle. Our study demonstrates empirically the importance of firm size and, more importantly, suggests that the shifting-focus model of risk taking (March and Shapira, 1987, 1992) yields insights that can help resolve the puzzle.

Future research could use the shifting-focus model of risk taking to explore other organizational characteristics that influence the choice of the reference point and thus explain the prevalence of risk aversion or risk seeking under low performance. Two specific directions strike us as particularly interesting. While we focused on firm size as an indicator of the stock of tangible resources (e.g., manufacturing infrastructures, technological capabilities, financial assets), there are other resources that contribute to forming an organizational endowment that are equally important (Hannan, 1998; Levinthal, 1991) but are less related to firm size. One such resource is social capital (Coleman, 1990), which can take the form of legitimacy, relationships with exchange partners, and trust among organizational members. Thus, a question that could help generalize the argument proposed in this paper to other forms of resources is: Does social capital influence the risk behavior of firms under low performance? Similar to the argument made to differentiate between the risk behavior of small and large firms, the lack of social capital could increase perceptions of threat when the performance is low and thus contribute to explain risk

aversion. This question is important because less tangible resources such as trust and legitimacy and more tangible resources such as financial capital and infrastructures are subject to different processes of accumulation and erosion (Sutton, 1990) and correlate imperfectly.

Compensation designs are also believed to have a direct impact on the risk behavior of executives (see Wiseman and Gomez-Mejia, 1998). Thus researchers could explore whether and what incentives facilitate the switch of the focus of attention from the aspiration level to the survival point when the organization is performing poorly. One could speculate, for example, that incentive designs that increase executive risk bearing may facilitate the switch of the focus of attention from the aspiration level to the survival point thereby inducing risk aversion.

Our results also add to a growing body of work that seeks to incorporate the role of the organizational context in theories of organizational risk taking. Several researchers have noted that theories of organizational risk taking solely based upon individual level explanations offer unrealistic representations of strategic decision making within organizations (Baird and Thomas, 1985; March and Shapira, 1987; Ruefli et al., 1999). A response to this call for a more contextual theory of organizational risk taking has been to

question the view of the organization as a unitary actor with a single risk preference and to disaggregate firm-level risk into distinct operational risks. This approach allows exploration of whether managers exhibit heterogeneous risk preferences across choice domains (Kahneman and Lovallo, 1993; Wiseman and Catanach, 1997). A second response has been to explore whether characteristics of the organizational context such as the standardization of decision processes or the heterogeneity of the top management team may have a direct influence on risk taking (McNamara and Bromiley, 1997; Palmer and Wiseman, 1999). Our study proposes a third direction by suggesting that a structural feature of the organizational context such as firm size can moderate the effect of performance on risk behavior, arguably the key process in theories of risk taking. Future research could extend this approach by exploring the moderating role of other structural characteristics.

Finally, by combining ideas from the behavioral and the structural perspective, our study has theoretical implications for research on firm size and change (Barnett and Carroll, 1995). Structural accounts generally attribute greater flexibility to small organizations (Hannan and Freeman, 1977, 1984). The argument goes that small firms are “little more than the extensions of the wills of the individuals” and therefore that “they are capable of changing their strategy almost as quickly as the individuals who control them” (Hannan and

Freeman, 1984: 158). Although from a structural perspective this difference between small and large firms seems quite straightforward, the empirical evidence on the effect of firm size on change is inconclusive (Barnett and Carroll, 1995; Baum and Amburgey, 2002). Our study suggest that the mixed findings might be due to the failure in most previous empirical work to consider psychological sources of organizational rigidity. Small firms are more responsive than large firms but their greater responsiveness does not imply greater flexibility. In our study, small firms exhibit remarkable levels of rigidity because of their risk aversion when performance is high and when performance is low. Their rigidity appears to derive not from constraints that limit the discretion of decision makers, as structural accounts suggest, but rather from decision makers' psychological responses to changes in performance. A potential implication is that a clearer understanding of the effect of firm size on change might emerge by taking into consideration the role of psychological processes.

The interpretation of our findings comes with some caveats related to the sample of firms used. The observed range of the size variable starts at 589, which is small for a shipbuilder but not for many other organizational forms. Thus it is unclear whether our findings extend to industries with much smaller organizations. We believe that the

theoretical argument on threat rigidity ought to apply all the way down the size gradient, since smaller means more vulnerable for a given form of business. However, this is an issue that merits further attention in future work. Second, shipbuilding seems an ideal context to study risky decisions since it is a highly capital-intensive business and it is subject to significant fluctuations in demand. Other contexts, however, may show weaker adjustment of risk taking than we found. Third, the effect of analyzing Japanese firms is worth consideration because the institutional context could influence firm responsiveness to various organizational goals. Managerial folklore would suggest that Japanese firms pay less attention to ROA and more to sales than their US counterparts, and some researchers have made the same suggestion (Johansson & Yip, 1994). However, this suggestion is not consistent with our data, as shown by our strong results on ROA, nor with the findings of others who have studied the connection between low profitability and change in Japanese organizations (Kaplan & Minton, 1996; Lincoln, Gerlack, & Ahmadjian, 1996). The firms in our study appear to be largely responsive to the four measures of organizational performance examined in this study, a pattern that may not extend to other institutional contexts.

In conclusion, although the conflicting hypotheses of risk aversion and risk seeking when performance is low have received much attention, there has been a paucity of empirical research investigating when these opposite risk behaviors prevail. By specifying and showing the effect of firm size on risk behavior, this study reminds researchers of the importance of the structural context in which risky decisions are made. There may be other structural features of the social context besides firm size that influence organizational risk taking, suggesting rich opportunities for additional research. Future work in the intersection of behavioral and structural explanations of organizational behavior can shed additional light on the causes of organizational risk taking.

## REFERENCES

- Ahmadjian CL, Robinson P. 2001. "Safety in Numbers: Downsizing and the deinstitutionalization of permanent employment in Japan." *Administrative Science Quarterly*, 46: 622-654
- Barron D N., West E, Hannan, MT. 1994. "A time to grow and a time to die: Growth and mortality of credit unions in New York City, 1914-1990." *American Journal of Sociology*, 100: 381-421.
- Baum, JAC, Amburgey, TL 2002. "Organizational ecology." In JAC Baum (Ed.), *Companion to Organizations*, 304-326. Oxford, UK: Blackwell Publishers.
- Bower JL. 1970. *Managing the resource allocation process*. Boston, MA: Harvard Business School Press.
- Bromiley P. 1991. "Testing a causal model of corporate risk taking and performance." *Academy of Management Journal*, 34: 37-59.
- Bromiley P, Miller KD, Rau D. 2001. "Risk in strategic management research." In MA Hitt, RE Freeman, and JS Harrison (Eds.), *The Blackwell Handbook of Strategic Management*; 259-288. Oxford: Blackwell.
- Chattopadhyay P, Glick WH, Huber GP. 2001. Organizational actions in response to

- threats and opportunities. *Academy of Management Journal*, 44: 937-955.
- Coleman, JS. 1990. *Foundations of Social Theory*. Cambridge: Harvard University Press
- Cyert, RM, March, JG. 1963. *A Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.
- Fiengenbaum A. 1990. Prospect theory and the risk-return association: An empirical examination in 85 industries. *Journal of Economic Behavior and Organization*, 14: 187-204.
- Fiengenbaum A, Thomas H. 1986. Dynamic and risk measurement perspectives on Bowman's risk-return paradox for strategic management: An empirical study. *Strategic Management Journal*, 7: 395-408.
- Gooding, RZ, Goel S, Wiseman RM. 1996. "Fixed versus variable points in the risk-return relationship." *Journal of Economic Behavior and Organization*, 29: 331-350.
- Greene WH. 2000. *Econometric Analysis*, 4<sup>th</sup> ed. New York: Macmillan.
- Greenhalgh L. 1983. Organizational decline. *Research in the Sociology of Organizations*, 2: 231-276
- Greve HR. 1998. "Performance, aspirations, and risky organizational change."

*Administrative Science Quarterly*, 44: 58-86.

Hannan MT. 1998. "Rethinking age dependence in organizational mortality: Logical formalizations." *American Journal of Sociology*, 104: 126-164

Hannan MT, Freeman J. 1977. "The population ecology of organizations." *American Journal of Sociology*, 82: 929-964

Hannan MT, Freeman J. 1984. "Structural inertia and organizational change." *American Sociological Review*, 49: 149-164.

Johansson JK, Yip GS. 1994. "Exploiting globalization potential: U.S. and Japanese Strategies." *Strategic Management Journal*, 15: 579-601.

Kahneman D, Lovallo D. 1993. "Timid choices and bold forecasts: A cognitive perspective on risk taking." *Organization Science*, 39: 17-31

Kahneman D, Tversky A. 1979. "Prospect theory: An analysis of decision under risk." *Econometrica*, 47: 263-291.

Kameda T, Davis JH. 1990. "The function of the reference point in individual and group risk decision making." *Organizational Behavior and Human Decision Processes*, 46: 55-76.

Kaplan, SN, Minton, BA 1994. "Appointments of outsiders to Japanese boards:

- Determinants and implications for managers.” *Journal of Financial Economics*, 36: 225-258.
- Lant TK. 1992. Aspiration level adaptation: An empirical exploration. *Management Science*, 38: 623-644.
- Laughunn DJ, Payne JW, Crum R. 1980. Managerial risk preferences for below target returns. *Management Science*, 26: 1238-1249.
- Levinthal, D. A. 1991. “Random walks and organizational mortality.” *Administrative Science Quarterly*, 36: 397-420.
- Levinthal DA, March JG. 1981. “A model of adaptive organizational search.” *Journal of Economic Behavior and Organization*, 2: 307-333.
- Lincoln, JR, Gerlach, ML, Ahmadjian, CL 1996. “Keiretsu networks and corporate performance in Japan.” *American Sociological Review*, 61: 67-88.
- MacCrimmon KR, Wehrung DA. 1986. *Taking Risks: The Management of Uncertainty*. New York: Free Press.
- March JG, Shapira Z. 1987. “Managerial perspectives on risk and risk taking.” *Management Science*, 33: 1404-1418.
- March JG, Shapira Z. 1992. “Variable risk preferences and the focus of attention.”

*Psychological Review*, 99: 172-183.

March, JG, Simon, H. 1958. *Organizations*. New York: Wiley.

Maritan CA. 2001. Capital investment as investing in organizational capabilities: An empirically-grounded process model. *Academy of Management Journal*, 44: 513-532.

McNamara G, Bromiley P. 1997. "Decision making in an organizational setting: Cognitive and organizational influences on risk assessment in commercial lending." *Academy of Management Journal*, 40: 1063-1088.

Meyer MW. and Zucker LG. 1989. *Permanently Failing Organizations*. Newbury Park, Calif.: Sage Publications.

Miller KD, Bromiley P. 1990. "Strategic risk and corporate performance: An analysis of alternative risk measures." *Academy of Management Journal*, 4: 756-779

Milliken FJ, Lant TK. 1991. The effect of an organization's recent performance history on strategic persistence and change. *Advances in Strategic Management*, 7: 129-156.

Mone MA, McKinley W, Barker VL. 1998. Organizational decline and innovation: A contingency framework. *Academy of Management Review*, 23: 115-132.

Nickel MN, Rodriguez MC. 2002. "A review of research on the negative accounting relationship between risk and return: Bowman's paradox." *Omega-International*

*Journal of Management Science*, 30: 1-18.

Ocasio, WC. 1994. "Political dynamics and the circulation of power: CEO succession in large US industrial corporations, 1960-1990." *Administrative Science Quarterly*, 39: 285-312.

Ocasio WC. 1995. "The enactment of economic adversity: A reconciliation of theories of failure-induced change and threat-rigidity." In LLCummings and BM Staw (Eds.), *Research in Organizational Behavior*, 287-331. Greenwich, CT: JAI Press.

Palmer TB, Wiseman RM. 1999. "Decoupling risk taking from income stream uncertainty." *Strategic Management Journal*, 20: 1037-1062.

Pfeffer J, Salancik GR. 1978. *The External Control of Organizations*. New York: Harper and Row.

Ruefli, TW, Collins, JM, Lacugna, JR 1999. "Risk measures in strategic management research: Auld lang syne?" *Strategic Management Journal*, 20: 167-194.

Shapira Z. 1986. *Risk Taking*. New York: Russel Sage Foundation.

Sitkin, SB, Pablo AL. 1992."Reconceptualizing the determinants of risk behavior." *Academy of Management Journal*, 17: 9-38.

Staw BM., Sandelands LE, Dutton, J. E.1981. "Threat-rigidity effects in organizational

- behavior: A multilevel analysis.” *Administrative Science Quarterly*, 26: 501-524.
- Sutton RI. 1990 “Organizational decline processes: A social psychological perspective.  
In BM Staw and L Cummings (Eds). *Research in Organizational Behavior*, 12:  
205-253
- Wiseman RM, Bromiley P. 1996 “Toward a model of risk in declining organizations: An  
empirical examination of risk, performance and decline.” *Organization Science*, 7:  
524-543.
- Wiseman RM, Catanach AH. 1997. “A longitudinal disaggregation of operational risk  
under changing regulations: Evidence from the savings and loan industry.” *Academy of  
Management Journal*, 40: 799-830.
- Wiseman, RM, Gomez-Mejia LR. 1998. “A behavioral model of managerial risk taking.”  
*Academy of Management Review*, 23: 133-153.

**Table 1. Descriptive Statistics and Correlations**

Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Factory expansion	0.006	0.627															
2. Employees	0.508	0.229	.05														
3. Diversification	1.486	0.424	-.02	.60													
4. Added factory	0.135	0.342	-.02	.00	.08												
5. Number of functions	1.859	1.099	-.02	-.23	-.33	-.04											
6. Asset proportion	0.125	0.187	.05	-.44	-.50	-.07	.46										
7. Order reserve	1.393	1.068	.06	.74	.40	-.02	-.19	-.31									
8. Oil shock	0.199	0.399	.08	.27	-.12	.00	.04	-.02	-.10								
9. Ship production	9.279	2.859	.14	.26	-.11	.05	.03	-.02	-.06	.85							
10. Shipping revenue	0.021	0.004	.03	.13	.15	.17	.01	-.03	.03	-.24	.00						
11. ROE > aspiration	0.051	0.106	-.15	-.18	-.07	.07	.07	.09	-.15	.04	-.04	.10					
12. ROE < aspiration	-0.061	0.114	.13	.25	.28	.09	-.12	-.16	.25	.15	.20	.16	.26				
13. ROA > aspiration	0.008	0.159	-.05	-.26	-.18	.05	.08	.17	-.16	-.01	-.05	.05	.77	.28			
14. ROA < aspiration	-.0008	0.016	.14	.21	.17	.09	-.14	-.22	.23	.14	.23	.13	.24	.84	.28		
15. Sales > aspiration	0.001	0.026	.09	.16	-.14	.02	.05	.02	-.09	.69	.64	-.05	.20	.25	.25	.27	
16. Sales < aspiration	0.108	0.221	.21	.29	.12	.11	-.17	-.21	-.24	.23	.40	.03	-.09	.30	.05	.49	.35

N = 1235; correlation coefficients  $\geq .06$  are significant at the  $< .05$  level

**Table 2. FGLS Regressions of Factory Expansion<sup>a</sup>**

	ROE			ROA		Sales	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-0.540** (0.101)	-0.022 (0.122)	-0.078 (0.132)	-0.192 (0.114)	-0.257* (0.120)	-0.251* (0.111)	-0.380** (0.110)
Employees	-0.354* (0.147)	-0.287† (0.171)	-0.569** (0.161)	-0.252 (0.155)	-0.407* (0.186)	-0.361* (0.169)	-0.269† (0.177)
Diversification	0.077† (0.040)	0.027 (0.045)	-0.080† (0.048)	0.034 (0.040)	0.044 (0.044)	0.059 (0.042)	0.081† (0.043)
Added factory	-0.059 (0.045)	-0.042 (0.046)	-0.053 (0.046)	-0.058 (0.045)	-0.052 (0.044)	-0.082† (0.045)	-0.085† (0.044)
Number of functions	-0.048* (0.022)	-0.040† (0.021)	-0.042* (0.021)	-0.043* (0.020)	-0.045* (0.020)	-0.030 (0.021)	-0.035 (0.022)
Factory asset proportion	0.425** (0.134)	0.467** (0.114)	0.423** (0.121)	0.521** (0.112)	0.561** (0.109)	0.428** (0.113)	0.616** (0.101)
Order reserve	0.091** (0.026)	0.044 (0.027)	0.069** (0.026)	0.056* (0.027)	0.050** (0.029)	0.070* (0.028)	0.067* (0.027)
Oil shock	0.098 (0.093)	0.117 (0.095)	0.098 (0.094)	0.105 (0.092)	0.127 (0.092)	0.215* (0.094)	0.221* (0.096)
Ship production	0.034** (0.011)	0.016 (0.012)	0.022† (0.012)	0.020† (0.012)	-0.022† (0.012)	0.009 (0.012)	0.013 (0.012)
Shipping revenue	10.129* (5.072)	7.021 (5.371)	7.758 (5.325)	5.623 (5.271)	8.439 (5.354)	10.658** (5.292)	3.955** (1.318)
Performance > aspiration		-0.979** (0.191)	-1.240** (0.353)	-3.964** (0.937)	-2.250 (1.441)	-0.114† (0.063)	0.418** (0.104)
Performance < aspiration		1.277** (0.129)	2.015** (0.225)	7.126** (1.134)	9.356** (1.622)	1.660** (0.331)	2.821** (0.594)
Performance > aspiration X employees			1.272* (0.642)		-4.283 (3.650)		-0.885** (0.190)
Performance < aspiration X employees			-2.485** (0.441)		-9.614* (3.873)		-3.954** (1.318)

\*\*p<.01; \*p<.05; †p<.10.<sup>a</sup>Models have 89 autoregression coefficients (one per factory) and heteroskedastic standard errors. There are 1235 observations.

**Figure 1: The Effect of ROA and Firm Size on Factory Expansion**

