Nonlinearity in the organizational environment-performance relationship:
an empirical exploration

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The external circumstances that organizations confront are an important influence upon their prospects of success. The resources available within the environment, the multiplicity of stakeholder demands to be addressed and the rates of change in these, each have serious implications for organizational functioning. Although numerous empirical studies furnish evidence on the impact of organizational environments on performance, few consider the presence of complicated nonlinear patterns in this relationship. In this paper, we examine the potentially nonlinear effects of different dimensions of the organizational environment on the performance of over 500 organizations using both objective and subjective measures of the environment. The results suggest that the pattern of the environment-performance relationship varies across environmental dimensions and according to whether the environmental measure is objective or subjective. The theoretical and practical implications of the findings are discussed.
Introduction

The relationship between organizational environments and performance is a key topic in organizational studies (e.g. Aldrich 1979; Boyd and Gove 2006; Dess and Beard 1984). In particular, contingency theory suggests that the external circumstances that organizations confront are likely to have important effects on organizational outcomes (see Donaldson 2001; Miles and Snow 1978; Perrow 1970). Theories of the organizational environment advanced by scholars adopting a contingency perspective suggest that the relative munificence, complexity and dynamism of the circumstances faced by organizations are likely to influence their behaviour and outcomes (Dess and Beard, 1984). Environmental munificence (or exogenous resource capacity), is thought to be associated with better organizational performance, while complexity (client homogeneity-heterogeneity and concentration-dispersion) and dynamism (environmental instability and turbulence) are assumed to increase the degree of task difficulty and so lead to worse performance. These relationships are arguably likely to hold for both “objective” archival measures of the environment drawn from secondary administrative sources and “subjective” perceptual measures of the environment drawn from surveys of practising managers.

Despite a growing evidence base supporting linear patterns in the environment-performance relationship in both the public (e.g. Andrews, 2009; Meier and Bohle, 2003) and private sectors (e.g. Keats and Hitt, 1988; Sheppard, 1995), it remains conceivable that the effects of different dimensions of the environment are not straightforwardly positive or negative. The benefits of environmental munificence may turn negative as organizations become complacent or overconfident in their capacity to keep on doing what they did well in the past. Likewise, at low-medium levels, complexity and dynamism may actually sharpen managerial awareness of the challenges to be confronted, at least until the environment becomes too complicated or unpredictable to manage effectively. However, to date, there has
been little systematic research examining nonlinearity in the organizational environment-performance relationship using either objective or subjective measures of the environment. Does the impact of external environmental circumstances on organizational performance follow a nonlinear pattern? Do managerial perceptions of organizational environments affect the achievements of organizations in different ways depending on the strength of those perceptions? To answer these questions, this paper explores nonlinearities in the relationship between “objective” recorded and “subjective” perceived environments on the performance of a set of over 500 public organizations.

In the first part of the paper, Dess and Beard’s (1984) model of the organizational environment is formalized and arguments on non-linearity in the environment-performance relationship developed. Measures of performance, along with archival and perceptual measures of environmental munificence, complexity, and dynamism are then identified and described. The results of statistical models of the environmental determinants of performance in over 500 Texas school districts are presented, before the findings are discussed and conclusions drawn for theories of organizational performance.

**Organizational environments and performance**

Attempts to conceptualize and evaluate the relationship between organizational environments and performance have a venerable history within organization theory. In the early work of contingency theorists, for example, it was claimed that managers made strategic choices based on the assessment of the environmental conditions faced by their organization, which in turn, had major implications for organizational outcomes (Chandler 1962; Child 1973). This argument was later refined by scholars, such as Miles and Snow (1978), to suggest that organizational performance was dependent on the adoption of a consistent strategy for aligning an organization with its environment. In its most extreme form, the contingency
perspective implies that organizations failing to achieve environmental alignment will cease to exist (see Hannan and Freeman 1977). As these arguments about the environment-performance relationship have evolved, so too have debates about the best way to conceptualize and measure organizational environments. Amongst the many frameworks for classifying organizational environments that have been advanced by organizational theorists (e.g. the “Five Forces” model, Porter 1980; Political Economic Social Technological Environmental and Legal analysis, Johnson and Scholes, 2002), a strong consensus has emerged around the validity and applicability of Dess and Beard’s (1984) framework for analysing organizational environments (see Boyd and Gove, 2006; Harris 2004).

Dess and Beard (1984) identify three key dimensions of the organizational environment: munificence, complexity and dynamism. Each of these dimensions is arguably a powerful influence upon managerial decision-making and thus in turn organizational performance. Moreover, it is possible to derive strong arguments on the potentially curvilinear impact of these three environmental dimensions. Environmental munificence is constituted by “the scarcity or abundance of critical resources” made available within an organization’s operating context (Castrogiovanni 1991, 452). A high degree of munificence is therefore typically thought to buffer organizations from environmental pressures because it generates financial and organizational slack that can if used effectively facilitate both organizational stability and growth (Cyert and March 1963; Dess and Beard 1984).

Although the accrual of a greater fund of residual resources might be thought unproblematic, it is nevertheless conceivable that organizations can have “too much of a good thing”. Organizational slack may be bad for performance, on the one hand, because it leads managers to become complacent about the need to monitor performance improvement effectively, or, on the other, because it leads them to become overconfident in their ability to deliver more and better services. Empirical evidence on the relationship between objective
measures of organizational slack and innovation in the private sector suggest that there is an
inverted u-shaped relationship between slack and innovation. It is highly plausible that this
relationship will hold too for the connection between slack and performance; and for this to
be observed for subjective as well as objective measures of exogenous resource capacity.
Managers’ perceptions of environmental munificence are likely to reflect the extent to which
they feel they feel buffered from the vicissitudes of the external context by organizational
slack (Bourgeois 1981). In such circumstances, managers may be especially prone to feeling
confident in the ability of their organization to cope with exogenous pressures. Thus a strong
perception of munificence may lead inexorably towards the potential pitfalls of strategic
inertia (Kelly and Amburgey 1991). Alternatively, if managers perceive the environment to be
highly munificent they may adopt multiple new and innovative ways of working, which in
turn can lead to problems of product proliferation and “overreach” (Barnet and Freeman,
2001). In both cases, the expectation is the same:

**Hypothesis 1:** Environmental munificence will exhibit an inverted u-shaped
relationship with performance

Environmental complexity comprises the heterogeneity and the dispersion of an
organization’s domain. In a heterogeneous environment, an organization is grappling with a
wide range of markets and services (Dess and Beard 1984). To do this effectively, managers
require more and better information-processing skills and systems, leading to higher levels of
strain on the existing resource capacity of an organization (Dutton, Fahey and Narayanan
1983). Environmental dispersion is present where organizations provide services across a
broad geographical domain (Dess and Beard 1984). This increases the need for strategic
management and effective partnership arrangements with suppliers, customers and other
stakeholders, thereby generating additional costs (Aldrich 1979), which might be reduced where services are concentrated in a narrow domain, through multi-output production or site-sharing (Starbuck 1976).

Although the very notion of environmental complexity implies a degree of task difficulty that is likely to create coordination problems for an organization, it is possible that there are benefits associated with low-to-moderate levels of heterogeneity and dispersion. For instance, a diverse and dispersed client base may prompt organizations to more effectively tailor the services that they provide to clients’ requirements. However, it is likely that beyond a certain point these pressures towards enhancing the customer focus of an organization will prove overwhelming, as the resources required to maintain client responsiveness outstrip any potential benefits garnered from specialisation. This curvilinear pattern may be especially likely to apply to the subjective environment. Managerial perceptions of the heterogeneity of the needs, demands and dispersion of clients may be much more nuanced than the relative levels of complexity revealed by archival measures. For example, managers’ views on the circumstances they face often reflect a deep understanding of service users’ widely differing needs, the competing values held by external stakeholders (Quinn & Rohrbaugh, 1981), and the problems associated with the “goal ambiguity” that both of these cause (Chun & Rainey, 2005). “Realistic” assessments of moderate levels of complexity may therefore be particularly likely to result in service improvement, but again may be unlikely to enable organizations to overcome the pressures that are associated with extremely high levels of heterogeneity and dispersion, making it likely that:

*Hypothesis 2:* Environmental complexity will exhibit an inverted u-shaped relationship with performance
Environmental dynamism comprises the rate of change in external circumstances (instability), and the unpredictability (or turbulence) of that change (Emery and Trist 1965). Organizations typically seek to cope with turbulence and instability in the environment through the introduction of strategic management and vertical integration (Dess and Beard 1984). Organizational decision-makers require a certain degree of environmental stability to direct and plan the use of resources effectively, which, in turn, necessitates the accumulation of knowledge in order to manipulate the environment (Dutton, Fahey and Narayanan 1983). Large or unexpected shifts in the circumstances that they face may lead managers to be increasingly cautious about developing new services, and to become progressively less willing or able to adapt to environmental change, potentially leading to “threat-rigidity” (Staw 1981). Pressure to deliver customer-led services in what are perceived to be unstable or unpredictable social and economic circumstances can lead to reactive decision-making or an absence of strategic behaviour altogether (Inkpen and Choudhury 1995). This, in turn, is highly likely to result in worse performance.

Turnover in the environmental circumstances that managers confront is likely to heighten uncertainty about the services that should be provided to clients. As the rate of environmental change rises, the need to accumulate new knowledge about clients’ expectations places ever greater burdens on service providers, requiring, in particular, the devotion of additional resources to environmental scanning (Boyd and Fulk 1996). Although a dynamic environment implies an increased performance management burden, it is possible that the need to exhibit a heightened sensitivity to the external constraints surrounding an organization may ineluctably lead towards strategic behaviour that will enhance performance. Like environmental complexity, this curvilinear relationship may be particularly evident within the subjective environment. Low levels of perceived dynamism may simply reflect an underestimation of organizational contingencies, which results in a mismatch between
strategy, structure and environment. By contrast, perceptions of moderate to high levels of
dynamism may be associated with increased innovation and thereby lead to better
organizational outcomes (see Daft, Sormunen, & Parks, 1988; Ozsomer, Calantone, & Di
Benedetto, 1997; Russell & Russell, 1992) – at least until environmental instability and
unpredictability become so great as to preclude any kind of effective managerial response.
The final hypothesis is, therefore,

_Hypothesis 3:_ Environmental dynamism will exhibit an inverted u-shaped relationship
with performance

**Methodology**

To explore our hypotheses, we look at independent local governments in one state in the
United States, Texas. Specifically, our dataset includes information on over 500 school
districts in Texas from 2008-9.¹ School districts in Texas have their own governing body (a
locally elected school board), taxing powers, and a relatively flat organizational structure with
a clear hierarchy. This dataset includes performance and demographic data obtained from the
Texas Education Agency (TEA), which collects and compiles this information for every
school district in Texas every year. It also incorporates superintendent survey responses about
various organizational challenges. We use a panel data set that includes 2 years of data on
each school district. To control for problems with serial correlation, we include a dummy
variable for the first year of the analysis.

**Dependent variables**

¹ We would like to thank Kenneth J. Meier and Laurence O’Toole, Jr. for the use of their data.
Public sector performance is complex and multidimensional. Public organizations are typically required to meet multiple and potentially conflicting organizational goals (Rainey 1993). Moreover, their achievements are judged by a diverse array of constituencies, such as taxpayers, staff and politicians. The criteria, weighting, and interpretation of performance indicators are thus all subject to ongoing debate and contestation amongst key stakeholders (Boyne, 2003). There are many ways to evaluate school district performance. In Texas, the most important and salient performance measure is student performance on the state standardized test, the Texas Assessment of Academic Skills (TAAS). The federal ‘No Child Left Behind’ policy is based on the Texas experience with this test. It is a basic skills test designed to measure student success and teacher effectiveness. All students in grades 3-8 and 10 must take the test. Students in tenth grade must pass the test in order to graduate from high school. These test scores are used by the Texas Education Agency (TEA) to rank districts and are widely reported in the news media; the state standardized test is the most visible indicator of school performance and the quality of schools. This performance measure is the percentage of students in a district who pass all (reading, writing, and math) sections of the test.

School district performance can also be measured through other important indicators of effectiveness. In addition to drawing on the TAAS, we analyse nonlinearity in the environment-performance relationship by investigating school attendance and graduation rates. Academic success is not possible unless students are in school. In other words, before students can be taught basic skills, they must be in the classroom. Thus, student attendance is a very simple and yet important measure of school district performance. We calculate this as the district’s average daily student attendance rate. A further performance measure is completion of the school curriculum. In order to graduate students must fulfil the necessary requirements: passing the state standardized test and passing the necessary courses. Thus, we gauge the percentage of students in each year who successfully graduate from high school.
Independent variables

Debates on the influence of organizational environments on performance center on two contrasting approaches to its measurement. The first approach focuses on “objective” quantifiable measures based on “scientifically rigorous measurement procedures” (Dess and Beard 1984, 53). For example, private sector studies of environmental determinants of performance are often based on “archival” indices of aggregated economic data (e.g. Keats and Hitt 1988). The second approach concentrates on “subjective” measures that gauge how key organizational stakeholders perceive certain features of their organizational environments. For instance, there is a large literature on the impact of perceived environmental uncertainty on firm performance (e.g. Daft, Sormunen and Parks 1988; Russell and Russell 1992). “Objective” or “archival” measures arguably provide especially useful data for investigating organizational outcomes (Boyd, Dess and Rasheed 1993). Although perceptual measures suffer from potential contamination by respondent biases, such as common method bias (Huber and Power, 1985), they more directly reflect the ways in which “environmental forces mold organizations through the mediation of human minds” (Simon 1976, 334). To model nonlinearity in the organizational environment-performance relationship it is therefore important to test objective and subjective features of the environment in the same study (Randolph and Dess 1984).

Objective measures of the environment

Environmental munificence is measured using proxies for district wealth. The tax rate of the district tells us how much money is available to the district. Total revenue is the amount of money the district receives from taxes and state funding. The percentage of low-income students tells us about the general income of the populace. To create an overall munificence
measure, we performed a principal components analysis on these three variables. Higher values indicate greater munificence.

Environmental complexity is comprised of the heterogeneity and dispersion of the school district’s student population. A diverse student population means that the school district has to address a multitude of needs and challenges. We use three indicators of population heterogeneity: the percentage of students in the district who are black, Latino and low-income. We measure dispersion with three variables: the number of students in the district, the number of schools in the district, and the density of the school district (the number of students per 10,000 square meters). We created our objective environmental complexity measure by performing a principal components analysis. Higher values indicate greater complexity.

Environmental dynamism is comprised of two parts. First, the raw change in munificence and complexity, and, second, the unpredictability (or turbulence) of that change. For munificence we calculate the change in the tax rate and total revenue. For complexity we calculate the change in the percentage of low-income students, black students and Latino students, student density and district enrollment. For each variable, we calculated the turbulence of the measure following Rattso (1999) and as applied by Boyne and Meier (2009). For instance, to measure the turbulence (or unpredictability of a change) of enrollment we regressed this year’s logged enrollment on last year’s enrollment. The residual from this equation becomes a measure of environmental unpredictability. The value of the residual for each school district shows the extent to which enrollment deviates from the level that would be expected on the basis of the previous year’s enrollment. Since we are interested in the degree of unpredictability rather than its direction (i.e. if it increased or decreased) we then took the absolute value of the residual. We calculated the turbulence of each measure this way.
and then summed the residuals to create an overall objective measure of dynamism. Higher values indicate greater dynamism.

**Subjective measures of the environment**

The subjective measures, or the perceptions of public managers, were gathered from a survey of all school district superintendents that was administered during the 2006-2007 school year. 1,100 survey respondents were asked a variety of questions about their environment, resources, and goals; 757 responded for a response rate of 68 percent. For subjective munificence, superintendents were asked to rate the quality of their buildings and facilities, parental involvement, community support and school board support. Values range from 5 for excellent to 1 for inadequate. A factor score was produced from these four variables. Higher values indicate a perception of higher organizational munificence.

For subjective complexity, three questions from the survey were used. These questions asked respondents how much they agreed or disagreed with the following prompts: 1) “I would characterize relations between diverse groups in my district as harmonious”, 2) “I would characterize my district’s environment—the political, social, and economic factors at work—as relatively complex”, and 3) “There is a lot of conflict over educational issues in our community.” Responses range from 4 for strongly agree to 1 for strongly disagree. The responses to the first question were reversed and then added to the responses to the second and third questions to get an additive index of subjective complexity. Higher values indicate greater complexity.

Perceptions of dynamism were gathered from two survey items. Respondents were asked how much they agreed or disagreed with the following prompts: 1) “My district’s environment—the political, social, and economic factors—is relatively stable”, and 2) “There is a great deal of uncertainty in the environment in which my district operates.” Values for
the second prompt were reversed and then added to the values of the first prompt to create an additive index of subjective dynamism. Higher values indicate less dynamism.

**External and internal controls**

While we have a subjective complexity measure that includes an aspect of political complexity, we want to include a variable that measures and controls for political complexity. We use the number of state legislators in each school district as an indicator of political complexity. All districts have two legislators (one in the State House of Representatives and one in the State Senate). However, some districts have more than two legislators. In districts where there are many legislators, the political environment is one of multiple political actors making multiple and maybe competing demands on school districts.

School performance is also influenced by the quality of the service providers, namely the teachers and the immediate educational environment. Measures of average teacher experience, average teacher salary, and the number of new teachers in a district provide us with teacher quality indicators. Descriptive statistics for all variables are presented in Table 1.

[Insert Table 1 here]

**Statistical results**

The results of the statistical models of organizational environments and performance are shown in Table 2. We present nine Generalized Least Squares (GLS) regression models with random effects in the following sequence: model 1 regresses all the independent variables onto the TAAS measure. The inclusion of the quadratic terms for each of the objective and subjective environmental measures in model 2 then shows whether the environment exhibits a u-shaped or inverted u-shaped influence on performance. Finally, cubic terms for each
environment measure are added in model 3 to examine the potential for the nonlinear relationship to follow an s-shaped rather than an inverted u-shaped direction, whereby organizations potentially adapt best to the environment after having struggled initially to do so - though eventually they succumb to the pressures associated with high munificence, complexity and dynamism. The same pattern is then repeated for the other dependent variables in models 4-9. Since the data are homoscedastic it is unnecessary to control for nonconstant error variance in the regression models.

[Insert Table 2 here]

Looking at the first three columns in Table 2, we can examine the linear and nonlinear relationships between test scores and our organizational environment measures while controlling for other factors likely to affect performance. We see evidence of a nonlinear relationship with subjective complexity and objective complexity. For subjective complexity we see a pattern of an inverted U shape; the linear term is significant and negative and the nonlinear term is positive and significant. Very low levels of subjective complexity are detrimental to test score performance; as complexity increases so does performance to a given level, but then even higher complexity reduces performance. For objective complexity we see an S-shaped pattern. The linear and cubed terms are both significant and negative and the squared term is significant and positive. Very low and high levels of objective complexity have little effect on performance—the effect is relatively flat. Moving from low to high values of objective complexity greatly increases test scores. The other organizational environment measures show a linear relationship. Munificence has a positive relationship with test score performance. Dynamism has the expected relationship with test scores. The models on average explain 45% of the variance in test score performance.
Columns 4-6 allow us to explore the relationship between attendance rates and our environment measures. We see a nonlinear relationship with objective dynamism. Objective dynamism shows an inverted U pattern, with a positive linear term and a negative nonlinear coefficient. Very low levels of objective dynamism have a detrimental impact on attendance. As objective dynamism increases, so do attendance rates until a certain level of dynamism is reached and then even higher dynamism reduces attendance. Subjective dynamism has a linear and positive relationship with attendance rates. The other environment measures show a linear relationship. Munificence has a significant and positive relationship with attendance rates. Complexity does not have a significant effect on attendance. The models explain on average 26% of the variance in attendance.

Columns 7-9 show us the linear and nonlinear relationships between our environmental measures and graduation rates. We see three nonlinear relationships. We see an inverted U shape with objective dynamism; the linear coefficient is positive and the nonlinear term is negative. We see a half U shaped relationship with objective munificence because both the linear and nonlinear terms are positive. In this pattern we see that low levels of munificence have an impact on graduation rates until a certain point where we see a dramatic increase in the effect munificence has on graduation rates. We see an S shaped pattern with objective complexity since the linear and cubed terms are negative and the squared term is positive. As the level of complexity moves from low to high, we see a fairly steep positive impact on performance although very low and very high levels of complexity have a relatively small positive impact on graduation rates. The subjective environmental measures are linear but not significant. The model explains on average 36% of the variance in graduation rates.

Table 3 summarises the findings of our analysis. It indicates that environmental munificence has mostly has a linear relationship with organizational outcomes in the public
sector, while objective complexity and dynamism exhibit a nonlinear influence on performance. By contrast, subjective dynamism has a linear negative relationship with performance, while subjective complexity mostly makes no difference. These findings suggest that the objective environment is a more important determinant of organizational outcomes than the subjective environment. Eight out of the nine possible objective environment-performance relationships are statistically significant, while only five out of the nine subjective ones are. At the same time, it appears that nonlinear relationships are most prevalent for objective measures of the “simple-complex” and “static-dynamic” dimensions of the environment that Duncan (1972) argues are the key external determinants of the perceived environmental uncertainty that influences managerial decision-making.

Conclusions
This paper has explored the nonlinear effects of organizational environments on public service performance. The statistical results show that objective and subjective measures of the environmental munificence confronted by organizations exhibit a linear positive relationship with performance. Organizations operating in a munificent context perform better than their counterparts in less favourable circumstances, irrespective of how munificence is measured. By contrast, those operating in an environment perceived by managers to be dynamic do worse than their counterparts in a more stable and predictable context. At the same time, delivering services in an objectively complex or dynamic environment appears to pose unique challenges and opportunities at different levels of complexity and dynamism. Performance falls before rising and then falling again in an objectively complex environment, while in an objectively dynamic environment it largely follows the kind of nonlinear pattern that we had
envisaged, rising at first before turning negative. On the whole, subjective complexity appears to have no relationship with performance. These results have important theoretical and practical implications.

This analysis has expanded on work on organizational environments and performance in several ways. First, a comprehensive model of the nonlinearity in the organizational environment-performance relationship has been formalized and tested. Previous studies have so far focused exclusively on the linear effects of the organizational environment (e.g. Hall and Leeson, 2010). Second, systematic evidence on the impact of both archival and perceptual measures of the environment is presented. Nearly all existing work concentrates on the effects of archival measures of the organizational environment drawn from secondary data sources (e.g. Boyne and Meier, 2009; Meier and Bohle, 2003; though see Andrews, 2009). Third, we analyse the impact of all three dimensions of the organizational environment identified by Dess and Beard. Previous public sector studies have so far focused on the independent impact of only one or two dimensions of the environment on performance (e.g. Meier and Bohle 2003; though see Andrews and Boyne, 2008).

Despite the strengths of the study, there are, nonetheless, limitations of our analysis. The statistical results may be a product of where and when the research was conducted. It is therefore important to identify whether the potential curvilinear effects of objective and subjective environments differ over other time periods and in other organizational settings both in the US and elsewhere. In addition, the data set limits adequate measurement of the changes in managers’ perceptions of the environment. This means the analysis may be biased by the potential influence of “recency” on managerial perceptions (Wholey and Brittain 1989). Variables measuring the impact of sudden ‘crises’ on organizations (Kelman 2006) could also add significantly to the explanatory power of the model. Finally, a large proportion of the variation in performance found here remains unexplained. While this may be a product of
limitations in the measures used, it is also likely to be attributable to organizational variables that were not tested on this occasion, such as strategy, structure and process. At the same time, these organizational characteristics may have important moderating effects on the environment-performance relationship (Boyne and Meier, 2009). Future studies of nonlinearity in the environment-performance relationship should therefore examine the potential interaction between curvilinear environmental effects and management strategies, structures and processes.

References


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TABLE 2  Organizational environment and performance

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<td>Adj. R²</td>
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Table 3 Summary of statistical results of organizational environments and performance analysis

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</tbody>
</table>

+ = significant positive association; - = significant negative association; S = s-shaped relationship; ∩ = inverted U shaped relationship; U = u-shaped relationship; hU = half U shaped relationship; ns = no significant association