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STRATEGIC RESPONSIVENESS AND BOWMAN'S RISK–RETURN PARADOX

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One of the most enduring puzzles in the strategy literature is the negative association between risk and return known as the Bowman paradox. This paper formalizes a model of strategic conduct based on the concept of strategic fit and the heterogeneity of firm strategic capabilities. This model is shown mathematically to yield the negative association of the Bowman paradox. Furthermore, the model makes several other testable predictions. To examine these predictions, simulated data from the model are compared with a large empirical study of 45 industries during 1991–2000. The predictions of the model are consistent with the empirical data. Copyright © 2007 John Wiley & Sons, Ltd.

The negative association between cross-sectional, accounting-based, firm performance and the variance of performance known as the 'Bowman paradox' (Bowman, 1980, 1982, 1984) has inspired a rich stream of research and continues to fascinate strategy scholars (e.g., Bettis, 1982; Baird and Thomas, 1985; Fiegenbaum and Thomas, 1986, 1988, 2004; Miller and Bromiley, 1990; Bromiley, 1991; Miller and Chen, 2003, 2004; Ruefli, Collins, and LaCugna, 1999). This negative association was unexpected, since higher returns are generally thought to require higher risks. Furthermore, it was counter to the financial market-based results embodied in the capital asset pricing model (CAPM). Even though more than 25 years have passed since Bowman (1980) observed the negative correlation, there is no general agreement on the source of this phenomenon. The interest in and significance of this issue is obvious, since strategy proposes to have important things to say about both returns and the risks associated with those returns.

Explanations for the source of the Bowman paradox include various contingencies, strategy conduct and statistical artifacts. The most common explanation today is probably the effect of performance relative to a reference point and its impact on managerial risk taking as discussed by prospect theory (Kahneman and Tversky, 1979, 1984; Tversky and Kahneman, 1986) and the behavioral theory of the firm (Cyert and March, 1963; March and Shapira, 1987, 1992).

Here we pursue Bowman's (1980) original inclination that effective management makes a difference and can positively influence both the mean and variance of performance (e.g., Bettis 1982; Baird and Thomas, 1985). A major contribution of the paper is that we show how a relatively simple model, closely associated with common conceptualizations of effective strategy, can explain the Bowman paradox. We adopt a three-pronged research approach combining mathematical derivations, model simulations, and empirical studies.

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In what follows, we first provide a general overview of the different rationales that have been developed to explain Bowman's paradox. We then develop a model of strategic fit in the presence of heterogeneous firm capabilities, and show how we can mathematically adduce the Bowman paradox from this model. Next we simulate the model to examine its predictions. We then perform a comprehensive empirical analysis across 45 different industries from 1991 to 2000 to assess model predictions. The results of this empirical analysis conform with the simulation results to a considerable degree. Finally, we discuss extensions and wider implications of the proposed modeling framework.

BACKGROUND

Previous management research on the risk–return relationship may be broadly classified in accordance with three basic explanatory rationales: (1) contingencies that influence the risk behavior of organizational decision-makers; (2) outcomes from strategic conduct; and (3) statistical artifacts. Appendix 1 provides an overview of different contributions organized in accordance with the three classifications, realizing that some studies may incorporate multiple perspectives. The purpose of the Appendix is not to provide a full literature review but to highlight alternative explanations for the negative risk–return relations. We will have more to say about some of these explanations directly below and at various points in the paper. For comprehensive reviews of the literature we refer the interested reader to Bromiley, Miller, and Rau (2001) and Nickel and Rodriguez (2002).

The first explanatory rationale, 'contingencies that influence behavior of organizational decision-makers,' includes a wide variety of explanations, as an examination of the Appendix shows. Prominent among these explanations is prospect theory (Kahneman and Tversky, 1979, 1984; Tversky and Kahneman, 1986). Prospect theory holds that the risk propensity of decision-makers is influenced by expected performance outcomes in such a way that individuals are risk averse when prospects are positive (expected gains) and risk seeking when prospects are negative (expected losses). These arguments were transposed to situational framing where high performance is associated with risk aversion and poor performance with risk-seeking behavior. This perspective is consistent with behavioral models where the choice of actions, and hence risk behavior, is driven by firm performance in relation to given aspiration levels (e.g., March and Shapira, 1987, 1992; Bromiley, 1991). Accordingly, negative risk–return relationships arise as managers in the underperforming firms decide to take riskier actions to increase returns, thus implying that individual decision behaviors aggregate into organizational outcome effects (Bazerman, 1984; Hartman and Nelson, 1996). Bromiley (1991) also found that higher risk seems to cause poorer performance, thus leading to vicious or virtuous performance cycles over time. Today these rationales constitute widely accepted explanations for Bowman's risk–return paradox.

Various empirical studies have tested these prospect theory/behavioral model explanations based on split samples between above and below median performers (e.g., Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding, Goel, and Wiseman, 1996; Lehner, 2000). Firms operating below target performance were on average found to have inverse risk–return relationships, while those operating above target displayed positive risk–return relationships as predicted. The below-target performers also showed a higher risk–return trade-off than above-target performers as suggested by theory. The prospect theoretical view has been extended to consider both external and internal environmental conditions such as business cycles and organizational life cycles that can frame the risk-taking behavior of strategic decision-makers. Fiegenbaum and Thomas (1986, 1988) proposed that the oil crisis of the 1970s with the resulting economic uncertainty and increased competition could explain the negative risk-return relationships. However, inverse risk-return relationships were also found in five-year intervals during 1960-79 including the steady growth scenarios of the 1960s (Bettis and Mahajan, 1985).

Industry clusters characterized by intense rivalry among members also constitute competitive environments where risk behaviors are associated with inverse risk–return relationships (e.g., Cool, Dierickx, and Jemison, 1989; Oviatt and Bauerschmidt, 1991). Henderson and Benner (2000) further suggested that risk behaviors may be influenced by the age of the organization as young agile firms avoid losses and score gains, while aging inertial organizations have below-average performance and increase their propensity to risk. Finally, organizational conditions may influence the perception of risk among individual decision-makers and their risk propensities (e.g., Fischoff, Watson, and Hope, 1984; March and Shapira, 1987) and thereby affect the organization's ability to manage risk events (e.g., Sitkin and Pablo, 1992; Pablo, Sitkin, and Jemison, 1996).

The second explanatory rationale shown in the Appendix is 'strategic conduct' as originally suggested by Bowman (1980). Although strategic conduct explanations relate to managerial decision-making, they are different from contingency perspectives. Rather than explaining on the basis of induced management behaviors, the strategic conduct approach attempts to show that good management practices can make a difference; i.e., inverse risk–return relationships could be the result of firm heterogeneity of strategic management capabilities. Clearly, the 'strategic conduct' perspective implies that managerial discretion matters. This stream of research has been less grounded in theory than the 'contingency approach' above, and has tended to advocate normative approaches to strategic management as an effective way to manage both risk and return. However, there have also been some empirical and theoretical contributions.

An analysis of alternative risk measures in strategy research questioned the premises of prospect theory and suggested that income variability can impose incremental costs on the firm (Miller and Bromiley, 1990). From this perspective, it would seem likely that managerial intervention to reduce performance risk is associated with lower cost and better performance, as illustrated by Miller and Chen (2003). Furthermore, decision-makers seem to have higher risk propensities in contexts where they feel knowledgeable and competent (Heath and Tversky, 1991) and executives consider these exposures to be manageable (Shapira, 1995). Accordingly, Palmer and Wiseman (1999) found that managerial choice has a significant influence on performance risk. It has also been claimed that the associated risk management practices can lead to higher firm value as they induce investment in firm-specific rent-bearing resources (Miller, 1998; Wang, Barney, and Reuer, 2003) and empirical studies seem to corroborate this view (e.g., Sneier and Miccolis, 1998; Bartram, 2000).

The third explanatory rationale detailed in the Appendix is 'statistical artifacts.' This rationale deals with the possibility of misspecifications and spurious effects in empirical studies that have found the negative association between risk and return. This explanation suggests that the negative association may be due to flawed statistical analyses. Since it is impossible to distinguish between time specific risk–return relationships and shifts in these relationships over time, the calculations might indicate true relationships, although we cannot be certain (e.g., Ruefli, 1990; Ruefli and Wiggins, 1994; Ruefli *et al.*, 1999). Henkel (2003) demonstrated that samples where accounting measures are skewed toward negative returns lead to spurious effects of negative risk–return correlations. Nonetheless, after disentangling the true effects he still found inverse risk–return relationships across industries during 1970–79, the period analyzed by Ruefli and Wiggins (1994). Denrell (2004) also demonstrated that heterogeneity in risk propensity as well as serial correlation in performance can produce spurious u-shaped relationships between risk and return.

As this brief overview indicates, research has suggested a variety of possible explanations of the Bowman paradox. Nevertheless, most research has focused on prospect theory and the behavioral theory of the firm, possibly because their implications are well understood. In the next section we introduce an alternative model that explicates the implications of the strategic conduct perspective. We show formally how heterogeneity in the effectiveness of strategic management can provide an alternative explanation of the Bowman paradox, with different empirical predictions

MODEL

In our model we pursue the view that high performance with low variability can be achieved through superior strategic conduct, and that low performance with high variability can result from inferior strategic conduct. More generally, heterogeneity in the effectiveness of strategic management processes can result in an inverse relationship between return and variability of return.

Overview of the model

Before developing the formal model, we pause in this section to motivate it and embed it in some fundamental strategy literature.

First, our objective is to explain the negative *cross-sectional* association between risk and return, which has been the focus of most of the literature (e.g., Bowman, 1980; Fiegenbaum, 1990; Gooding *et al.*, 1996). Given this emphasis, and since our model does not assume that low performance leads to risk taking, we pay less attention to the longitudinal association, i.e., the direction of causal relationships between risk and performance and vice versa (Bromiley, 1991; Wiseman and Bromiley, 1996; Wiseman and Catanach, 1997). Second, our ambition is to show that an inverse risk–return relationship can emerge even if it is not assumed, as in financial models, that there is an association in equilibrium between risk and return due to risk aversion. For this reason, we measure performance by the return rather than the risk-adjusted return.

Our model is based on the long-standing concept of strategic fit (e.g., Andrews, 1971; Hofer and Schendel, 1978; Fiegenbaum, Hart, and Schendel, 1996; Siggelkow, 2001). According to this view, high performance is achieved by aligning the strategy content and organizational structure of the firm with prevailing environmental conditions. As environmental conditions change, the alignment to obtain strategic fit will also need to change appropriately. Furthermore, the 'farther' one deviates from achieving optimal fit, the more severe the performance penalties. We conceive of strategic fit broadly to include external environmental conditions, such as competitive structure, customer demand, and stakeholder relationships, as well as internal organizational structure and resource mobilization (Barney, 1991; Drazin and Van de Ven, 1985; Porter, 1996).

The concept of strategic fit is consistent with several different approaches to strategy, including Porter's (1996) idea of achieving third-order strategic fit to optimize organizational effort. The model is also consistent with both the resource-based view and with the concept of dynamic capabilities. It incorporates the basic tenet of the resource-based view that superior performance comes from making the best use of unique resources that a firm may possess (Barney, 1986, 1991; Winter, 1995; Denrell, Fang, and Winter, 2003). In a changing environment obtaining strategic fit over time requires capabilities (and other resources) that allow a firm to accurately assess environmental changes, formulate an appropriate response, and then reconfigure internal resources appropriately. This is in line with the conclusions of the resource-based view of the firm (e.g., Barney, 1986, 1991, 2001). It is also consistent with the conceptualization of dynamic capabilities as the organization's ability to identify available resources, and apply them in effective responses to uncertain and changing environmental conditions (e.g., Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000; Adner and Helfat, 2003).

We will refer to this bundle of capabilities to assess the environment, identify firm resources, and mobilize them in effective responsive actions (achieving strategic fit over time) as strategic responsiveness. Our concern here is not with and of the individual capabilities, but with the overall concept of strategic responsiveness as the accomplishment of fit. Finally, it should be noted that strategic responsiveness is almost always distributed heterogeneously in the population of firms.

Model specification

To narrow the focus on an analysis of risk–return effects, we project strategic responsiveness as a relatively simple periodic adaptation process. From a strategic fit perspective, firm performance depends on how well management is able to impose strategic responsiveness on the organization. A simple way to model this is to assume that, given an initial resource endowment of the firm, it can achieve an optimal performance level at a given point in time expressed by a value K. The optimal performance, K, is achieved when the environment that circumscribes the firm is accurately assessed and responded to so as to achieve the best strategic fit available to the firm. This approach is comparable to rationales that define production frontiers in classical economics and investment opportunity sets in financial economics where periodic choices are limited by upper bounds determined by prevailing technologies and investments. Similar ideas have been applied in the introduction of concepts like productivity frontiers (e.g., Porter, 1996) and efficient frontiers (Devinney, Midgley, and Venaik, 2000) in organizational studies. The value of K can differ between firms, depending on their individual business prospects and resource endowments. A constant K, as an indicator of optimal performance, is obviously restrictive since performance usually will be influenced by a large number of exogenous variables and can change over time, but a relaxation of this assumption does not change the conclusions from the subsequent analysis.[1]

If a firm is not able to respond perfectly to environmental change, its performance is expected to be below K. In particular, performance will suffer if the firm's position deviates substantially from the optimal one, i.e., if the strategic fit is poor. To reflect this, we may express the performance of firm i during period t as

$$P_{t,i} = \begin{cases} K - r|c - d_{t,i}|^a \text{ if } d_{t,i} < c \\ K - l|c - d_{t,i}|^a \text{ if } d_{t,i} > c \end{cases} \tag{1}$$

In this profit function, c can be interpreted as a key environmental parameter, e.g., demand, customer need, technology stage, and the like, while $d_{t,i}$ is a discretionary decision variable reflecting the organization's attempt to adapt its strategic position to fit the environmental parameter. For example, if demand has increased in period t, then an optimally performing firm is able to exactly meet output requirements during that time period without incurring excessive capacity costs. Consistent with strategic fit theory, the coefficients r and l are assumed to be positive and a is assumed to be larger than 1. That is, deviations from the perfect fit (when $d_{t,i} \neq c$) implies less than optimal performance and the size of the coefficients (r, l, and a) describes the relative disadvantage of misfit, which may differ across environmental settings. For example, the coefficients r, l, and a may be relatively low in munificent and protected industries, whereas they may be relatively high in hostile and competitive environments. The coefficients r and l reflect negative linear performance relationships where effects can differ between positions above and below an optimum fit, while a indicates exponential adverse effects where large discrepancies between firm position and the environment may be more severely punished.[2]

In summary, a discrepancy between the firm's actual position and an optimal position characterized by one or more environmental parameters will reduce organizational performance below the optimal profit potential. The environmental parameters (c's) can comprise internal structural design elements as well as external market characteristics the firm is attempting to adapt towards (e.g., Drazin and Van de Ven, 1985; Porter, 1996; Fiegenbaum, Hart, and Schendel, 1996; Siggelkow and Levinthal, 2003). Hence, if the firm is unable to 'hit it on the nail' in a vector of essential environmental parameters (c's), performance is expected to suffer in some proportion to the size of the misfit with the environmental context. Several organizational problem contexts display this feature. For example, performance deteriorates if a firm fails to estimate demand correctly and resource accumulation, inventory buildup, etc., become too high or too low. Similarly, performance may deteriorate whenever customer service is excessive or poor, if advertising is too high or too low, technology investments exaggerated or neglected (March, 1991), and so forth.

To achieve optimal performance, organizations should be able to adapt so that $d_{t,i}$ gets closer to or becomes equal to c in each period.[3] We assume, however, that organizations are not always capable of achieving a perfect fit, due to inertia, errors in judgment, resource limitations, structural rigidities, etc. (e.g., Tripsas and Gavetti, 2000). In fact, many aspects of the complex strategic response processes can influence the firm's ability to obtain strategic fit. While these aspects could be incorporated into a full-blown model of strategic responsiveness, we refrain from that temptation here in the interest of remaining focused. To describe the uncertainty associated with the organization's response processes, we simply assume that for firm $i, d_{t,i}$ is normally distributed with mean c and variance σ_i^2 in each period t. We assume that σ_i^2 differs among firms but remains constant over time for each firm. Hence, the distribution of $d_{t,i}$ differs among firms, but remains constant over time for each firm. These assumptions reflect the fact that organizations can face a variety of obstacles in their environmental assessments, identification of available resources, coordination of strategic actions, etc., and hence are unreliable in their attainment of strategic fit over time.[4]

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[1] If K is assumed to develop stochastically to reflect exogenous influences on performance, it can be shown that the correlation between performance and variance of performance remains negative.

[2] Hence incremental gains in performance also get increasingly smaller the closer we move toward an optimum, a phenomenon that is consistent with the notion of diminishing marginal returns observed in classical economic analysis.

[3] We later relax the assumption of a constant c and show that if c is developing stochastically over time as reflective of a dynamic environment, it will not affect the conclusion derived from the basic model.

[4] The responsive behavior could also be conceived as an ongoing learning process, where the organization gains experiences from actions and outcomes over consecutive time periods. If the

Finally, we also assume that organizations differ in their ability to respond to the environmental state. Some firms display better strategic responsiveness and are consequently more likely to reach positions where $d_{t,i}$ is closer to c than other firms. Such an assumption is consistent with ideas about heterogeneity in dynamic capabilities among firms (Teece *et al*., 1997; Eisenhardt and Martin, 2000). To model this, we assume that the value of σ_i^2 is different across firms. This implies that firms differ in the average accuracy of their responses in the sense that firms that have a lower variance in $d_{t,i}$, are more likely to reach positions where $d_{t,i}$ is closer to c.

Implications

The specified performance function (1) together with the heterogeneity assumption implies an inverse cross-sectional risk–return relationship. That is, the expected performance and the variance of performance will be negatively correlated.

Proposition: $Corr(E(P_{t,i}), Var(P_{t,i})) < 0$

This relationship can be derived mathematically as shown in Appendix 2. The proposition expresses the relationship between the expected profitability and the *variance* of profitability but it is easy to extend this proposition to show that the correlation between expected performance and the *standard deviation* of performance will also be negative. In practice, only average profitability and the estimated variance or standard deviation of periodic profitability measures can be observed. Since estimation introduces noise, the empirically observed correlations will be closer to zero but still negative. Similarly, if the value of K varies between firms, the correlation will also be closer to zero but still negative.

Simulations

To illustrate the correlations generated by the model and how they depend on the model parameters, a series of simulations were performed, the results of which are shown in Table 1. We simulated an industry with 50 firms for 10 years and calculated the correlation between average performance and the standard deviation of performance. The simulations assumed that the value of K differed among firms, so K was drawn from a normal distribution with mean zero and standard deviation one for each firm. The results are based on averages from 1,000 simulations.

Table 1(a) shows the result of a simulation where σ_i was uniformly distributed between 0 and 2 and $r = l = 1$, while a varied. As shown, the correlation is lower when a is larger. Table 1(b) shows the result of a simulation where σ_i was uniformly distributed between 0 and 2, $a = 1$, and the value of $r = l$ varied. As shown, the correlation is lower when the parameters $r = l$ are larger. These two simulations illustrate that the correlation will be more negative in environmental settings that impose higher penalties on organizations that fail to adapt effectively to the prevailing environmental conditions. Table 1(c) shows the result of a simulation where $a = 1$, $r = l = 1$, and σ_i was uniformly distributed between 0 and w, where w varied. As shown, the correlation is lower the higher the value of w. This simulation illustrates that the correlation also is more negative the more variability there is in the response capabilities of firms.

While it is problematic to empirically test these determinants of the correlation directly (since it is difficult to find adequate measures of a, for example), the model makes several testable predictions about the relationships between the correlation between risk and return, the variability in average firm performance, and average performance within a certain industry environment. The expected associations are illustrated in Figures 1–3, which are based on simulated data.

In these simulations, the parameters of the model were picked randomly to make the results robust to variation in the parameters. Specifically, the value of K differed among firms and was drawn from a normal distribution with mean M and standard deviation S. M was drawn from a uniform distribution between zero and ten and S was drawn from a uniform distribution from one to five. Moreover, σ_i was uniformly distributed between 0 and w, where w was drawn from a uniform distribution between zero and ten. Finally, a was drawn from a uniform distribution between zero and two and $r = l$ was drawn from a uniform distribution from one to eight. These values were

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assessment of environmental characteristics in such a learning process follows Bayesian updating then $d_{t,i}$ may differ significantly from c. However, $d_{t,i}$ converges over time and will be normally distributed with positive variance and therefore the results from this analysis still apply. A simulation model that incorporates sequential learning loops will therefore reach comparable results (Andersen and Bettis, 2002).

Table 1.

(a) Simulation of risk–return relationships for different values of a[a]

	$a = 0.5$	$a = 1.0$	$a = 1.5$	$a = 2.0$	$a = 2.5$
Correlation	−0.22	−0.41	−0.60	−0.77	−0.88

[a] The correlation coefficient between average performance and the standard deviation of performance

(b) Simulation of risk–return relationships for different values of r and l[a]

	$r = l = 1$	$r = l = 2$	$r = l = 3$	$r = l = 4$	$r = l = 5$
Correlation	−0.42	−0.65	−0.76	−0.82	−0.85

[a] The correlation coefficient between average performance and the standard deviation of performance

(c) Simulation of risk–return relationships for different values of w[a]

	$w = 1$	$w = 2$	$w = 3$	$w = 4$	$w = 5$
Correlation	−0.22	−0.42	−0.56	−0.65	−0.72

[a] The correlation coefficient between average performance and the standard deviation of performance

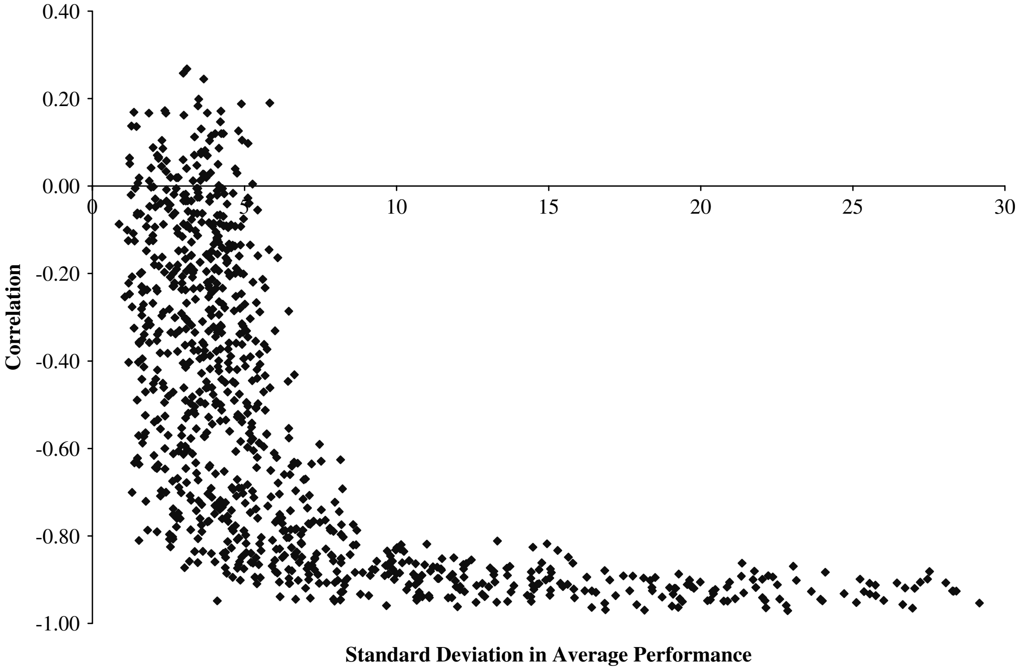

Figure 1. Simulated association between the standard deviation in average firm performance in the industry and the correlation between average performance and the standard deviation of performance

picked so the average performance, the standard deviation in performance, and the range in average performance would roughly match the empirical data (discussed below). The simulation was based on 1,000 industries with 50 firms simulated for 10 periods.

Figures 1–3 show the result of the simulations. Figure 1 shows how the risk–return correlation in

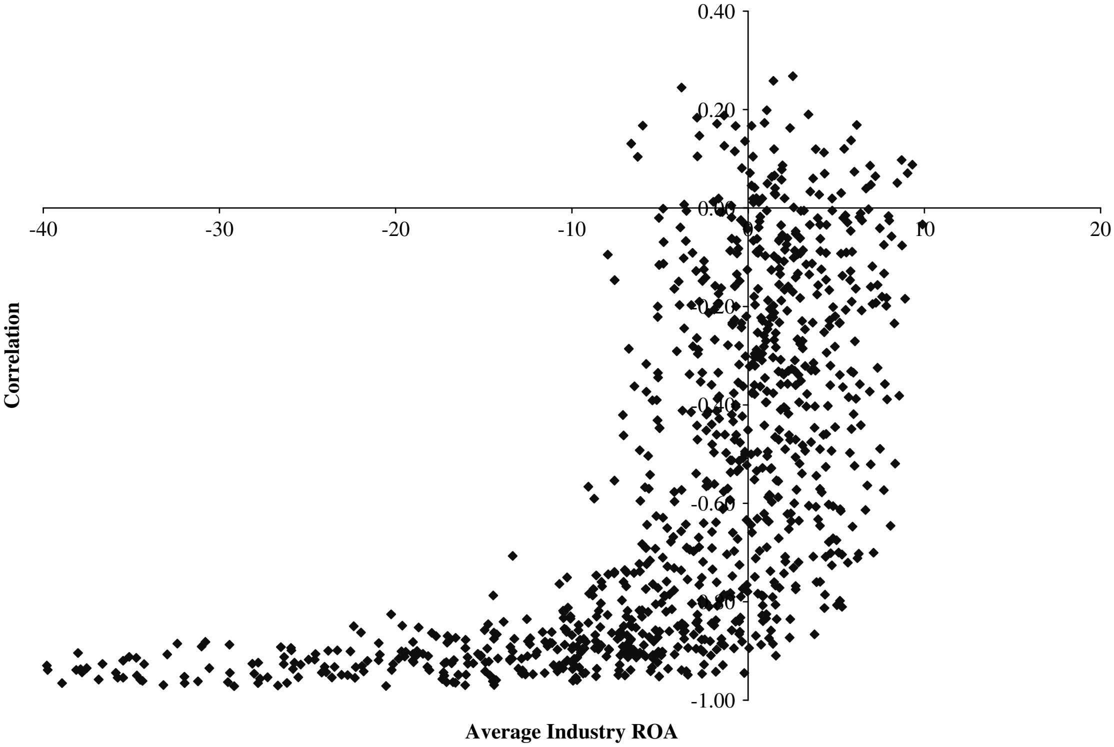

Figure 2. Simulated association between average industry performance and the correlation between average performance and the standard deviation of performance

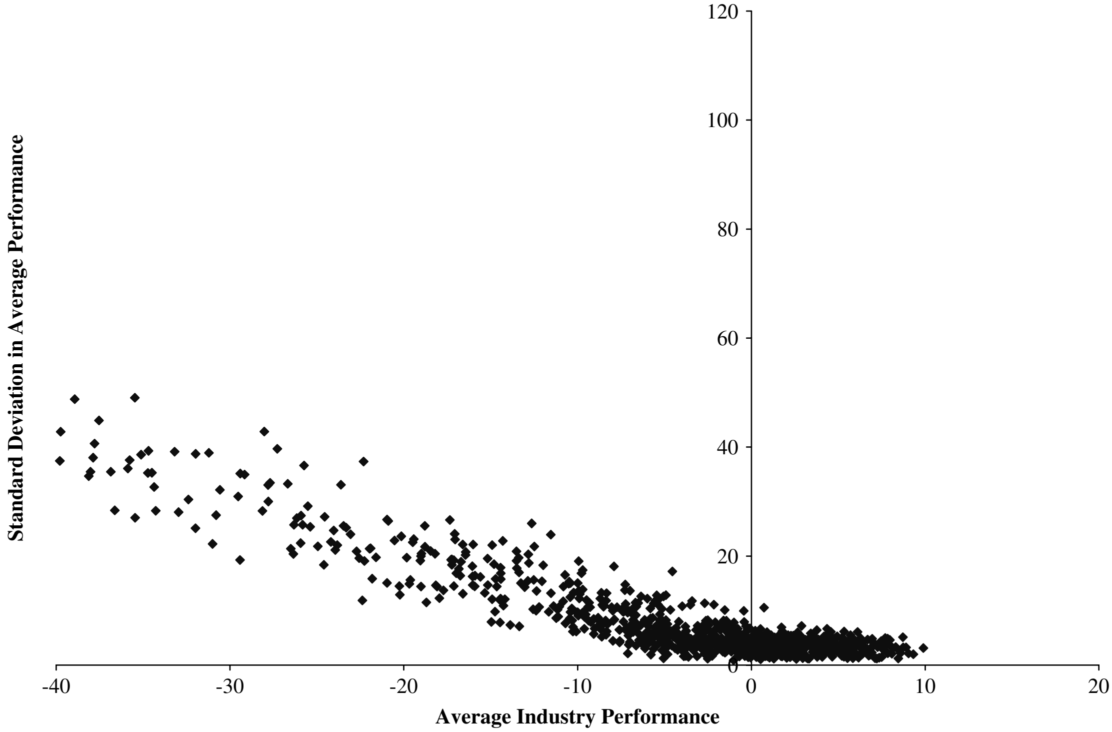

Figure 3. Simulated association between the standard deviation in average firm performance and the average industry performance

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an industry (the correlation between average firm performance and the standard deviation of firm performance) varies with the standard deviation of *industry* performance (the standard deviation of average firm performance). Figure 2 shows how the risk–return correlation in an industry varies with *average* industry performance (the average performance of all firms in all 10 periods). As shown, the model predicts that the risk–return correlation will be lower in industries with substantial variation in average firm performance as measured by the standard deviation in average firm performance (Figure 1). The model also predicts that the correlation will be higher in industries with high average performance (Figure 2). Figure 3 shows the association between average industry performance and the standard deviation of industry performance. As illustrated, the model predicts that average industry performance and the variability in average firm performance (as measured by the standard deviation) will be negatively associated. These associations emerge in the proposed model since average performance will be lower and more variable in industry settings where the penalty is higher for failing to adapt to essential environmental characteristics, and when there is more variation in the abilities of firms to adapt. In such settings, the inverse risk–return relationship is also more pronounced.

EXTENSIONS AND COMMENTS

In the following, we extend the modeling framework by considering the possibilities of multiple environmental parameters, dynamic environmental change, and changes in the optimal profit level over time, and show that these modifications will have no effect on the general conclusion drawn from the basic model. We further consider how the model can lead to u-shaped risk–return relationships as observed in some industries.

Rather than dealing with a single environmental parameter, the model could incorporate a vector of N relevant environmental parameters (c's), in which case the performance of the firm could be modeled as a function of the deviations from each of the environmental parameters.[5] This approach resembles recent applications of the NK model where the firm attempts to identify a range of environmental dimensions through a number of strategic choices (e.g., Rivkin, 2000; Siggelkow, 2001; Siggelkow and Levinthal, 2003). If firms differ in their ability to respond to the true environmental state represented by a string of c's, and this ability constitutes an organizational trait, then the ability to respond to essential environmental characteristics in each firm is the same, or are positively correlated, for any environmental contingency and the previous conclusions will hold.

The value of the c's could also vary between periods representing dynamic environmental change rather than stable conditions. This will not alter the basic conclusions either. The magnitude of the negative correlation, however, depends on how much the underlying environmental characteristics change. If the values of the c's never change, all firms should be able to adapt perfectly to the correct environmental characteristics sooner or later by observing the environment and monitoring performance. Such adaptive learning implies that the variability in σ_i^2 will be lower because even firms with high degrees of environmental misfit will adapt to the correct values of the c's after some time and thus their performance outcomes will deviate less. This implies that performance variation caused by differences in responsiveness will explain less of the variance in performance and that the correlation between risk and return will be closer to zero.

The variability in σ_i^2 may also be affected by selection forces when poorly performing firms exit the industry over time. Hence, strong selection forces that may intensify as an industry moves from growth toward a mature stage may reduce the variability in σ_i^2. By implication, industries should have less negative cross-sectional risk–return relations once they have gone through a shakeout.

These effects are illustrated in Table 1(c). As appears from Table 1(c), the correlation is closer to zero if there is less variation in σ_i, i.e., when there is less variation in the ability of firms to achieve strategic fit. Overall, this argument implies that the negative correlation between risk and return should be stronger in dynamic environments characterized by frequent changes in demand conditions, technology use, regulatory settings, etc.

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[5] This could entail simple summation of deviations or more advanced distance measures between vectors, such as Euclidian distance and Mahalinobis distance.

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One could also think of scenarios where a firm's extraordinary ability to mobilize resources and respond to the environmental context resulted in periodic 'jumps' in the overall profitability of the firm (K_i) and possibly the industry in its entirety (K). However, such changes in overall profitability would not alter the results of the model. In case only the responsive firm increases its profitability, the remaining firms in the industry would perform comparatively worse after this event, and the inverse risk–return mechanics would prevail unabated. In case all industry participants would benefit from a one-time shift in performance, they would still differ in their ability to adjust to the new circumstances, and consequently would be disfavored economically to the extent they fail to match the environmental setting that provides the new higher return. Hence, even in situations of periodic increases in the optimal profit level (K_i or K), the mechanics of the model would be retained.

The model can also generate positive risk–return associations for firms performing above the industry median and negative risk–return associations for firms below the median (cf. Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Jegers, 1991; Sinha, 1994; Gooding *et al.*, 1996). As noted by Denrell (2004, 2005) this pattern can be an artifact of heterogeneity in the variance of performance and therefore may also occur in our model. To illustrate this, suppose the underlying profit function as expressed in Equation 1 is determined by parameters $r = l = 1$ and $a = 2$. That is, $P_{t,i} = K_{i,t} - |c - d_{t,i}|^2$ and $K_{i,t}$ are normally distributed with mean zero (the value of the mean does not matter) and standard deviation s_i, where s_i differs among firms. We then simulate an industry with 50 firms during 10 years and assume that σ_i is uniformly distributed between 0 and 2 and that s_i is uniformly distributed between 0 and 4. The average correlation between average firm performance and the standard deviation of firm performance is -0.64 for all firms, -0.71 for firms with average performance below the median, and $+0.17$ for firms above the median (based on 1,000 simulation runs).[6]

Consistent with empirical findings, the absolute value of the correlation is smaller for firms performing above the median (Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Jegers, 1991). Fiegenbaum (1990) explained this asymmetry by prospect theory (Kahneman and Tversky, 1979) but these simulations suggest an alternative explanation. In the model, a positive correlation for firms performing above the median and a negative correlation for firms below will occur because extreme performances, both high and low, are more likely for firms with a variable performance (Denrell, 2004). Thus, if we observe a very high or very low performance, this suggests that the firm also had a variable performance. For firms with a high performance, the higher the average performance is, the larger the expected variability. For firms with a low performance, the lower the average performance is, the larger the expected variability.[7]

The association between average performance and the variance in performance is weaker, however, for firms with high performance. To achieve high performance, firms must be able to consistently achieve high fit. Firms with a high observed performance are thus likely to be firms with a low value of σ_i. This also implies that their performance is likely to be less variable.[8]

Consistent with empirical evidence (Fiegenbaum, 1990; Gooding *et al.*, 1996), the model also implies that a positive correlation for firms above the median does not always occur. In industries where the penalty for deviations from perfect fit are larger, that is, when the values of a, r, or l are larger, the correlation for firms above the median is lower and can also be negative. For example, if $r = l = 4$ rather than 1 in the above simulation, the correlation for firms above the median is -0.48, -0.88 for firms below, and -0.92 for

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[6] Similar results will hold, but with weaker correlations, if the mean of K is also assumed to differ among firms.

[7] More formally, firms with large variability in $K_{i,t}$, i.e., large standard deviations in environmentally determined optimal performance, s_i, are more likely to obtain very high but also very low performance outcomes. Thus, if the observed average performance is very high, or very low, this suggests that the value of s_i was large. As a result, firms with high average performance are likely to have high values of s_i and thus high variance in performance. Similarly, firms with a low average performance most likely have high values of s_i and thus high variance in performance (see Denrell, 2004, 2005, for more detail and a formal derivation).

[8] Formally, since expected performance is a decreasing function of the value of σ_i (see Equation 7 in Appendix 2), a high average performance suggests that the value of σ_i was low. Holding s_i constant, a low value of σ_i implies a low variance in performance (see Equation 15 in Appendix 2). As a result, the association between average performance and the variance in performance is weaker for firms with high performance.

all firms (based on 1000 simulations). The correlation for firms above the median is also lower when there is more heterogeneity in the abilities of firms to achieve fit, i.e., when the values of σ_i are more widely dispersed. Since larger penalties for failing to achieve fit and larger variability in the ability to achieve fit implies that average performance in an industry will be more variable, these relations imply (and simulations confirm) that the value of the correlation for firms above the median should be negatively associated with the variability in average performance.

Finally, the model assumed that the expected value of $d_{t,i}$ was equal to c, i.e., there was no bias. It is possible, however, that some firms consistently over- or underestimate the value of c. If such a bias was included, the correlation would still be negative, but closer to zero. Similarly, the correlation would still be negative even if we assumed that firms with low performance exit the industry. Whereas such selection on performance would eliminate firms with poor fit and with bias, simulations indicate that this does not change the correlation substantially.

EMPIRICAL ANALYSIS

The model predictions illustrated in Figures 1–3 were analyzed empirically on firms operating in different industries based on accounting data from Compustat over the 10-year period 1991–2000. All firms accessible on Compustat with complete performance records were included in the analysis. The firms were considered across industries identified by four-digit SIC codes and grouped into meaningful industry clusters. Only industry groups with more than 25 firms were considered and potential outliers with return measures exceeding three times the standard deviation were eliminated from the sample following previous literature (Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Henkel, 2003; Miller and Chen, 2004). We used data on return on assets, defined as income before extraordinary events divided by total assets as performance indicator.

For each industry in our sample, Table 2 shows the mean and median performance (ROA) and the standard deviation in average performance across firms within an industry. Note that mean performance is typically lower than median performance (the average mean performance is −6.13%, while the average median performance is 1.19%), which illustrates that the distribution of performance is (positively) skewed. Such skew has been found in previous research (e.g., Foster, 1986: 109) and is consistent with the model outlined above.

Table 2 also reports cross-sectional risk–return correlations for each industry sample, as well as for below-median and above-median sets of firms within each industry. As shown, most correlations are negative, as is the average correlation (−0.8369). However, the average correlation is positive for firms above the median (+0.1872).

As shown in Figures 4–6, the empirical observations are consistent with the proposed modeling framework and the related simulation results shown in Figures 1–3. The correlation is lower in industries in which there is substantial variation in average firm returns, as measured by the standard deviation in average firm performance (the correlation between these variables is −0.34, p-value $= 0.021$). The correlation is higher in industries with a high average performance (the correlation is 0.41, p-value $= 0.005$). Finally, average industry performance and the variability in average firm performance (as measured by the standard deviation in average performance) are negatively associated (the correlation is −0.66, p-value < 0.001). Moreover, the shapes of the empirical associations are very similar to the simulation results. Consistent with the predictions of the model, there is also a negative, albeit not significant, association between the correlation for firms above the median and the standard deviation in average performance (the correlation between these variables is −0.08, p-value $= 0.615$).[9]

These empirical results provide significant validation of the view that strategic conduct, which underpins the performance implications of strategic fit theory, can serve as a plausible explanation for Bowman's risk–return paradox. It appears that in industry settings where it is more demanding to

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[9] If ROE was used as the return measure instead of ROA we would reach comparable outcomes. Accounting for firm equity and net assets generally covary, although the covariation for obvious reasons is less than perfect. The standard deviation of firm equity is somewhat higher than the standard deviation in net assets and consequently tends to register more extreme performance outcomes. Since the two return measures are correlated ($\rho = 0.31$, $p < 0.001$), the reported relationships are consistent with Bowman's (1980, 1982) findings.

Table 2. Risk–return relationships across industry groups

Industries (grouped by industry classification)	SIC (four-digit code)	n (#)	ROA			Correlation coefficient[a]		
			(mean)	(median)	(S.D.)[b]	(full sample)	(below median)	(above median)
Metal mining	0100–1220	45	−14.49	−7.46	27.16	−0.8582	−0.8382	−0.4923
Energy extraction	1311–1389	156	−7.31	−0.44	49.20	−0.9053	−0.9353	0.0938
Operative builders	1531	35	1.30	3.50	9.36	−0.6572	−0.7317	0.5095
Food products	2000–2090	94	0.30	4.00	32.87	−0.9639	−0.9878	0.3893
Textile industry	2200–2273	28	−1.68	2.44	15.09	−0.8476	−0.8327	0.3401
Apparel industry	2300–2390	43	−25.44	3.65	347.28	−0.9800	−0.9805	0.0978
Lumber & wood products	2400–2452	27	1.97	3.29	6.12	−0.4573	−0.4898	0.3269
Household & office furniture	2510–2590	32	−0.71	4.20	21.21	−0.9588	−0.9631	0.1276
Paper milling & products	2600–2673	39	−1.29	3.14	19.11	−0.9739	−0.9862	0.0321
Newspaper & book publication	2711–2790	67	−3.77	5.38	35.84	−0.8959	−0.8934	0.5819
Chemical & pharmaceutical products	2800–2891	302	−36.31	−6.73	145.98	−0.8508	−0.8523	−0.3659
Petroleum refining	2911–2990	27	−4.29	2.22	13.71	−0.9276	−0.9277	0.0439
Rubber & plastic products	3011–3089	62	−0.93	2.72	9.50	−0.8046	−0.7453	−0.1525
Steel works & metals	3300–3390	74	−1.27	2.37	41.55	−0.9810	−0.9916	−0.0704
Fabricated metal products	3400–3490	79	−1.44	4.68	78.82	−0.9279	−0.9396	0.0343
Industrial machinery	3510–3569	120	1.70	3.59	9.58	−0.5709	−0.5318	0.1432
Computer & office equipment	3570–3590	141	−24.63	−2.76	93.17	−0.8956	−0.8825	−0.1093
Electrical equipment & electronics	3600–3695	315	−9.68	2.96	61.07	−0.9130	−0.9137	0.0431
Vehicles & transportation equipment	3700–3790	87	3.02	3.66	9.03	−0.7567	−0.8415	0.3070
Industrial instruments & equipment	3812–3873	272	−14.21	−0.42	38.95	−0.8243	−0.7856	−0.1899
Toys, games, sporting goods, etc.	3910–3990	54	−0.73	2.41	16.59	−0.7117	−0.8975	0.7779
Line-haul operations & trucking	4011–4213	51	3.12	3.21	7.38	−0.7274	−0.7962	−0.0219
Air transportation	4512–4522	30	0.28	1.43	10.58	−0.5762	−0.8202	0.8015
Communications & broadcasting	4812–4899	105	−9.41	2.56	33.57	−0.9479	−0.9434	−0.0505
Electric services	4911	48	3.01	3.07	1.41	−0.6553	−0.7554	0.1629
Gas transmission & distribution	4922–4991	125	−1.62	2.95	23.15	−0.9442	−0.9430	0.4858
Miscellaneous wholesaling	5000–5190	189	−1.75	2.21	24.89	−0.9408	−0.9585	0.1303
Department & variety stores	5311–5399	28	2.69	3.44	5.82	−0.7495	−0.8218	−0.1540
Grocery & convenience stores	5411–5412	26	1.48	1.95	4.83	−0.7426	−0.8622	0.1816
Apparel & clothing stores	5600–5661	41	5.64	6.23	10.98	−0.7053	−0.9052	0.5493
Restaurants & eating places	5810–5812	77	−1.63	1.14	12.76	−0.7901	−0.7144	0.0007
Miscellaneous shopping stores	5912–5990	71	−3.68	1.77	20.76	−0.9125	−0.9186	0.2689
Deposit-taking institutions	6021–6099	340	−0.32	1.00	26.98	−0.9990	−0.9996	0.5560
Miscellaneous financial services	6111–6199	71	−5.51	1.19	53.44	−0.9838	−0.9875	0.5289
Brokerage & investment advice	6200–6282	46	3.18	2.20	10.33	−0.4850	−0.8049	−0.0053
Primary insurance	6311–6399	131	−0.54	2.15	60.16	−0.9872	−0.9935	0.3466
Real estate management	6500–6552	61	−8.21	0.33	53.51	−0.9583	−0.9770	0.3007
Real estate investment & trusts	6792–6799	198	6.53	2.83	80.58	−0.4707	−0.9768	0.7033
Advertising & other services	7200–7363	76	−2.79	3.45	28.69	−0.9266	−0.9380	0.2033
Programming & software services	7370–7389	272	−21.22	−5.07	72.95	−0.8489	−0.8838	0.6018
Motion pictures & theaters	7812–7841	36	−26.49	−4.38	103.03	−0.9703	−0.9698	−0.6417
Amusement & recreation services	7900–7997	56	−11.46	−1.51	162.22	−0.9847	−0.9920	0.4931
Medical & nursing services	8000–8093	79	−5.43	−0.74	20.21	−0.8388	−0.8172	−0.2282
Engineering & management services	8700–8744	72	−20.86	3.03	51.34	−0.9486	−0.9427	0.2591
Corporate conglomerates	9955–9997	37	−40.97	−17.36	125.65	−0.9036	−0.8993	0.4860
Total and average values		4,365	−6.13	1.19	46.37	−0.8369	−0.8793	0.1872

[a] The correlation between average return (ROA) and the standard deviation of returns 1991–2000

[b] The reported standard deviation is calculated on the average return (ROA) across firms within each industry

assess and adapt to essential environmental characteristics, and there is more variation in the abilities of firms to do so, average performance is lower and more variable, and the inverse risk–return relationship more pronounced. To our knowledge, these implications are not predicted by other theories of the risk–return associations. It is not clear, for example, from prospect theory or the

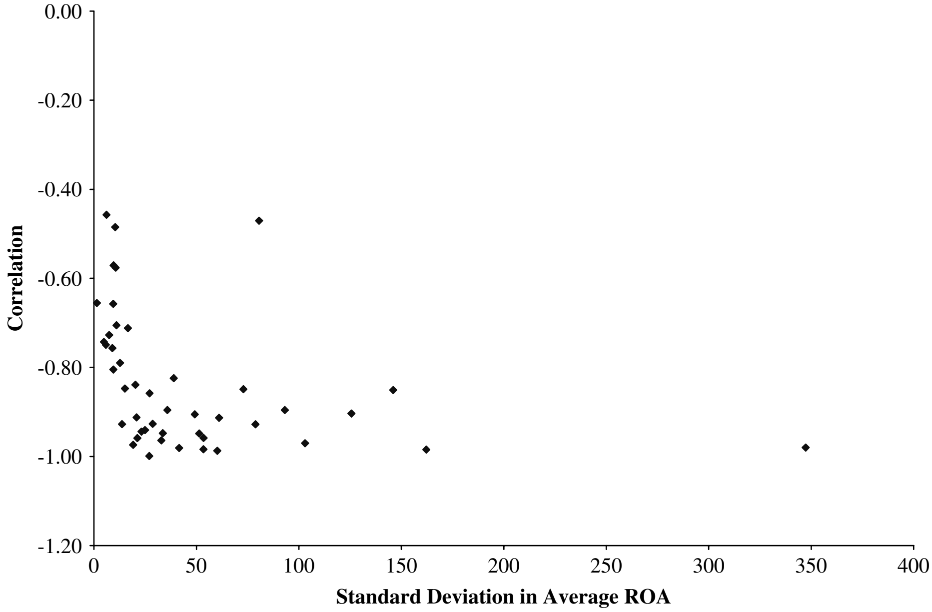


Figure 4. Empirical association between the standard deviation in the average firm ROA in the industry and correlation between average ROA and the standard deviation of ROA

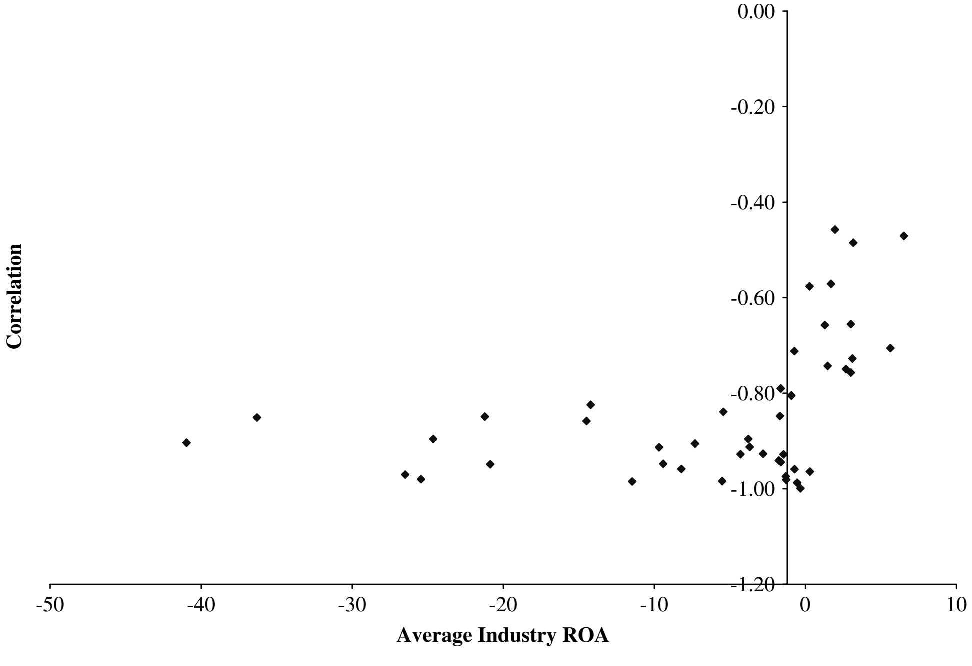


Figure 5. Empirical association between the average industry ROA and correlation between the average ROA and the standard deviation of ROA

behavioral theory of the firm how the variability in average returns would be associated with the correlation between risk and return.

As illustrated by the simulations in Table 1(c), the model also implies that the magnitude of the negative correlation between performance and the standard deviation of performance varies with the level of dynamism in the environment. In dynamic industry settings where environmental parameters are exposed to substantial change, firms may differ

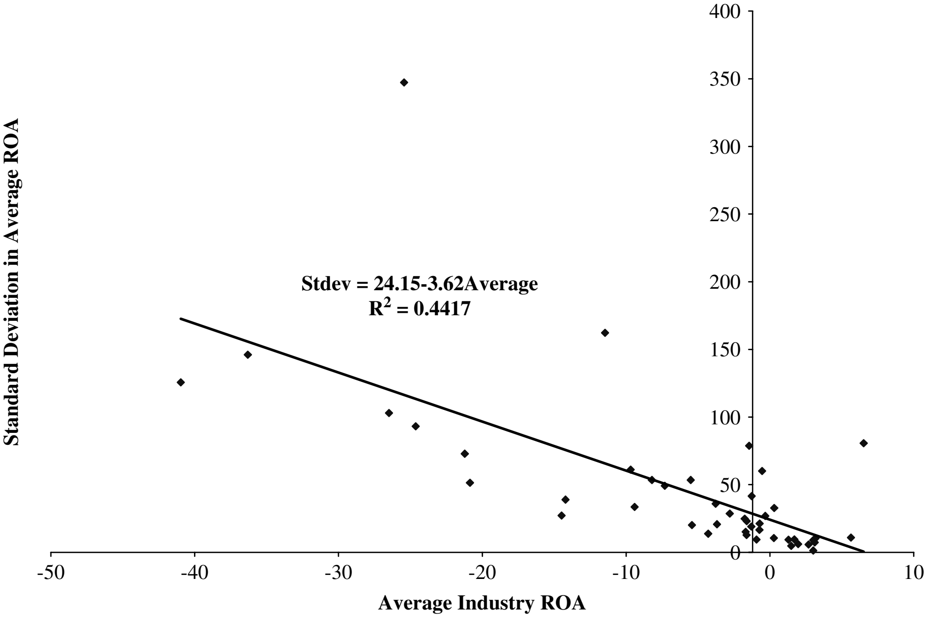


Figure 6. Empirical association between the standard deviation in the average firm ROA and the average industry ROA

Table 3. Risk–return relationships in selected industries

Industries (grouped by industry classification)	SIC (four-digit code)	n (#)	ROA (mean)	ROA (median)	ROA (S.D.)	Correlation coefficient (full sample)	Correlation coefficient (below median)	Correlation coefficient (above median)
1. *Manufacturing*								
Electrical equipment & electronics	3600–3695	315	−9.68	2.96	61.07	−0.9130	−0.9137	0.0431
Vehicles & transportation equipment	3700–3790	87	3.02	3.66	9.03	−0.7567	−0.8415	0.3070
2. *Services*								
Communication & broadcasting	4812–4899	105	−9.41	2.56	33.57	−0.9479	−0.9434	−0.0505
Electric services	4911	48	3.01	3.07	1.41	−0.6553	−0.7554	0.1639
3. *Retailing*								
Miscellaneous shopping stores	5912–5990	71	−3.68	1.77	20.76	−0.9125	−0.9186	0.2689
Grocery & convenience stores	5411–5412	26	1.48	1.95	4.83	−0.7426	−0.8622	0.1816

more in their ability to achieve fit, and, therefore we should expect stronger inverse relationships between risk and return. For example, manufacturing firms operating in electric equipment and electronics industries (SIC 3600–3695) should be more sensitive to strategic responsiveness than firms in vehicles and transportation equipment industries (SIC 3700–3790) because technologies and product features change more frequently in this environment. Hence, the inverse risk–return relationship should be more pronounced among manufacturers of electronics components as opposed to manufacturers of transportation equipment.

We would also expect a higher negative correlation between performance and standard deviation in performance among firms in communication and broadcasting industries (SIC 4812–4899) compared to firms in the electric services industry (SIC 4911) as the telecom sector has been exposed to intensified competition from deregulation during the period of observation, while returns among utilities were still protected by regulation. Similarly, we would expect that firms in miscellaneous shopping stores (SIC 5912–5990) that include more luxury-related outlets like jewelry, hobby, and game stores would be more exposed to changes in demand compared to grocery and convenience stores (SIC 5411–5412) that sell common household goods for everyday use. Preliminary analyses of data from these selective industries largely confirm the expected relationships (Table 3).

As demonstrated in the simulations discussed in the previous section, we might also expect that firms in relatively dynamic industry settings would display larger negative correlations between average performance and standard deviation of performance among below-median performers and lower positive correlations among above-median performers. This is clearly the case among the electrical equipment and electronics manufacturers and the communication and broadcasting companies, where the correlation even is slightly negative for the above-median performers in the latter group (Table 3). Indeed, a comparison of firms operating in the communication and broadcasting industries and firms in the electric services industry display quite distinct risk–return relationship profiles (Figure 7).

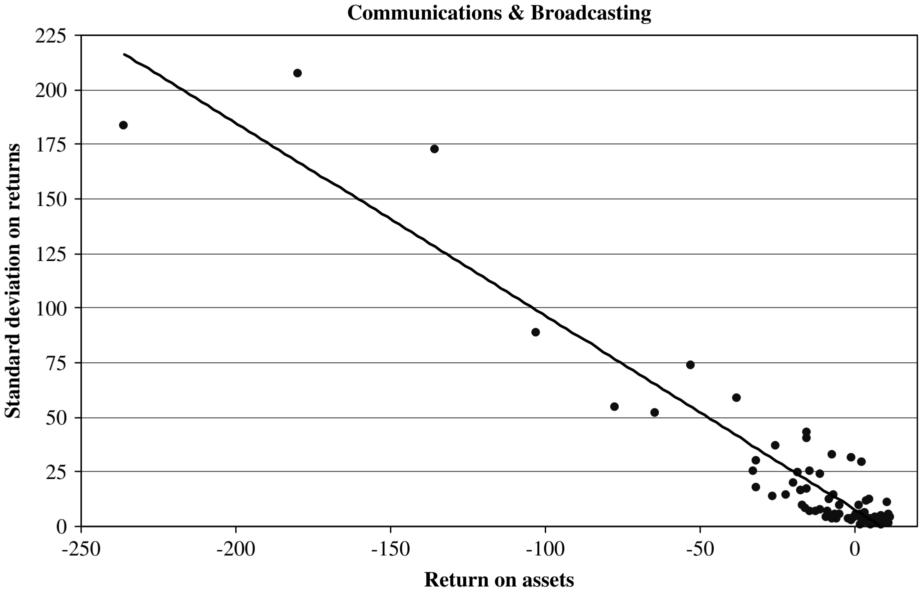
DISCUSSION

This paper has introduced a performance model of strategic responsiveness for which average performance and the variance of performance will be negatively correlated. While this result should not be surprising, it is nevertheless important for interpretations of observed negative risk–return relationships in different industry environments. It suggests that a negative risk–return relationship need not be the result of context-dependent risk attitudes (Kahneman and Tversky, 1979, 1984); performance feedback (Fiegenbaum, 1990; Lehner, 2000), misspecifications (Ruefli, 1990; Henkel, 2003), or risk-related costs (Miller and Chen, 2003). In accordance with Bowman's (1980) initial suggestion, it could also be the result of good management that enables firms to adapt toward a closer match with environmental conditions where a better strategic fit is associated with higher performance outcomes. While the model predictions are consistent with many elements of the extant literature discussing effects of environmental uncertainty (Fiegenbaum and Thomas, 1986, 1988), dynamic competition (Cool *et al.*, 1989), ageing (Henderson and Benner, 2000), and other organizational conditions (e.g., Pablo *et al.*, 1996), they are explained on the basis of a different logic.

The model is also able to explain and predict how risk–return relationships will play out under specific environmental conditions in different industry settings, which is beyond the scope of alternative theoretical explanations. A formal model specification of strategic responsiveness and environmental fit makes it possible to examine environmental contexts where inverse risk–return effects may be particularly pronounced. To this end, the model simulations outline the contours of distinctly different risk–return profiles as a function of the underlying model coefficients, and the empirical analyses illustrate this across industry settings that are characterized by different competitive dynamics.

The strategic responsiveness model is also consistent with dominant ideas in strategic management. For example, it captures basic elements of industry analysis through the strategic fit considerations and ties this to central aspects of the resource-based view as the ability to create a better environmental fit requires identification, mobilization, and utilization of resources in view of their potential strategic value. Hence, the associated strategic response capabilities constitute an essential link between dynamic environmental change and the firms' ability to adapt effectively to those changing conditions. The results indicate that strategic responsiveness is an important element of effective management and suggest that more effort to investigate these complex response processes may be worth our while.

We do not claim that our model is the sole explanation for the inverse risk–return relationship or that it excludes other dynamic effects discussed in the literature. The purpose of the model is to explain the cross-sectional association between risk and return as a result of heterogeneity in response capabilities. This modeling approach does not exclude the possibility that performance also influences risk attitudes, which could explain the longitudinal association between risk and return found in several studies (e.g., Miller and Chen, 2004). While most of the previous literature has tried to explain both associations using the same theory or model, the explanation for the cross-sectional association may differ from the explanation of the longitudinal association.



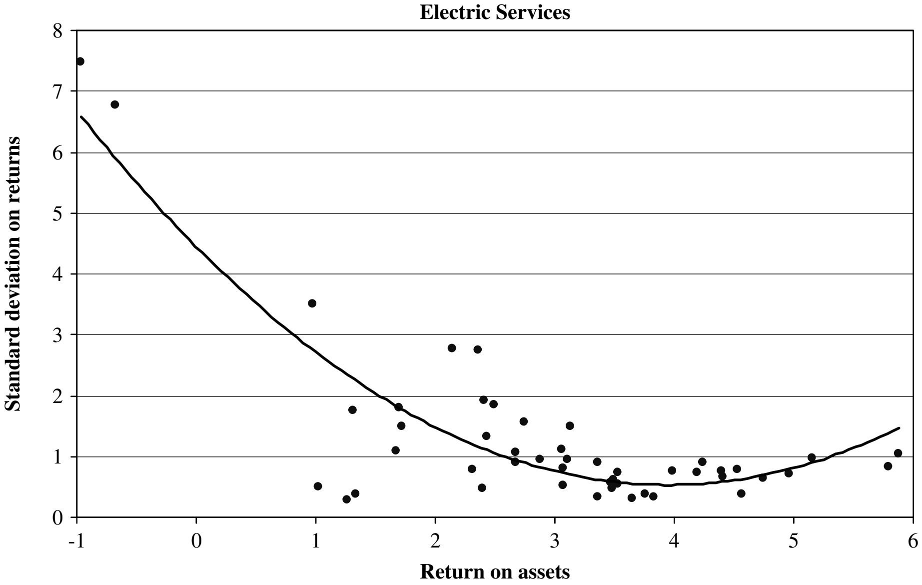


Figure 7. Empirically observed risk–return relationships in the communications and broadcasting (SIC 4812–4899) and electric services (SIC 4911) industries

The difference in the magnitude of the cross-sectional and the longitudinal correlations also suggests that different explanations may be needed. For example, Miller and Chen (2004: Table 1) find that the correlation between ROA and the standard deviation of ROA in the next period is −0.42, whereas we find an average cross-sectional correlation of −0.84 (Table 2). It is not obvious how this discrepancy could be explained if the cross-sectional association is assumed only to reflect changes in risk taking in response to past performance.[10] It is possible, however, that our model, which generates a cross-sectional negative association due to heterogeneity, may explain much of the cross-sectional association, while the influence on performance on risk attitudes may

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[10] Differences in sample sizes do not seem to explain the discrepancy, since Miller and Chen (2004) calculated the average and the standard deviation based on eight quarterly observations.

explain the longitudinal association. More comprehensive models and more detailed empirical analyses are needed to examine the influence of these different perspectives.

A more comprehensive model would also need to take into account how the performances of firms within an industry are interdependent and linked over time. In this paper we have outlined a simple model, which does not specify the competitive interactions between firms in detail, but hopefully provides a good first approximation. As illustrated in the empirical analysis, the model helps to locate the forces that explain the aggregate patterns, including when the correlation between risk and return is expected to be especially negative. More detailed model specifications may be needed to explain additional features of the data, such as the dynamics of firm performances and risk taking. This is an important but difficult task for future research. The challenge here is to develop an explicit model of competition and environmental changes and derive the implications for the cross-sectional and longitudinal association between risk and return.

CONCLUSION

The strategic responsiveness framework introduced here provides an alternative approach to model the negative risk–return relationships observed across industries. This approach is distinct from previous attempts to explain Bowman's risk–return paradox and elaborates the idea that strategic conduct influences performance outcomes and shapes the risk–return profiles of firm performance. Whereas it may not constitute a preemptive explanation, it can serve as a basis for analyzing risk–return relationships in different industries as a function of specific industry characteristics, competitive structure, and the firms' ability to respond to these environmental conditions.

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APPENDIX 1: DIFFERENT PERSPECTIVES ON BOWMAN'S RISK–RETURN PARADOX

Perspectives	References	Theoretical rationales	Causalities
1. *Contingencies*			
Prospect theory • return prospects • framing	Kahneman and Tversky (1979, 1984) Bowman (1980, 1982) Fiegenbaum and Thomas (1986, 1988) Fiegenbaum (1990) Jegers (1991) Johnson (1992) Sinha (1994) Wiseman and Catanach (1997)	Decision-makers are influenced by the prospective outcomes of their decisions and current performance. Positive prospects and performance are associated with risk aversion whereas negative prospects and performance are associated with risk-seeking behavior. Hence, low-performing firms tend to accept higher risk.	Good prospects and high performance → risk aversion Poor prospects and low performance → risk seeking
Behavioral theory • reference points • reference matrix	Cyert and March (1963) March and Shapira (1987, 1992) Bromiley (1991) Fiegenbaum, Hart, and Schendel (1996)	Decision-makers 'satisfice' rather than optimize and therefore base decisions on how the firm is performing in relation to certain thresholds for central outcome references.	Performance > reference point(s) → risk aversion Performance < reference point(s) → risk seeking Performance near survival level → risk aversion
Cognitive influences • perceptions • propensity to take risk	Singh (1986) Jemison and Sitkin (1986) Sitkin and Pablo (1992) Pablo, Sitkin, and Jemison (1996) McNamara and Bromiley (1997, 1999)	Decision-makers are influenced by their perceptions of environmental risks and the organization's capacity to handle them. Risk behavior is determined by the associated risk propensity of the decision-makers.	Perceptions of environment → risk perception and risk propensity → risk behavior
Organizational age • life cycle	Henderson and Bender (2000)	Adverse performance is a function of the organization's age.	Life cycle stage → performance → risk behavior
Economic conditions • business cycle • uncertainty	Bettis and Mahajan (1985) Fiegenbaum and Thomas (1986, 1988) Cool and Schendel (1988)	Environmental uncertainty influences the risk behavior of decision-makers and seems to follow the business cycle.	Environmental uncertainty → risk behavior
Competitive structure • strategic groups • rivalry	Cool, Dierickx, and Jemison (1989) Oviatt and Bauerschmidt (1991)	The risk behavior of decision-makers is influenced by the intensity of competitive rivalry and firm conduct under competition.	Competitive rivalry → risk behavior

(*continued overleaf*)

APPENDIX 1: (*Continued*)

2. *Strategic conduct*			
Strategic management • attitude to risk • risk management	Bowman (1980) Bettis (1982) Baird and Thomas (1985) Miller and Bromiley (1990) Shapira (1995) Miller (1998) Palmer and Wiseman (1999) Andersen and Bettis (2002) Miller and Chen (2003) Fiegenbaum and Thomas (2004)	Good management practices can lead to higher returns and lower risk simultaneously. Managers are willing to accept risk in the belief that they are able to handle the exposures. Formal risk management processes can be associated with economic benefits as relationship costs are reduced. Good managers are risk prone and support innovative behaviors that enhance the organization's ability to respond to environmental change.	Good management practices = risk-seeking behaviors and proactive risk management → high average performance and low variation in performance
3. *Statistical artifacts*			
Misspecification • spurious effects	Ruefli (1990) Ruefli and Wiggins (1994) Henkel (2003) Denrell (2004)	The risk–return relationships are indeterminate. Skewness of return distributions, heterogeneity and serial correlation of performance can lead to inverse risk–return relationships.	Data characteristics and measures → inverse risk–return relationships

APPENDIX 2: DERIVING THE INVERSE RISK–RETURN RELATIONSHIP

> *Proposition: Expected performance and the variance in performance are negatively correlated,* $Corr(E(P_{t,i}), Var(P_{t,i})) < 0$.

Proof: Let $X = c - d_{t,i}$. Then X has a normal distribution with mean zero. Suppose that the standard deviation of $X = c - d_{t,i}$ is equal to σ_i for firm i. We have

$$E(P_{t,i}) = K - rE[|X|^a|X > 0]P(X > 0) - lE[|X|^a|X < 0]P(X < 0) \quad (2)$$

Since the conditional density of X, given $X > 0$, is $h(x|x > 0) = f(x)/P(x > 0)$, where $f(x)$ is the underlying normal density of X, we have

$$E[|X|^a|X > 0]P(X > 0) = P(X > 0) \times \int_0^\infty x^a h(x|x > 0)dx = \int_0^\infty x^a f(x)dx \quad (3)$$

Similarly, due to the symmetry of $f(x)$,

$$E[|X|^a|X < 0]P(X < 0) = P(X < 0)\int_{-\infty}^0 \times (-x)^a h(x|x < 0)\mathrm{d}x = \int_0^\infty x^a f(x)\mathrm{d}x \quad (4)$$

Inserting Equations 4 and 3 into Equation 2, it follows that the expected performance for firm i, with standard deviation σ_i, is

$$E(P_{t,i}) = K - (r + l)\int_0^\infty \frac{1}{\sqrt{2\pi}\sigma_i} x^a e^{\frac{-x^2}{2\sigma_i^2}}\,\mathrm{d}x \quad (5)$$

From standard tables of integration we get

$$\int_0^\infty x^a e^{\frac{-x^2}{2\sigma_i^2}}\,\mathrm{d}x = \sigma_i^{a+1} 2^{(a-1)/2}\Gamma\left(\frac{a+1}{2}\right) \quad (6)$$

where $\Gamma(\cdot)$ is the Gamma function, defined as $\Gamma(q) = \int_0^\infty x^{q-1}e^{-x}\mathrm{d}x$. Inserting Equation 6 into Equation 5 implies

$$E(P_{t,i}) = K - \sigma_i^a \frac{r + l}{2\sqrt{\pi}} 2^{a/2}\Gamma\left(\frac{a+1}{2}\right) \quad (7)$$

It is clear that this is a strictly decreasing function of σ_i, for positive coefficients (a, r, and l).

Now, $\mathrm{var}(P_{t,i}) = (P_{t,i} - E(P_{t,i}))^2$. Define $Y = P_{t,i} - K$. Then the variance can be expressed as $\mathrm{var}(P_{t,i}) = E[Y - E(Y)]^2 = E[Y^2] - E[Y]^2$. Equation 7 gives

$$E[Y]^2 = \sigma_i^{2a}\frac{r^2 + l^2 + 2rl}{4\pi} 2^a \Gamma\left(\frac{a+1}{2}\right)^2 \quad (8)$$

Moreover, Y^2 is equal to $r^2|X|^{2a}$ if $X > 0$ and $l^2|X|^{2a}$ if $X < 0$. Thus,

$$E[Y^2] = r^2E[|X|^{2a}|X > 0]P(X > 0) + l^2E[|X|^{2a}|X < 0]P(X < 0) \quad (9)$$

Again,

$$E[|X|^{2a}|X > 0]P(X > 0) = P(X > 0)\int_0^\infty \times x^{2a}h(x|x > 0)\mathrm{d}x = \int_0^\infty x^{2a} f(x)\mathrm{d}x \quad (10)$$

Similarly, $E[|X|^{2a}|X < 0]P(X < 0) = \int_0^\infty x^{2a} f(x)\mathrm{d}x$. It then follows that

$$E(Y^2) = (r^2 + l^2)\int_0^\infty \frac{1}{\sqrt{2\pi}\sigma_i} x^{2a} e^{\frac{-x^2}{2\sigma_i^2}}\,\mathrm{d}x \quad (11)$$

From standard tables of integration we get

$$\int_0^\infty x^{2a} e^{\frac{-x^2}{2\sigma_i^2}}\,\mathrm{d}x = \sigma_i^{2a+1} 2^{(2a-1)/2}\Gamma\left(\frac{2a+1}{2}\right) \quad (12)$$

Inserting Equation 12 into Equation 11 and simplifying gives

$$E(Y^2) = \sigma_i^{2a}\frac{r^2 + l^2}{2\sqrt{\pi}} 2^a\Gamma(0.5 + a) \quad (13)$$

It follows that $\mathrm{var}(P_{t,i}) = E[Y^2] - E[Y]^2$ is equal to

$$\sigma_i^{2a}\frac{r^2 + l^2}{2\sqrt{\pi}} 2^a\Gamma(0.5 + a) - \sigma_i^{2a}\frac{r^2 + l^2 + 2rl}{4\pi} 2^a\Gamma\left(\frac{a+1}{2}\right)^2 \quad (14)$$

or

$$\sigma_i^{2a}\left[\frac{r^2+l^2}{2\sqrt{\pi}}2^a\Gamma(0.5+a) - \frac{r^2+l^2+2rl}{4\pi}2^a\Gamma\left(\frac{a+1}{2}\right)^2\right] \qquad (15)$$

Since $\mathrm{var}(P_{t,i}) > 0$, and $\sigma_i > 0$, the term in brackets must be positive. As a result, $\mathrm{var}(P_{t,i})$ is a strictly *increasing* function of the random variable σ_i. Since $E(P_{t,i})$ is a strictly *decreasing* function of the random variable σ_i, this implies that $\mathrm{cov}(E(P_{t,i}),\ \mathrm{var}(P_{t,ii})) < 0$ (e.g., Ross, 2000: 625–626). QED.