The Strength of Corporate Culture and the Reliability of Firm Performance

Jesper B. Sørensen
Massachusetts Institute of Technology

December 2001
Running Head: "Culture and Reliability"

Approximate word count: 8,500

The Strength of Corporate Culture and the Reliability of Firm Performance

Abstract

Prevailing accounts of the benefits of strong corporate cultures emphasize the virtues of internal consistency resulting from internal agreement about core values and norms. An unexamined implication of this argument is that strong cultures should affect the variability of firm performance. The nature of this relationship depends on how strong cultures affect organizational learning in response to internal and external change. I argue that strong culture firms excel at incremental change but encounter difficulties in more volatile environments. Using a sample of firms from a broad variety of industries, I show that strong culture firms have more reliable or consistent performance in relatively stable environments. In volatile environments, however, the reliability benefits of strong cultures disappear.

The Strength of Corporate Culture and the Reliability of Firm Performance

How do strong corporate cultures affect firm performance? Much popular and scholarly attention has been focused on the hypothesis that strong cultures, defined as "a set of norms and values that are widely shared and strongly held throughout the organization" (O'Reilly and Chatman, 1996: 166), enhance firm performance. This hypothesis is based on the intuitively powerful idea that organizations benefit from having highly motivated employees committed to common goals (e.g., Kotter and Heskett, 1992; Peters and Waterman, 1982; Deal and Kennedy, 1982). In particular, the performance benefits of a strong corporate culture are thought to derive from three consequences of having widely shared and strongly held norms and values: enhanced coordination and control within the firm, improved goal alignment between the firm and its members, and increased employee motivation. In support of this argument, quantitative analyses find that firms with strong cultures outperform firms with weak cultures (Kotter and Heskett, 1992; Gordon and DiTomaso, 1992; Burt et al., 1994).

The existing literature on the culture strength - performance relationship focuses on the consequences of strong culture for performance levels, but has not examined how strong cultures affect performance variability, or the reliability of firm performance. This is surprising, since the arguments relating culture strength to performance draw particular attention to the benefits of having greater internal consistency in goals and behaviors. It is therefore reasonable to expect that strong culture firms should exhibit more consistent, or less variable, performance. This expectation is complicated, however, by the fact that the variability of firm performance depends

not only on the ability to maintain consistency in internal processes, but also on the ability of the firm to adapt to environmental change. The relationship between culture strength and performance reliability therefore depends on how strong culture firms learn from and respond to their experiences and changes in their environment. I argue that incremental adjustments to organizational routines should be easier in strong cultures firms, because participants have an agreed upon framework for interpreting environmental feedback and a common set of routines for responding to different signals from the environment. In relatively stable environments, firms with strong corporate cultures should therefore have less variable performance than firms with weak corporate cultures, in addition to performing at a higher average level. In more volatile environments, however, incremental adjustments to organizational routines may not be sufficient. This suggests that the variance-reducing benefits of strong cultures may attenuate as environmental volatility increases, and may help explain why some strong culture firms have encountered great difficulties in responding to changes in their environment (Tushman and O'Reilly, 1997; Carroll, 1993)

One reason to study the relationship between culture strength and performance variability is therefore to shed light on the ability of strong culture firms to adapt to change. Performance variability is also an important outcome because it plays an central role in a variety of theoretical approaches to organizations. For example, behavioral theories of the firm suggest that risk taking by managers depends on firm performance relative to aspiration levels (Cyert and March, 1963; Bromiley, 1991); highly variable performance may therefore increase risk-taking behavior. Similarly, highly variable performance may make it more difficult for organizations to buffer

themselves successfully from environmental variability in order to facilitate planning and decision-making (Thompson, 1967) and increase organizational autonomy (Pfeffer and Salancik, 1978). Organizational ecologists have attributed causal importance to performance variability by arguing that external stakeholders typically value predictable performance, giving reliable firms a survival advantage (Hannan and Freeman, 1984). For example, suppliers will generally prefer customers that generate predictable orders and reliably pay on time, and many employees value stable employment prospects. Investors generally prefer to have less temporal variability in performance for a given return (Bodie, Kane and Marcus, 1996). Performance variability also affects the chances of failure directly: A simple random-walk model of the accumulation and depletion of organizational resources suggests that for a given stock of resources, firms with more variable performance are more likely to exhaust their resources and fail (Levinthal, 1991a).

While these arguments from organizational theory suggest the importance of variability in overall firm performance, theory and evidence in corporate finance suggest the importance of variability in specific aspects of firm performance. This literature finds that firms with highly variable cash flows find themselves at a competitive disadvantage, for two reasons. First, highly variable cash flows imply that there will be periods when a firm is unable to finance discretionary investments internally. If external capital is more expensive than internal capital, then projects that might have been funded from internal funds will be unattractive investments during periods of internal cash flow shortfall. This is one reason why firms may wish to engage in risk management activities, such as hedging (Lessard, 1990; Froot, Scharfstein and Stein, 1993). Second, firms with more variable cash flows have higher costs of external capital than firms with more stable

cash flows, which means that fewer projects will be attractive (from a capital budgeting perspective) in firms with variable performance. The increased cost of capital derives in part from greater information asymmetry in the external capital market, because firms with highly variable cash flows are less likely to be followed by market analysts. Empirically, Minton and Schrand (1999) found that firms with highly variable cash flows have lower levels of capital investment, lower levels of analyst following, lower S&P bond ratings, and higher weighted average costs of capital. Thus if strong corporate cultures lower performance variability, strong culture firms are less likely to suffer from under-investment.

For all of these reasons, corporate culture strength has implications for organizational outcomes that go beyond their effects on mean performance levels. In this paper, I explicitly model the temporal variance in firm performance as a function of the strength of corporate culture, using both an overall measure of firm performance (return on invested capital), and a measure of operating cash flow. The remainder of the paper is organized as follows. In the next two sections, I discuss the relationship between the strength of corporate culture, organizational learning processes and firm performance and discuss their implications for reliable performance. I then discuss the data – the same sample of large, publicly held firms as analyzed by Kotter and Heskett (1992) and Burt et al. (1994) – followed by a discussion of the analytic methods. I conclude with a discussion of the results and their implications.

The Strength of Corporate Cultures and Firm Performance

Interest in the concept of organizational culture has exploded in the past two decades. Researchers have approached the topic with a wide array of theoretical interests, methodological tools and definitions of the concept itself. Debate over fundamental issues of theory and epistemology is intense (Martin, 1992; Trice and Beyer, 1993). While some see attempts to measure organizational cultures and their effects on organizations as highly problematic (e.g., Martin, 1992; Siehl and Martin, 1990; Alvesson, 1993), a large body of research starts from the assumption that culture is a measurable characteristic of organizations (O'Reilly and Chatman, 1996).[1] These studies do not seek to interpret the meaning of different organizational cultures or cultural forms *per se,* but rather focus on their consequences for organizational behavior and processes. Studies of the effects of strong corporate cultures for firm performance, including this paper, fall within this tradition. I adopt O'Reilly and Chatman's (1996: 160) definition of organizational culture as "a system of shared values (that define what is important) and norms that define appropriate attitudes and behaviors for organizational members (how to feel and behave)" (for similar definitions, see Kotter and Heskett, 1992; Rousseau, 1990; Gordon and DiTomaso, 1992). Moreover, a culture can be considered strong if those norms and values are "widely shared and strongly held" throughout the organization (O'Reilly and Chatman, 1996: 166; O'Reilly, 1990; Gordon and DiTomaso, 1992; Kotter and Heskett, 1992).[2]

One of the key consequences of a strong corporate culture is that it increases behavioral consistency across individuals in a firm.[3] Organizational culture defines a normative order that

serves as a source of consistent behavior within the organization. In this sense, organizational

culture is a social control mechanism (O'Reilly, 1989; O'Reilly and Chatman, 1996). At the

same time, organizational cultures frame people's interpretations of organizational events and

basic assumptions about organizational processes. Schein (1991: 15) emphasizes that

organizational cultures "provide group members with a way of giving meaning to their daily

lives, setting guidelines and rules for how to behave, and, most important, reducing and

containing the anxiety of dealing with an unpredictable and uncertain environment." Widespread

agreement about basic assumptions and values in the firm should increase behavioral consistency

(Gordon and DiTomaso, 1992).

Why should strong cultures, defined in this way, enhance organizational performance?

Organizational performance is a function of the potential return to an organization's activities

and its ability to carry out those activities. Firms with excellent strategies (high potential return)

may perform poorly if they fail to execute well. Firms that execute their routines extremely well

may compensate for suboptimal strategies. While it is possible that strong culture firms may be

better (or worse) at choosing appropriate strategies, theories of the culture effect tend to focus on

the benefits of a strong culture for a firm's ability to execute its routines.

Theorists have put forward three interrelated explanations for the performance benefits of strong

cultures (Kotter and Heskett, 1992). First, the widespread consensus and endorsement of

organizational values and norms facilitates social control within the firm. When there is broad

agreement that certain behaviors are more appropriate than others, violations of behavioral norms

may be detected and corrected faster. Corrective actions are more likely to come from other employees, regardless of their place in the formal hierarchy. Informal social control is therefore likely more effective and lower cost than formal control structures (O'Reilly and Chatman, 1996). Second, strong corporate cultures enhance goal alignment. With clarity about corporate goals and practices, employees face less uncertainty about the proper course of action when faced with unexpected situations, and can react appropriately. Goal alignment also facilitates coordination, as there is less room for debate between different parties about the firm's best interests (Kreps, 1990; Cremer, 1993). Finally, strong cultures can enhance employee motivation and performance due to the perception that behavior is more freely chosen (O'Reilly, 1989; O'Reilly and Chatman, 1996).

Early studies reported mixed evidence of a positive relationship between culture strength and performance (Siehl and Martin, 1990), but generally defined culture strength in terms of the content of organizational values and norms. More recent studies, which define culture strength in terms of the degree of agreement and commitment to organizational values and norms, found evidence in favor of the linkage (Burt et al., 1994; Kotter and Heskett, 1992; Gordon and DiTomaso, 1992; Denison, 1990). For example, Kotter and Heskett (1992) related mean performance over a ten year period to measures of the strength of corporate culture. They found that, across industries, firms perceived to have strong cultures generally had greater average levels of return on investment, net income growth and change in share price. Gordon and DiTomaso (1992) found that the performance of insurance companies increased to the extent that there was consensus surrounding cultural values. Denison (1990), using both qualitative and

quantitative evidence, also suggested that consensus surrounding organizational values increases organizational effectiveness. Burt et al. (1994) reanalyzed the Kotter and Heskett data and found that the effect of corporate culture strength was contingent on market context. Specifically, the performance benefit of strong cultures was enhanced in highly competitive markets. Since I analyze the same data as Kotter and Heskett (1992) and Burt et al. (1994), I similarly expect to find that firms with strong cultures will have higher average levels of performance.

Culture, Learning and Environmental Change

Past studies examined the effects of culture strength on mean performance levels, but strong cultures can, under the right environmental conditions, also enhance the reliability of firm performance. To see the link between the strength of corporate culture and reliability, it helps to conceive of organizations as consisting of interrelated routines that are subject to modification in response to experience (Cyert and March, 1963); reliability is then a function of organizational learning processes (March, 1991; Levitt and March, 1988; Levinthal, 1991b).

Organizational cultures and organizational learning are closely related. In fact, several authors conceptualize organizational cultures as the product of histories of organizational learning. Weick (1985) characterizes organizational culture as the product of attempts by the organization to impose coherence, order and meaning on its experiences. Similarly, Schein (1992: 68) suggests that "culture ultimately reflects the group's effort to cope and learn and is the residue of learning processes." Schein further argues that organizational cultures are strongly influenced by

shared experiences in the firm's early history, and that, once established and taken for granted, the firm's basic assumptions are difficult to change. This suggests that organizational cultures reflect the imprinting of a firm's early environmental conditions (Stinchcombe, 1965), and that they are subject to inertial pressures (Hannan and Freeman, 1984).

How does the strength of corporate culture affect reliability? Performance reliability depends on two factors: the consistency with which a firm performs its organizational routines, and the degree to which those routines are well adapted to environmental conditions. Environmental change therefore poses dual threats to reliable performance. First, environmental change can create internal problems by increasing the likelihood of failures in communication, coordination, and control. Second, environmental change can render existing organizational routines inadequate or inappropriate. Such environmental shifts demand learning and modifications in organizational routines that take the new conditions into account. Unless the organization discovers such solutions rapidly, it will perform haphazardly.

Strong culture firms should generally be better at avoiding internal threats to reliable performance, or breakdowns in coordination and control. Efficient and consistent firm functioning in the face of environmental change depends on both appropriateness and coordination: employees must respond to events by deploying the right routines at the right times, in the right sequence. Employees are more likely to take actions consistent with a firm's goals if they understand those goals and agree with them (Levinthal, 1991b). If employees lack a clear understanding of the organization's goals, coordination will also be more difficult, as they are

more likely to take actions that conflict with what is happening in other parts of the organization (Cremer, 1993). Thus heterogeneity in beliefs within the organization makes performance more haphazard. If employees differ in their understandings of the environment, they will either spend more time debating alternatives or behave inconsistently, and therefore be more likely to job carry out routine tasks poorly.

Strong cultures minimize heterogeneity in beliefs about the state of the environment and thereby enhance internal reliability. Organizational cultures can codify the organization's understanding of itself and its environment, and thereby clarify the organization's beliefs and goals for members (Weick, 1985; Schein, 1992). In strong culture firms most members work from a shared knowledge base and common beliefs, which enhances organizational reliability. As March (1991) argues, "Knowledge makes performance more reliable. As work is standardized, as techniques are learned, variability, both in the time required to accomplish tasks and in the quality of task performance, is reduced." Furthermore, strong culture organizations socialize new members faster, in part due to the explicit codification of beliefs and in part due to greater normative pressures (Harrison and Carroll, 1991). This enhances reliability by limiting the length of time new members hold discrepant views and pose threats to the smooth execution of organizational routines. This suggests the following hypothesis:

> *Hypothesis 1*: Firms with strong corporate cultures will exhibit more reliable (less variable) performance.

In the absence of environmental change, reliability (and performance more generally) is simply a

function of internal organizational processes. Environments do change, however, both

incrementally and in a more discontinuous fashion. Reliability in changing environments

depends on the ability of the firm to modify its routines in response to changes in conditions.

The nature of environmental change therefore affects the relationship between culture strength

and reliability, since organizational routines embody assumptions about the state of the

environment and the path of change in external conditions. When environmental change is

incremental (i.e., consistent with the basic assumptions underlying the organization's routines),

organizations achieve reliable performance through corresponding incremental adjustments to

routines. March (1991) terms this exploitation; Lant and Mezias (1992) use the term first-order

learning. The consequences of strong cultures – enhanced coordination and control, goal

alignment, and increased motivation – should all increase the speed and accuracy with which

organizations adapt to incremental changes in their environments.   In relatively stable

environments, strong culture organizations should exhibit more reliable performance than

organizations with weak cultures because they are more adept at refining and improving

established competencies.

Excellence at exploitation comes at a cost, however. When environmental change is radical or

discontinuous, successful adaptation cannot come about through incremental improvements in

organizational routines (Tushman and Anderson, 1986; Henderson and Clark, 1990). Rather,

successful adaptation depends on the ability to discover alternative routines, technologies, and

purposes. In short, adaptation to discontinuous change requires "exploration" (March, 1991) or

"second-order" learning (Lant and Mezias, 1992). Such exploratory learning demands an ability to perceive environmental shifts and a willingness to accept the possible failure and uncertain returns that accompanies fundamental change in organizational processes.

Strong culture organizations will, in general, be ill-suited to exploratory learning, for several reasons.[4] First, strong culture organizations may have greater difficulty recognizing the need for change. Lant and Mezias (1992) suggest that second-order learning is triggered by sub-optimal experiences that the organization can no longer ignore and cannot handle within its existing interpretive frameworks. Because members of strong culture organizations have a greater commitment to a particular understanding of the world, they may be slower to detect fundamental changes in environmental conditions.

Furthermore, the elements of strong cultures that facilitate first-order learning may simultaneously impede second-order learning. One source of exploratory learning is the presence of individuals with beliefs that contradict the organization's dominant beliefs. For a firm to learn from such individuals it must both allow them to maintain their deviant beliefs and be willing to incorporate potential insights into the organization's way of doing things. In simulations, March (1991) finds that organizations that are good at learning from their members and exhibit weak socialization pressures will have the most accurate understanding of a changing environmental reality. Strong culture organizations exhibit the opposite characteristics. As Denison (1984: 18) notes, in a strong culture "the lack of variety ... limits the organization's ability to adapt to changes in the environment."

Finally, strong culture organizations may be less likely to reap the benefits of any exploration that does occur. Innovation and change in organizational routines can be fostered by a viable counter-culture (Martin and Siehl, 1983), the emergence of which may be more difficult in strong culture firms. Moreover, even when counter-cultures can be sustained in strong culture firms, the transfer of new ideas and knowledge to the dominant culture is fraught with difficulty (Martin and Siehl, 1983; Tushman and O'Reilly, 1997). In this respect, Weick (1985: 385) states the dilemma of strong culture organizations succinctly: "A coherent statement of who we are makes it harder for us to become something else."

This reasoning suggests that, *ceteris paribus*, strong culture organizations should have greater difficulty responding to environmental volatility than weak culture organizations. If environmental change renders the organization's existing routines worthless, strong culture firms should have greater difficulty regaining their footing. Short of such radical environmental change, however, strong culture firms should still maintain the internal organizational benefits identified by culture researchers -- greater goal alignment, superior coordination and control and higher motivation levels. In general, we would therefore expect environmental volatility to diminish the performance benefits of strong corporate cultures:

> *Hypothesis 2*: As industry volatility increases, the positive effect of culture strength on
> mean performance declines.

Hypothesis 3: As industry volatility increases, the positive effect of culture strength on

performance reliability declines.

Since performance reliability is defined as reduced variance, Hypothesis 3 will be supported if

the negative effect of culture strength on the variance approaches zero with increases in industry

volatility.

Data

I investigate the effects of corporate culture strength on the reliability of firm performance using

Kotter and Heskett's (1992) data on the strength of corporate culture among a sample of large,

publicly-traded firms in 18 markets.[5] Kotter and Heskett asked the top six officers in the firms

selected for the study to complete a short, mailed questionnaire. The respondents were asked to

assess the strength of corporate culture in each of the other sampled firms that were in the same

industry as their own firm. Respondents were asked to assess the strength of corporate culture in

the late 1970s and early 1980s by judging the degree to which managers at a firm were

influenced in their decision making by a strong corporate culture (Kotter and Heskett, 1992:

161). The survey provided respondents with three indicators of a strong corporate culture:

1. Managers in the firm commonly speak of their company's style or way of doing
things

2. The firm has made its values known through a creed or credo and has made a
serious attempt to get managers to follow them

3.   The firm has been managed according to long-standing policies and practices

other than those just of the current CEO

Respondents were asked to rate each firm on a scale of one to five, and an average score across

respondents was computed for each firm. (Kotter and Heskett (1992) used an inverse coding of

culture strength, with 1 indicating a strong culture. I have reversed their coding to ease

interpretation.)

A strong advantage of this measurement strategy is that it measures culture strength across a

great breadth of firms and competitive contexts without requiring extensive culture surveys

within firms. Data on a variety of industries is critical to testing the claim that the culture

strength-reliability relationship is contingent on industry volatility. The Kotter and Heskett

measurement strategy leads a firm to be characterized as having a strong culture if other actors in

their industry associate the firm with a unique and common way of doing things, relative to other

firms in the industry. Moreover, this distinctive behavior must be codified and have persisted

over time. This culture strength variable does not, however, directly measure the extent to which

there is consensus within the firm. Such an external assessment of culture strength is suboptimal

in certain respects. It is possible that some strong culture firms in the sample are highly

fragmented but manage to project an aura of cohesion and consensus. It seems less likely,

however, that weak culture firms will be able to exhibit behavioral consistency over time. The

Kotter and Heskett questionnaire asks respondents to characterize firms according to different

specific behavioral characteristics, and not simply to generate a global culture ranking that might

be more subject to image manipulation.

Furthermore, surveying organizational members about their firm's culture may be equally problematic when studying variability in performance. As Weick (1985: 386) suggests, people may be more likely to attend to culture when their daily routines break down and they are presented with unfamiliar situations. The reliability of firm performance may thereby affect the measurement of culture strength. While this type of response effect may affect external evaluators as well (see the discussion below), it arguably has the greatest impact on internal informants.

Kotter and Heskett (1992) checked the validity of their measure in several ways. Most importantly, they conducted interviews with managers of a selected sub-sample of firms where they asked respondents a series of questions about the strength of corporate culture. The resulting scores correlated well with the external measures. Ultimately, however, this measure assumes that firms with widely shared and deeply held norms and values will possess these externally observable characteristics, and that firms characterized by dissension will be unlikely to exhibit the same characteristics.

An additional concern, as Burt et al. (1994) note, is that the culture scores generated by Kotter and Heskett's design might reflect a response effect. Respondents may make inferences about a firm's strength of corporate culture based on its performance or size. Firms that are more visible or salient to a respondent may receive higher culture scores. In fact, a regression of culture strength on a firm's average market capitalization between 1979 and 1984 (controlling for industry differences in both variables) yields a positive and significant effect of firm size (t=6.51,

p < 0.01). Market capitalization explains 24 percent of the within-industry variance in culture

strength, suggesting that it is an important factor but that there is substantial independent

variation in the culture scores. I include firm size in the models below.

I measure corporate performance in two ways: by the yearly return on invested capital (ROI) and

the yearly operating cash flow for the six years from 1979 to 1984. The first half of this period is

the same as the period about which respondents were asked to rank the corporate culture of firms.

I extend this period for an additional three years to allow for sufficient variability in firm

performance. Return on invested capital is computed as yearly net income divided by invested

capital (stockholders equity minus current liabilities). ROI is an accounting measure of how

profitably the firm's managers put invested capital to use. This measure is commonly used in

studies of corporate performance (e.g., Smith et al., 1994) and was also used by Kotter and

Heskett (1992). Operating cash flow is operationalized as annual sales less the sum of costs of

goods sold, selling, general and administrative (SG&A) expenses and the annual change in

working capital. Operating cash flow is measured in constant 1984 dollars. I use operating cash

flow as a dependent variable because this is the measure used in the finance literature to examine

the consequences of performance volatility (Minton and Schrand, 1999). These performance

measures are well suited for testing the hypotheses in this paper, which concern the ability of

firms to successfully execute their routines. (Analyses using two additional measures of

performance, return on sales and net income growth, supported the same conclusions.)

Performance data come from the COMPUSTAT database.

I include a number of control variables measuring the firm's size and financial position.

Operating leverage is measured as the ratio of fixed assets to total assets for each year. Financial

leverage is measured using the debt-to-asset ratio. Finally, I control for size in most models by

including the firm's market capitalization. Descriptive statistics and correlations are in Table 1.

I measure industry volatility using estimates from a Capital Asset Pricing Model (Sharpe, 1964).

This model relates the return on an individual security *i* to the return on a value-weighted

portfolio of securities in the entire market (in this case, the NYSE/AMEX and NASDAQ):

$$r_i = \alpha_i + \beta r_m + \varepsilon_i \quad (1)$$

Here, β measures the *systematic risk* of the security, or the extent to which it covaries with the

market. The returns of firms with $\beta < 1$ are less volatile than the returns of the market as a

whole, while firms with $\beta > 1$ are more volatile than the market as a whole. Yearly β parameters

are estimated separately for each firm in the Kotter and Heskett (1992) data using OLS. Daily

returns over the period from 1979 to 1984 come from the CRSP database. The industry volatility

measure used below is the mean of the β's for all of the sampled firms in an industry. Generally,

we would expect industries undergoing fundamental change to be characterized by greater

uncertainty among investors and hence greater than average volatility in stock-market returns.

These scores are presented in Table 2.[6]

Methods

I operationalize the reliability of firm performance as the degree of variation about a predicted

mean performance level. This definition is consistent with previous studies of risk (e.g., Armour

and Teece, 1978; Bowman, 1980). Past studies, however, typically measure variance about the

sample mean. This is an unsatisfactory measure of reliability for a simple reason. If one uses the

simple variance, firms that have improved their performance over time will appear to have

unreliable performance simply because the mean is a poor estimate of the time trend in

performance. (So will firms whose performance has consistently declined.) A measure of

reliability in performance should also allow for changes in performance levels due to changes in

firm characteristics. I therefore first try to account for firm differences in the mean performance

level using firm characteristics. The variability in performance is then defined as the residual

variance about the predicted regression line.

I first use multiplicative heteroscedasticity or variance function models (Davidian and Carroll,

1987; Greene, 1997; Sorenson and Sørensen 2001) to estimate the effects of culture strength on

reliability. These models involve extending the standard linear regression model of the expected

value of the dependent variable to include a model of the variance of the residual (or equivalently

the dependent variable):

$$
\begin{aligned}
y_i &= \mu_i + \sigma_i e_i \\
\mu_i &= E(y_i) = \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k \\
\sigma_i &= Var(y_i) = \exp(\gamma_0 + \gamma_1 z_1 + \ldots + \gamma_m z_m)
\end{aligned}
\tag{2}
$$

where y_i is the dependent variable with mean μ_i and variance σ_i. Thus we have a linear model for

the mean of the dependent variable, and a log-linear model for the variance of the dependent

variable, conditional on a set of covariates predicting the mean and variance. In this model, the γ

parameters capture the effect of covariates on the variance in the dependent variable. Factors that

increase reliability of performance should have $\gamma < 0$. This model is estimated using maximum

likelihood methods (Greene, 1997; Weesie, 1998).

This modeling approach has a methodological shortcoming, since the pooled cross-section/time

series nature of the data raise concerns about autocorrelation within firms, possibly due to

unobserved, time-invariant characteristics of the firms (Greene, 1997). A prominent candidate

for such an unobserved characteristics is the content of the corporate cultures in the sample firms.

If, for example, the corporate culture strength is correlated with a particular (unobserved)

constellation of values and beliefs that encourage reliable performance, we may make faulty

inferences about the effects of culture strength.

Adjusting for autocorrelation in the context of the multiplicative heteroscedasticity model does

not seem straightforward, so I adopt the following approach. For each firm, I estimate a separate

regression of ROI or operating cash flow on the firm's debt-to-asset ratio and operating

leverage.[7] (Since a firm's culture score is constant, its effects cannot be estimated.) These

analyses should help remove the potentially confounding influence of unobserved, firm-specific

characteristics. Using this approach, the reliability of firm performance is measured by the mean

squared error (i.e., average squared residual) from each firm's regression equation. If a firm

experiences alternating periods of high and low performance, the residuals about its regression

line will be greater, on average, than if the firm performs consistently. Firms with more reliable

performance will have smaller mean squared errors. I then pool the mean squared errors across

firms and regress them on each firm's culture score and dummy variables for industry.

Results

Table 3 presents estimates from the multiplicative heteroscedasticity models of corporate

performance. The effects of the covariates in this table are expressed relative to the mean levels

of the covariates in a firm's industry. This is also true for the effects on the log variance; this is

important since it removes industry differences in performance variability.

I concentrate first on the results for mean performance levels, the top panel in Table 3. One

question in these models is whether the performance benefits of a strong culture benefits persist

once the differences in variance have been modeled. This appears to be the case for the ROI

measure. We see in first two columns of the top panel that the measure of corporate culture

strength has a positive and significant effect on ROI, even when controlling for firm size. In the

third column, I include an interaction effect between corporate culture strength and the measure

of market constraint used by Burt et al. (1994). (Since the models include dummies for

industries, the main effect of market constraint is not identified.) Industries with higher market

constraint scores are internally fragmented and face well-organized suppliers and buyers; Burt et

al. (1994) show that these markets are more competitive and have lower profit margins (see also

Burt, 1992). Consistent with what Burt and his co-authors found, the performance benefits of strong cultures increase with industry competitiveness. In none of the models, however, does corporate culture strength appear to significantly affect the firm's operating cash flow.

The evidence in favor of the culture strength-reliability hypothesis is very strong, as seen in the lower panel of Table 3. Firms perceived to have a unique and coherent culture relative to other firms in their industry have less variable performance. This is true for both performance measures. The culture effect is sizable: increasing the strength of corporate culture by one standard deviation, for example, leads to an almost 30 percent reduction in the variance of the return on invested capital (exp(.794*-.437)=0.71). There is furthermore evidence that the reliability benefits of strong cultures are enhanced in more competitive environments, as measured by Burt's market constraint measure; the interaction effect is highly significant in the case of operating cash flow and marginally significant (at the 0.10 level) in the case of ROI.

The alternative analysis strategy also supports the claim that strong cultures lead to more reliable performance. Table 4 contains an analysis of the mean squared error from the firm-specific regressions of ROI and operating cash flow, respectively, on operating leverage and the debt-to-asset ratio. (Since the mean squared error is bounded by zero and highly skewed, the dependent variable in Table 4 is logged.) Higher levels of the mean squared error indicate less reliable performance, so we expect a negative effect of culture strength. In the first three columns both panels of Table 4, we see a pattern similar to the estimates in Table 3. Again, firms perceived to have strong cultures relative to other firms in their markets have more reliable performance, as

evidenced by the statistically significant, negative effect of the culture strength variable. The

support for the reliability hypothesis from these estimates is particularly reassuring, since the

models in Table 4 account for any unobserved firm-specific factors that might influence

variability, including differences in the content of corporate cultures.

I turn now to consider the second and third hypotheses, namely that the association between

culture strength and performance depends on industry volatility. I test these hypotheses by

interacting the culture strength measures with the yearly measures of industry volatility described

in Table 2. Hypothesis 2 implies that the interaction effect between culture strength and industry

volatility should have a negative effect on mean performance. There is no statistical support for

Hypothesis 2 in any of the models estimated in Table 5, although the coefficient estimates are in

the expected direction. There is however substantial support for Hypothesis 3, as evidenced by

the positive and significant effects on the log variance of the interaction between culture strength

and industry volatility. This pattern is found using both estimation strategies: the multiplicative

heteroscedasticity models in Table 5, and the analyses in Table 4 of the error from the firm-

specific regressions (models 4 and 8). These estimates suggest that as industry volatility

increases, the reliability enhancing benefits of strong corporate cultures attenuate. Moreover, this

effect is robust to the inclusion of the interaction effect between culture strength and market

competition.

Figure 1 presents the interaction effect between culture strength and industry volatility

graphically, using the estimates for cash flow volatility from Model 4 in Table 5. Each point on

the solid line in Figure 1 represents the estimated reduction in the log cash flow variance due to a one unit increase in culture strength, at a particular level of industry volatility. The dotted lines are 95 percent confidence intervals about this effect, computed according to the formula in Friedrich (1982). The figure suggests that at most observed levels of industry volatility, the strength of corporate culture has a substantial influence on cash flow volatility. At the same time, this effect diminishes markedly as volatility increases; when the volatility score equals approximately 1.5, the confidence interval includes zero, and culture strength has no reliability benefits. The interaction effect for the variance in ROI shows a similar pattern, although the confidence interval includes zero at a lower level of volatility (at a value of approximately 1.2).

Discussion

The foregoing analyses indicate that the strength of corporate culture affects the variability of firm performance, and that this relationship is contingent on the level of industry volatility. In stable environments, firms perceived to have strong corporate cultures benefit from superior and more reliable performance. In these environments, the consensus surrounding organizational goals and values that characterizes strong culture firms enhances their ability to exploit established competencies. The benefits of a strong culture carry a cost with respect to adaptation in volatile environments, however; the estimates in Tables 4 and 5 show that the reliability benefits of strong cultures attenuate as industry volatility increases.

Hypothesis 2, that the positive effect of culture strength on mean performance should be diminished in volatile environments, was not supported. It is not immediately apparent why this is the case. Substantively, it may be that firms with strong cultures can weather short periods of volatility without suffering a drop in performance. This would be the case, for example, if the internal benefits of a strong culture with respect to improving the efficient execution of firm routines outweigh any difficulties strong culture firms have in adopting to changed external demands. Similarly, the reliability benefits of a strong culture during periods of incremental change – such as the lowered likelihood of under-investment (Minton and Schrand, 1999) – may allow strong culture firms to develop sufficient organizational slack to better withstand periods of environmental change. Methodologically, the lack of support for Hypothesis 2 may reflect shortcomings of the volatility measure. It is difficult to construct a single volatility measure that applies across a wide range of industry contexts, and it seems likely that the volatility measured used here, based on stock market returns, will only imperfectly capture fundamental or discontinuous changes in the environment. If, as just argued, strong culture firms may be in a relatively good position to weather short-term volatility, it may only be when there are truly radical shifts in the underlying technologies and competitive conditions in an industry that we would see the mean performance benefits of a strong culture disappear.

These results are open to alternative interpretations that must be examined more carefully in future research. First, unobserved factors may lead some firms to have high levels of performance with little variability; these firms may in turn be more likely to develop strong corporate cultures. For example, consistently high levels of performance may make it easier for

members of the organization to arrive at a consensus regarding the firm's core values and norms.

By contrast, individuals in firms with haphazard performance may be less likely to reach

agreement about what the firm does and why it is successful. This alternative explanation cannot

be ruled out conclusively using the Kotter and Heskett data, since a proper test of this claim

would require tracking organizations over time in order to collect time-varying information on

culture strength and the variability of performance.

Alternatively, a response effect caused by the instrument used to measure culture strength could

result in a spurious association between culture strength and reliability. If respondents have

difficulty assessing the culture strength of firms in their industry and instead turn to more easily

observable firm attributes, they may rank firms according to their relative size or prominence in

the industry. Similarly, respondents may implicitly equate culture strength with consistent

performance, and therefore assign high culture scores to firms with reliable performance.

Neither of these alternative explanations (unobserved heterogeneity and the response effect) can

satisfactorily explain the contingent nature of the relationship between culture strength and

reliability. Reliable performance should be more noticeable in volatile environments, both to

internal and external observers. If the culture scores simply reflect perceptions of reliable

performance, one would expect the positive correlation between culture and reliability to be

strongest in volatile environments. This is not the case.

This study implicitly assumes that the strength of corporate culture can be represented adequately by a measurement taken at one point in time, a common assumption in studies of the effects of culture strength of performance (Kotter and Heskett, 1992; Gordon and DiTomaso, 1992; Denison, 1990). The validity of this assumption depends on the degree of inertia in cultural systems relative to the rate of change in environmental conditions. Harrison and Carroll's (1991) simulations suggest that cultural systems are relatively robust in the face of turnover and organizational growth and decline. More generally, organizational ecologists argue that organizational structures are relatively inert (Hannan and Freeman, 1984). It may therefore be reasonable to assume that organizational cultures have inertial tendencies (Schein, 1992). Future research, however, should test the validity of this assumption, and explore in greater detail the processes that drive change in the strength of corporate culture. An interesting question in this respect is whether cultural strength changes in response to unreliable performance.

Finally, both the theory and the evidence in this paper focus on the strength of corporate culture in terms of consensus, but do not address the question of cultural content. An important issue for future research is how the bias against exploratory learning in strong cultures is mediated by the content of the corporate culture. The statistical analyses in this paper address central tendencies: while strong culture firms on average exhibit less reliable performance in volatile environments, some strong culture firms handle the volatility better than others. Future research should address why this is the case. The answer may lie in other organizational characteristics of the firms in question – for example, differences in organizational structures, the delegation of authority and incentive systems – in addition to the content of firm cultures.

In terms of cultural content, a shortcoming of the Kotter and Heskett data is that it may under-represent firms with strong cultures of exploration, for two reasons. First, the measurement of culture strength relies on outsider's perceptions of a firm having a recognizable way of doing things. If strong cultures of exploration lead to frequent changes in organizational routines, it seems unlikely that they will be identified with a particular way of doing things. Second, the composition of the sample may create a survivor bias against strong cultures of exploration. Most organizational environments are characterized by relatively long periods of incremental change, interspersed with periods of volatility. The returns to exploitation dominate the returns to exploration during incremental environmental change. Apart from the difficulties inherent in designing and maintaining a culture of exploration, firms with strong cultures of exploration should find themselves at a disadvantage during periods of relative stability relative to firms with strong cultures of exploitation that are well-matched to environmental conditions. Research designed to examine the mediating effect of cultural content must be sensitive to this issue.

Conclusion

Firms with strong cultures incur a trade-off with respect to their adaptive ability in the face of environmental change. Strong corporate cultures facilitate reliable performance in relatively stable environments, but as volatility increases these benefits are dramatically attenuated. This pattern is consistent with the fundamental tradeoff between exploration and exploitation noted by March (1991) and suggests that strong culture firms excel at exploiting established competencies,

but have difficulty exploring and discovering new competencies that better suit changing

environmental conditions.

While the trade-off between exploration and exploitation has been acknowledged for some time,

there has been little empirical research linking this trade-off to organizational characteristics.

Organizations make implicit and explicit choices about the allocation of resources to each type of

learning. Some of the more explicit choices are encoded in formal structures. For example, the

interdependencies created by vertical integration demand a commitment to a particular

technology, and hence a shift of resources toward exploitation. This affects adaptability in

rapidly changing environments (Sorenson, 2001). In franchising organizations, the balance

between exploration and exploitation depends on the mix of company-owned and franchised

units (Sorenson and Sørensen, 2001). In hotel chains, Ingram and Baum (1997) found that the

effects of operating experience depend on the structure of the chain and the nature of the

operating experiences of chain members. The evidence in this paper suggests that a firm's

informal structure, in the form of the strength of its corporate culture, also affects the balance

between exploration and exploitation.

This research also helps us better understand the costs and benefits of strong corporate cultures.

Corporate cultures consist of ideas about the firm's unique capabilities, frameworks for

interpreting the state of the environment and routinized means of responding to environmental

changes (Weick, 1985; Schein, 1992; Levitt and March, 1988). Strong culture firms have a high

level of commitment to the established way of understanding the world, while weak culture firms

exhibit heterogeneity in participants' beliefs about the relationship between the organization and its environment. As long as the organization's perceptions of its environment are reasonably accurate, firms benefit from strong corporate cultures, both by achieving higher performance levels, and by doing so more reliably. Strong culture organizations do not bear the costs of disagreement surrounding organizational goals and the means to achieve them. When environments are volatile, however, exploration skills become more valuable. Success in volatile environments requires being able to learn from new and changing situations. In volatile environments, the assumptions forming the basis of the corporate culture become inaccurate at a faster rate. When the environment shifts, strong-culture organizations have no fall-back position and the lack of internal diversity in perspectives makes it more difficult for the firm to adapt.

One possible response to these findings would be to conclude that the optimal strategy for firms would be to develop strong cultures that explicitly encourage exploratory learning and innovation (Gordon and DiTomaso, 1992). Such a conclusion is unwarranted, however. The value of a strong culture of exploration still depends on the existence of environmental conditions that reward exploration. If the environment changes to reward efficiency and exploitation of organizational routines, firms that are strongly committed to exploration should have greater difficulty adapting than firms with weak cultures of exploration, because such an environment demands relative stability in organizational routines and the ability make incremental improvements in efficiency. The difficulty encountered by the firm with a strong culture of exploration is in this case not an inability to discover new routines, but a greater difficulty in discovering a set of values and norms that are appropriate to the new environment.

Finally, the fact that there are trade-offs associated with strong corporate cultures should not overshadow one of the central results of this paper, namely that strong cultures in general lead to reductions in performance variability. As noted at the outset, firms benefit from reduced variability in performance. For example, the fact that strong culture firms have less volatile cash flows suggest that they are less likely to under-invest (Minton and Schrand, 1999). Strong cultures therefore create competitive advantage not only by increasing motivation and facilitating coordination and control, but also by leaving the strong culture firm in a stronger position to respond to investment opportunities that might solidify their competitive advantage. While the results in this paper suggest that strong culture firms encounter difficulties during periods of fundamental change, the advantages that accrue to them during periods of incremental change may make them better able to weather periods of upheaval.

Endnotes

1. A substantial body of research is devoted to understanding and interpreting organizations as cultural systems. Research in this tradition often adopts an anthropological or ethnomethodological approach to studying cultural forms and the meanings attached to them (e.g., Louis, 1985; Trice and Beyer, 1993; Alvesson, 1993). Studies in this tradition typically do not address the relationship between organizational culture and performance. Some, such as Alvesson (1993: 43), are deeply skeptical of any attempts to establish such links since it requires making what they see as inherently problematic distinctions between "culture" and "non-culture."

2. An alternative definition of culture strength involves examining the content of an organization's shared values and norms using a variety of methods (e.g., Gordon and DiTomaso, 1992; Chatman, 1991) and considering a culture strong if its constituent norms and beliefs (such as adaptability, participation, or innovation), enhance firm performance (e.g., Ouchi, 1981; Deal and Kennedy, 1982; Denison, 1990). Researchers can then link organizational variation in such values and norms to differences in firm outcomes. For example, Gordon and DiTomaso (1992) found that the value placed on adaptability was positively associated with performance among US insurance companies. To avoid tautology in this definition of culture strength, however, researchers must be willing to specify *ex ante* the norms and beliefs that enhance performance; this may be difficult to do convincingly.

More importantly, it should be noted that the arguments I present here concerning the

relationship between culture strength and reliability do not apply in any obvious way to this alternative definition of culture strength.

3. Economic definitions of corporate culture generally emphasize the role of corporate culture in reducing coordination costs within firms, and are generally consistent with the approach adopted here (see Hermalin, 2001 for a discussion). Kreps (1990), for example, suggests that culture substitutes for specifying all contingencies in advance by establishing general principles that should be applied. As in O'Reilly and Chatman's definition, the effectiveness of a corporate culture – and hence its strength – depends on the degree of consensus surrounding the content of these general principles.

4. An important and interesting theoretical issue is whether a strong culture can be built around exploration. I return to this issue in the discussion section

5. Kotter and Heskett (1992) began with 21 markets defined according to their own criteria. In general, these markets are analogous to the market categories used in Fortune magazine. Missing data problems led Burt et al. (1994) to reduce the number of industries to 19 by a) eliminating the life insurance industry and b) combining savings and loans and commercial banking. In the current analyses, missing data on the banking industry resulted in the further exclusion of that industry from the analyses.

6. I have also conducted analyses using a different measure of industry volatility, namely the

coefficient of variation in firm sales growth for each industry. The results of those analyses

parallel those below in the case of the ROI measure, but not in the case of the cash flow measure.

This may be because the cash flow measure is a direct function of sales.

7. The firm-specific models have to be parsimonious, since there are at most six observations per

firm. I experimented with alternative specifications. The same results were found when

regressing the performance measures on operating leverage and a time trend, and when

regressing the performance measures on the debt-to-asset ratio and a time trend. When regressed

on all three independent variables (operating leverage, debt-to-asset ratio and year), the results

were the same for the ROI measure but not for operating cash flow, where the effect of culture

strength was insignificant.

References

Alvesson, M.
1993   Cultural perspectives on organizations. New York: Cambridge University Press.

Armour, H. O., and D. J. Teece
1978   "Organization structure and economic performance: A test of the multidivisional hypothesis." Bell Journal of Economics 9: 106-122.

Bodie, Z., A. Kane and A. J. Marcus
1996   Investments (3rd Edition). Boston: Irwin McGraw-Hill.

Bowman, E. H.
1980   "A risk/return paradox for strategic management." Sloan Management Review 21: 17-31.

Bromiley, P.
1991   "Testing a causal model of corporate risk taking and performance." Academy of Management Journal 34: 37-59.

Burt, R.S.
1992   Structural Holes: The Social Structure of Competition. Cambridge, MA: Harvard University Press.

Burt, R. S., S. M. Gabbay, G. Holt, and P. Moran
1994   "Contingent organization as a network theory: The culture performance contingency function." Acta Sociologica 37: 345-370.

Carroll, P.
1993   Big Blues: The Unmaking of IBM. New York: Crown Publishers.

Chatman, J.
1991   "Matching people and organizations: Selection and socialization in public accounting firms." Administrative Science Quarterly 36: 459-484.

Cremer, J.
1993   "Corporate culture and shared knowledge." Industrial and Corporate Change 2: 351-386.

Cyert, R. M., and J. G. March
1963   A Behavioral Theory of the Firm. Englewood Cliffs, NJ: Prentice-Hall.

Davidian, M., and R. J. Carroll
1987   "Variance function estimation." Journal of the American Statistical Association 82: 1079-1091.

Deal, T. E., and A. A. Kennedy
1982   Corporate Cultures. Reading, MA: Addison-Wesley.

Denison, D. R.
1984   "Bringing corporate culture to the bottom line." Organizational Dynamics 13: 5-22.

1990   Corporate Culture and Organizational Effectiveness. New York: John Wiley & Sons.

Friedrich, R. J.
1982   "In defense of multiplicative terms in multiple regression equations." American Journal
        of Political Science 26: 797-833.

Froot, K. A., D. S. Scharfstein and J. C. Stein
1993   "Risk management: Coordinating corporate investment and financing policies." Journal
        of Finance 48: 1629-1658.

Gordon, G. G., and N. DiTomaso
1992   "Predicting corporate performance from organizational culture." Journal of Management
        Studies 29: 783-799.

Greene, W. H.
1997   Econometric Analysis (3rd Edition). Upper Saddle River, NJ: Prentice Hall.

Hannan, M. T., and J. Freeman
1984   "Structural inertia and organizational change." American Journal of Sociology 49: 149-
        164.

Harrison, J. R., and G. R. Carroll.
1991. "Keeping the faith: A model of cultural transmission in formal organizations."
        Administrative Science Quarterly 36: 552-582.

Henderson, R. M., and K. B. Clark
1990   "Architectural innovation: The reconfiguration of existing product technology and the
        failure of established firms." Administrative Science Quarterly 35: 9-31.

Hermalin, B. E.
2001   "Economics and corporate culture." In S. Cartwright, C.L. Cooper, and P.C. Earley (eds.),
        Handbook of Organizational Culture and Climate: 217-261. New York: John Wiley &
        Sons.

Ingram, P., and J. A. C. Baum
1997   "Chain affiliation and the failure of Manhattan hotels." Administrative Science Quarterly
        42: 68-102.

Kotter, J. P., and J. L. Heskett
1992   Corporate Culture and Performance. New York: The Free Press.

Kreps, D. M.
1990   "Corporate culture and economic theory." In J.E. Alt and K.A. Shepsle (eds.), Perspectives on Positive Political Economy: 90-143. Cambridge, England: Cambridge University Press.

Lant, T. K., and S. J. Mezias
1992. "An organizational learning model of convergence and reorientation." Organization Science 3: 47-71.

Lessard, D.
1990   "Global competition and corporate finance in the 990s." Journal of Applied Corporate Finance 3: 59-72.

Levinthal, D. A.
1991a "Random walks and organizational mortality." Administrative Science Quarterly 36: 397-420.

1991b "Organizational adaptation and environmental selection – interrelated processes of change." Organization Science 2: 140-145.

Levitt, B., and J. G. March
1988   "Organizational learning." Annual Review of Sociology 14: 319-340.

Louis, M. R.
1985   "An investigator's guide to workplace culture." In P. J. Frost, L.F. Moore, M.R. Louis, C.C. Lundberg and J. Martin (eds), Organizational Cultures: 73-93. Beverly Hills, CA: Sage.

March, J. G.
1991   "Exploration and exploitation in organizational learning." Organization Science: 71-87.

Martin, J.
1992   Cultures in Organizations: Three Perspectives. New York: Oxford University Press.

Martin, J., and C. Siehl
1983   "Organizational culture and counterculture: An uneasy symbiosis." Organizational Dynamics 12: 52-64.

Minton, B. A., and C. Schrand

1999   "The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing." Journal of Financial Economics 54: 423-460.

Ouchi, W.
1981   Theory Z. Reading, MA: Addison-Wesley.

O'Reilly, C. A.
1989   "Corporations, culture and commitment: Motivation and social control in organizations." California Management Review 31: 9-25.

O'Reilly, C. A. and J. A. Chatman
1996   "Culture as social control: corporations, culture and commitment." Research in Organizational Behavior 18: 157-200.

Peters, T., and R.H. Waterman
1982   In Search of Excellence. New York: Harper and Row.

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

Rousseau, D. M.
1990   "Assessing organizational culture: The case for multiple methods." In B. Schneider (ed.), Organizational Climate and Culture: 153-192. San Francisco: Jossey-Bass.

Schein, E. H.
1991   "The role of the founder in the creation of organizational culture." In P. J. Frost, L.F. Moore, M.R. Louis, C.C. Lundberg and J. Martin (eds), Organizational Cultures: 14-25. Beverly Hills, CA: Sage.

1992   Organizational Culture and Leadership (2nd edition). San Francisco: Jossey-Bass.

Sharpe, W.
1964   "Capital asset prices: A theory of market equilibrium." Journal of Finance 19: 425-442

Siehl, C., and J. Martin
1990   "Organizational culture: A key to financial performance?" In B. Schneider (ed.), Organizational Climate and Culture: 241-281. San Francisco: Jossey-Bass.

Smith, K. G., K. A. Smith, J. D. Olian, H. P. Sims Jr., D. P. O'Bannon and J. Scully
1994.   "Top management team demography and process: The role of social integration and communication." Administrative Science Quarterly 39: 412-438.

Sorenson, O.

2001   "Interdependence and adaptability: Organizational learning and the long-term effect of integration." Unpublished manuscript.

Sorenson, O., and J. B. Sørensen
2001   "Finding the right mix: Franchising, organizational learning, and chain performance." Strategic Management Journal 22: 713-724.

Stinchcombe, A. L.
1965.   "Social structure and organizations." In J.G. March (ed.), Handbook of Organizations: 142-193. Chicago: Rand McNally.

Thompson, J.D.
1967   Organizations in Action. New York: McGraw-Hill.

Trice, H. M., and J. M. Beyer
1993   The Cultures of Work Organizations. Englewood Cliffs: Prentice Hall.

Tushman, M. L., and P. Anderson
1986   "Technological discontinuities and organizational environments." Administrative Science Quarterly 31: 439-465.

Tushman, M. L., and C. A. O'Reilly III.
1997   Winning through Innovation. Boston: Harvard Business School Press.

Weesie, J.
1998   "Regression analysis with multiplicative heteroscedasticity." Stata Technical Bulletin 42: 28-32.

Weick, K. E.
1985   "The significance of corporate culture." Pp. 381-389 in Peter J. Frost et al. (eds), Organizational Cultures. Beverly Hills, CA: Sage.

Table 1: Descriptive Statistics

Variable	Mean	SD	1	2	3	4	5	6
1. ROI	0.09	0.08	1.00					
2. Operating Cash Flow	1342.27	2895.10	0.02	1.00				
3. Debt/Asset Ratio	0.41	0.18	-0.59*	0.03	1.00			
4. Operating Leverage	0.42	0.17	-0.26*	0.34*	0.19*	1.00		
5. Culture Strength	3.29	0.79	0.30*	0.29*	-0.40*	0.06	1.00	
6. Log Market Capitalization	7.22	1.42	0.25*	0.58*	-0.42*	0.21*	0.38*	1.00
7. Log Market Constraint	-1.49	0.72	-0.26*	-0.21*	0.33*	-0.11*	-0.14*	-0.43*

Note: Culture strength ranges from 1 to 5, with higher scores indicating a stronger corporate culture.
* $p < 0.05$

Table 2: Industry Volatility Measures

Industry	β Mean	σ	N firms
Aerospace	1.201	0.127	10
Airlines	1.266	0.196	10
Apparel	0.694	0.120	8
Automotive	1.096	0.304	9
Beverages	0.823	0.099	8
Chemicals	1.050	0.080	9
Computers & Office Equipment	1.317	0.181	10
Packaged Food	0.741	0.053	11
Forest Products/Paper	0.971	0.095	10
Personal Care	0.844	0.095	8
Petroleum Refining & Marketing	1.208	0.191	10
Pharmaceuticals	0.951	0.142	9
Printing & Publishing	0.810	0.229	9
Retail -- Food & Drug	0.617	0.170	8
Retail -- Non-Food & Drug	1.013	0.244	10
Rubber	0.789	0.108	7
Telecommunications	0.620	0.224	6
Textiles	0.743	0.105	8

Table 3: Multiplicative Heteroscedasticity Models of Firm Performance Measures, 1979-1984

	ROI			Operating Cash Flow		
	(1)	(2)	(3)	(4)	(5)	(6)
Mean:						
Debt-to-Asset Ratio	-0.170†	-0.170†	-0.164†	-3.301	20.200	45.732
	(0.012)	(0.012)	(0.012)	(31.645)	(31.496)	(28.424)
Operating Leverage	-0.082†	-0.080†	-0.072†	301.249†	-42.230	-59.631
	(0.014)	(0.014)	(0.014)	(70.056)	(46.591)	(37.732)
Corporate Culture Strength	0.006†	0.006†	0.017†	14.575	-0.563	19.495
	(0.002)	(0.002)	(0.010)	(10.559)	(5.887)	(16.057)
Log Market Capitalization		-1.E-04	–2.E-04		14.009	15.188†
		(0.001)	(0.001)		(6.902)	(5.883)
Culture Strength * Log Market Constraint			0.006†			5.014
			(0.002)			(11.072)
Log variance:						
Corporate Culture Strength	-0.418†	-0.437†	-0.683†	0.940†	-0.277†	-1.790†
	(0.079)	(0.086)	(0.167)	(0.096)	(0.116)	(0.198)
Log Market Capitalization		0.073	0.086		1.454†	1.485†
		(0.062)	(0.062)		(0.085)	(0.086)
Culture Strength * Log Market Constraint			-0.182			-0.927†
			(0.111)			(0.110)
χ^2 (df)	1038	1019	1031	3339	3589	3646
	(38)	(40)	(42)	(39)	(41)	(43)
Firm-year spells	806	800	800	703	703	703

Note: Models include industry dummies in the prediction equations for both the mean and log variance; thus all covariates are relative to the market averages. The model for operating cash flow includes a control for the operating cash flow level in 1978.

† $p < 0.01$ (two-sided)
* $p < 0.05$ (two-sided)

Table 4: OLS Regression of Firm Specific Mean Square Error on Culture Strength

A) ROI

	(1)	(2)	(3)	(4)
Culture Strength	-0.265†	-0.275*	-0.472*	-1.399†
	(0.096)	(0.113)	(0.213)	(0.458)
Mean Market Cap (log)		0.053	0.049	0.015
		(0.088)	(0.088)	(0.088)
Culture Strength * Log Market Constraint			-0.144	-0.187
			(0.132)	0.131
Culture Strength * Industry Volatility				0.906*
				(0.398)
R^2	0.06	0.05	0.06	0.11
N	135	134	134	134

B) Operating Cash Flow

	(5)	(6)	(7)	(8)
Culture Strength	0.245	-0.242*	-0.738†	-1.596†
	(0.131)	(0.112)	(0.219)	(0.455)
Mean Market Cap (log)		0.830†	0.817†	0.794†
		(0.092)	(0.090)	(0.089)
Culture Strength * Log Market Constraint			-0.340*	-0.340†
			(0.131)	(0.129)
Culture Strength * Industry Volatility				0.911*
				(0.425)
R^2	0.03	0.46	0.49	0.51
N	123	123	123	123

The dependent variable has been logged. Models include industry dummies, thus all covariates are relative to the market averages.

† $p < 0.01$ (two-sided)
* $p < 0.05$ (two-sided)

Table 5: Contingent Effects of Culture Strength on Firm Performance, 1979-1984

	ROI		Operating Cash Flow	
	(1)	(2)	(3)	(4)
Mean:				
Debt-to-Asset Ratio	-0.169†	-0.166†	71.801†	83.023†
	(0.012)	(0.012)	(32.515)	(28.749)
Operating Leverage	-0.080†	-0.073†	-81.142	-73.242*
	(0.014)	(0.014)	(41.260)	(34.926)
Corporate Culture Strength	0.003	0.021*	51.027	66.070†
	(0.006)	(0.009)	(29.767)	(29.162)
Log Market Capitalization	-0.001	-4.E-04	20.539†	18.458†
	(0.001)	(0.001)	(6.495)	(5.509)
Industry Volatility	-0.008	-0.009	36.939	31.107
	(0.010)	(0.010)	(28.124)	(25.016)
Culture Strength * Industry Volatility	-0.003	-0.004	-54.975	-49.109
	(0.006)	(0.007)	(35.478)	(33.846)
Culture Strength * Log Market Constraint		0.006†		8.530
		(0.002)		(9.606)
Log variance:				
Corporate Culture Strength	-1.816†	-1.994†	-2.382†	-3.225†
	(0.310)	(0.344)	(0.364)	(0.316)
Log Market Capitalization	-0.005	0.021	1.538†	1.532†
	(0.066)	(0.066)	(0.090)	(0.090)
Industry Volatility	0.419	0.414	-0.841	-1.134*
	(0.411)	(0.409)	(0.464)	(0.465)
Culture Strength * Industry Volatility	1.428†	1.361†	1.951†	1.572†
	(0.307)	(0.307)	(0.342)	(0.308)
Culture Strength * Log Market Constraint		-0.180		-0.846†
		(0.112)		(0.105)
χ^2 (df)	1042 (44)	1052(46)	3620 (45)	3677 (47)
Firm-year spells	800	800	703	703

Note: Models include industry dummies in the prediction equations for both the mean and log variance; thus all covariates are relative to the market averages. The model for operating cash flow includes a control for the operating cash flow level in 1978.

† $p < 0.01$ (two-sided) * $p < 0.05$
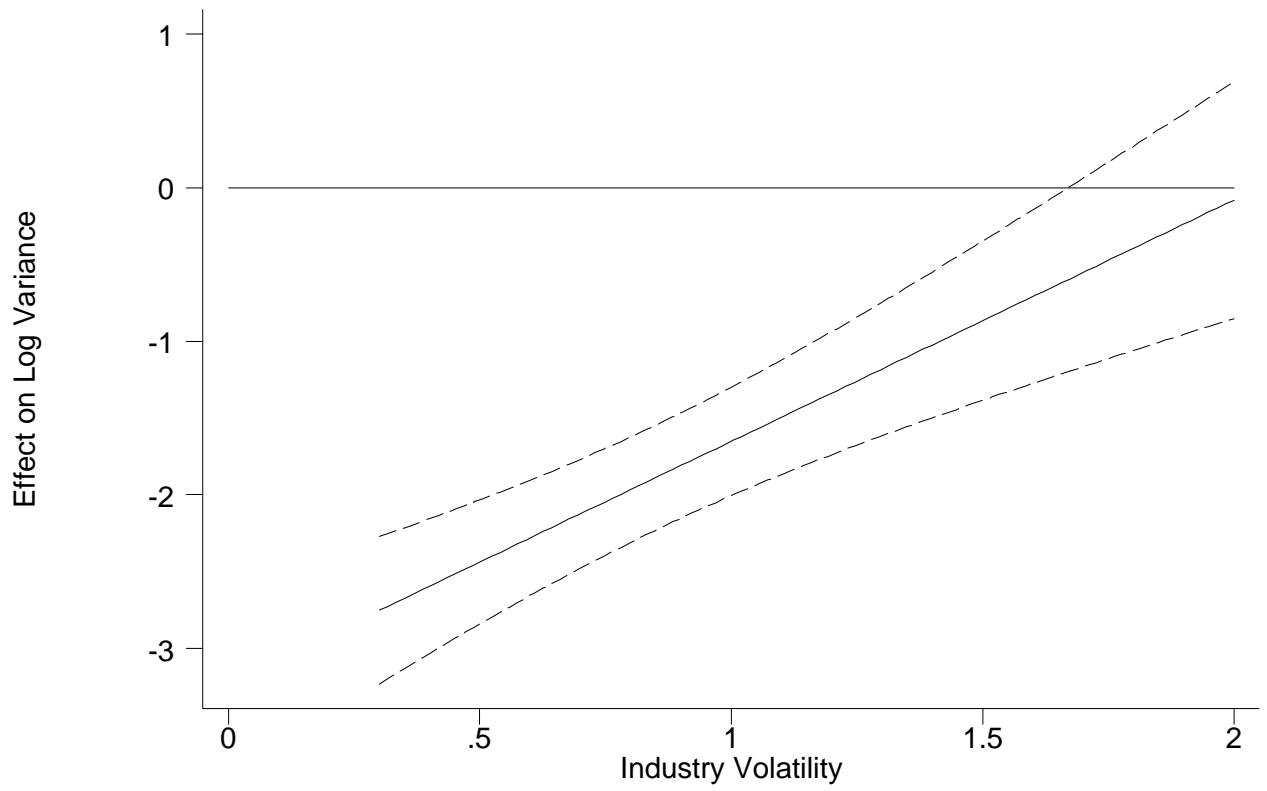
Figure 1 Conditional effect of culture strength on cash flow variance