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I've Seen Fire and I've Seen Rain: Public Management and Performance After a Natural Disaster

Kenneth J. Meier,[1,2] Laurence J. O'Toole Jr.,[3] and Alisa Hicklin[4]

Abstract

Public organizations operate as open systems in settings that can be a source of difficulties for managers and for program performance. The unexpected arrival of two major hurricanes in 2005 caused widespread havoc, and some of the consequences constituted major shocks to public agencies—in particular, to public educational systems. This article assesses whether such shocks caused drops in performance, and whether organization and management contributed to a mitigation of these deleterious effects. Evidence indicates that shocks do disrupt performance but also that staff capacity and stability in street-level personnel of the organizations can reduce or eliminate these negative consequences.

Keywords

public management, public education, hurricanes, organizational shocks, performance

Public organizations operate as open systems in contexts that can provide both opportunities and constraints for those who care about and benefit from program performance as well as for those who manage the organizations

[1]Department of Political Science, Texas A&M University, College Station
[2]Cardiff University, Wales, United Kingdom
[3]University of Georgia, Athens
[4]University of Oklahoma, Norman

Corresponding Author:
Kenneth J. Meier, Department of Political Science, Texas A&M University, College Station, TX 77845.
Email: kmeier@politics.tamu.edu

(Lynn, 1987). A portion of the benefits and difficulties that stem from a public organization's environment can be anticipated or at least planned for in some loose sense. Public organizations, in practice, often develop specialized subunits to help procure benefits from the setting (e.g., budget development), stimulate more diffuse support from the environment (public information offices), or protect against unwanted perturbations (information technology security bureaus).

One set of functions that public management can perform is to devote attention and resources to both exploiting and buffering from these and other external exigencies: in other words, managing outward (Moore, 1995; O'Toole, Meier, & Nicholson-Crotty, 2005). Sometimes, however, such externally directed managerial efforts are insufficient. When negative environmental fluctuations are not screened from the organization and its programs but instead penetrate into organizational operations, additional functions of management come to the fore. Internal management becomes essential in dampening the untoward impacts or mitigating the ramifications that might otherwise reverberate through the systems (Rainey, 2003).

One especially challenging variety of such disruptive influences originating in the environment of public organizations is the subset of disturbances comprising negative organizational shocks: unanticipated problems that arise without warning, spread quickly, carry manifold implications for the operations of programs, and penetrate deep inside public organizations and their production processes. Such "nightmare scenarios" haunt the dreams of many public managers—for instance, those organizing for the possibilities of deadly pandemics, mass terror, earthquake disasters, or overwhelming numbers of refugees from warfare or famine.

Even in more mundane but no less important fields of policy, managers and organizations must sometimes cope with sizable negative shocks that land without notice inside the organizational system and simply must be handled. A classic case of just such an eventuality occurred on the Gulf Coast of the United States during 2005, when two major hurricanes descended on the same region within weeks of each other and caused massive destruction and considerable loss of life. Aside from those who were required to deal swiftly with the emergency needs of the moment—police, fire and rescue, disaster relief, public health, and other such programs and agencies—many additional organizations and their managers found themselves having to manage major shocks stemming from the hurricanes and their aftermath, perturbations that had penetrated their organizations as well and posed substantial managerial challenges.

Public organizations and public managers, in short, sometimes face the "fire and rain" (to borrow singer-songwriter James Taylor's imagery) from a

major unanticipated disruption and must seek to mitigate its negative impacts. In this article, we examine via a natural experiment design how the performance of a large set of public organizations—public school districts—in the Gulf Coast region was affected by the hurricanes of 2005. We also explore the key question of whether and how aspects of management were able to reduce or eliminate measurable disruptive impacts.

We begin by sketching a perspective on how public organizations might deal with shocks from their environments. We connect this theoretical discussion to a formal model of management and performance that offers a precise way to think about the question. We then summarize the hurricane-related events and their consequences for public school districts in the state of Texas. The core of the analysis then focuses on performance impacts of the unanticipated shocks, as well as whether and how aspects of the organizations and their management were able to mitigate the consequences of the fire and rain. We conclude by sketching implications.

Environmental Shocks, Public Organizations, and Public Management: A Perspective and a Model

Organizations can deal with environmental shocks in two ways. First, they can buffer the shocks and prevent them from interfering with the technical core of the organization (Lynn, 2005; Thompson, 1967). Second, organizations can cope with the shocks that penetrate the boundaries of the organization.

A basic fact of organizations is that not all shocks can be buffered to avoid affecting the organization. In fact, a rational organization would not seek a process of total buffering because that would create an internally closed system that would limit organizational learning and change (Lynn, 2005; Sorenson, 2003). Some turbulence can be anticipated and is likely to occur with sufficient frequency and generate only mild to moderate negative impacts on organizational routines and production; these are the situations in which buffering efforts can be effective. But not all negative shocks can be anticipated, at least in sufficient detail to protect organizational processes. Some such shocks are low-probability events, and it could be counterproductive to design buffering units or processes to guard against many such different varieties of rare events. An important concern therefore is how to deal with the environmental turbulence that penetrates the organizational buffers and affects the production elements of the organization. Two possibilities are sketched in the literature. First, the organization can establish internal structures that permit the organization to adjust to these shocks. An organization might decentralize its processes (say, geographically) and permit these

independent units to assess and deal with the change. Resulting successes can then be communicated to the rest of the organization. Alternatively, the organization might build slack into parts of the organization most likely to come into contact with environmental changes and ask those parts to devise solutions for the organization (see Sorenson, 2003). Second, the organization might seek to manage the shock and its organizational consequences. An untimely budget cut, for example, can be dealt with by reducing noncritical expenditures, procuring cheaper inputs, or focusing only on key clientele (see Meier & O'Toole, 2009).

How might these two general strategies for addressing organizational shocks be fit into current management theory? In 1999 O'Toole and Meier provided a parsimonious model of public management that incorporated these environmental functions of public management, (including a specification of the buffering function). Specifically, after reviewing the extensive case study and qualitative literature on public management, they posited the following model:

$$O_t = \beta_1(S + M_1)O_{t-1} + \beta_2(X_t/S)(M_3/M_4) + \varepsilon_t \quad (1)$$

where
O is some measure of outcome,
S is a measure of stability, denoting structural, procedural, and other elements that support unperturbed production,
M denotes management, which can be divided into three parts:

M_1 management's contribution to organizational stability through additions to hierarchy or structure as well as regular operations,
M_3 management's efforts to exploit the environment,
M_4 management's effort to buffer environmental shocks,

X is a vector of environmental forces,
ε is an error term,
the other subscripts denote time periods, and
β_1 and β_2 are estimable parameters.

Where does buffering, as we have defined it, appear in the model? It is present as the denominator of the second, or environmental, term:

$$\beta_2(X_t/S)(M_3/M_4) \quad (2)$$

or, after rearranging,

$$\beta_2(X_t M_3)/(SM_4) \quad (3)$$

This term models the impact of the set of environmental forces X_t on outcome O_t. The impact can be leveraged by managerial effort (M_3) or buffered by the combined impacts of stabilizing forces (S) like structure as well as managerial influences aimed at protecting the production system (M_4). Note that this model simplifies by treating the buffering function in mathematical terms solely as a dampener. This reciprocal function ($1/SM_4$) essentially reduces the size of impact that an X or environmental variable can have (hence the division into X), by dampening the impact over time. It is the SM_4 denominator as a whole, then, that serves as the model's term for buffering (Meier & O'Toole, 2008).

If the environmental shock penetrates the organization (or if X′—i.e., some portion of the shock X—does) then the public management model reduces to the following:

$$O_t = \beta_1(S + M_1)O_{t-1} + \beta_2(X'_t) + \varepsilon_t \quad (4)$$

This formula suggests that coping with an environmental shock that has penetrated the organization will be addressed either by the internal structure of the organization (S) or by management (M_1). Although there are only a modest number of studies of organizational buffering (Lynn's 2005 review essay cites only five) and only one study that focuses on the role of buffering to improve performance (Meier & O'Toole, 2008), quantitative studies of organizations that deal with shocks penetrating the organization are even rarer. Conducting such an analysis is our focus here.

The Environmental Shocks

On August 29, 2005, Hurricane Katrina slammed into the Gulf Coast of the United States near the Louisiana–Mississippi state line. Although it had achieved Category 5 status (the highest rating for a hurricane), its impact had diminished to Category 3 at landfall. An estimated 1,900 deaths were attributed to Hurricane Katrina and the subsequent flooding; property damage was estimated at $81.2 billion. The flooding of New Orleans and subsequent problems resulted in a mass evacuation of Louisiana residents. Included among these evacuees were 46,503 students (plus their families) who were relocated to Texas and enrolled in Texas public schools. Of these students, a

total of 35,091 remained in Texas schools until the end of the 2005-2006 school year.[1]

While coping with widespread devastation from Hurricane Katrina, and also the relocation of thousands of students and their families, the people of the Gulf Coast region took a second blow—this one from Hurricane Rita, the most intense tropical cyclone ever observed in the Gulf of Mexico. The storm made landfall near the Texas–Louisiana border on September 24, 2005. Although only seven fatalities were attributed directly to the hurricane, it did cause $10 billion in property damage.[2] Many damaged facilities were schools in east Texas. The evacuation itself shut down most schools in the Gulf Coast region, and because schools further inland served as evacuee centers, these schools were also closed for a period of time. A total of 243 Texas school districts were closed an average of 6 days, with some districts closed for 5 or more weeks.

The two hurricanes created two distinct natural experiments in terms of how public organizations respond to environmental shocks. First, many districts received an influx of students from Louisiana. Given that the Louisiana public schools are generally perceived to be inferior to the Texas schools and given the poor urban areas that sent evacuees to Texas, the general perception was that Texas schools received an unexpected flood of students who were not likely to perform well in class and were also living with multiple challenges resulting from their evacuee status. Many struggled with health, housing, and other difficulties. Second, many districts were then closed for a week or more, thus creating the need to adjust curricula and lesson plans to the shortened time period.

The important theoretical aspect of these two environmental shocks is that they both penetrated to the technical core of the organization (i.e., the teaching of students). Many environmental shocks can be screened out (as indicated in the second term of the model) as management seeks to buffer or as stabilizing forces dampen the environmental shocks. For example, a law such as No Child Left Behind with its massive reporting requirements might be handled by special reporting units rather than the schools themselves. In the present case, there was no way to avoid the arrival of new students or the closing of schools. The addition of new students or the cancelling of class days directly affected the production processes (i.e., the schools and classrooms) of the school district. This logic suggests that we then seek information on how school districts mitigated the impact of the two hurricanes and that we do so by focusing on the first term of the model, the internal management and structural elements represented in the model's first term.

Data and Measurement

The units of analysis are all Texas school districts with 500 or more students.[3] The smaller districts are excluded from study here because these units often have highly fluctuating test data (our dependent variable measuring performance) that are overly sensitive to the handful of students who are examined. In such cases, the ability to control for past performance is limited, and thus the estimation of how much an intervention event affected performance may be biased or inefficient. One advantage of using the Texas schools data set is that it has been used by a number of public management scholars (Fernández, 2005; Goerdel, 2006; Gonzalez Juenke, 2005; Hicklin, 2004; Hill, 2005; Pitts, 2005) and therefore offers several validated measures of management, structure, and performance. The 703 school districts included in the study range widely on a variety of dimensions, including student composition (race, ethnicity, etc.), resources, setting (urban, rural, suburban), and performance. All data used in the analysis, including hurricane-related data, were obtained from the Texas Education Agency.

X: Measuring the Environmental Shock

Unexpected influxes of students who are hurricane evacuees constitute shocks or perturbations to school districts and their educational mission. Two measures of environmental shock are used in this analysis. First, the Katrina-student-influx shock is tapped by using the percentage of the student body in a school district that was composed of Katrina evacuees at the end of the 2005-2006 school year (thus, measured in late spring 2006). The year-end count is used rather than the initial count because students often moved from temporary districts to "permanent" districts in Texas as parents became employed. A total of 424 of the 703 districts in the study enrolled at least some Katrina evacuees as students, with a range from 0% to 5.42% of the district's total enrollment; these districts enrolled 99.8% of all Katrina evacuees enrolled in Texas public schools (see Table 1). Of those districts receiving students, the average evacuee enrollment was 0.47% of the overall total; but as the standard deviation shows, the distribution is positively skewed.

Second, the shock due to Rita is measured by the total number of days the school district was closed because of the impact of the storm. (Rita caused a number of Texas system closures, but Katrina, for which the brunt of the impact occurred considerably further to the east, caused few Texas district closures.) Table 1 shows that 243 districts were closed approximately 1 week (5.14 days) but that the standard deviation indicates a positively skewed

Table 1. Organizational Shocks: Hurricanes Katrina and Rita

	M	*SD*	Low	High	Mean of Affected Districts
Relocated students as percentage of enrollment	0.28	0.52	0.00	5.42	0.47
Days of school missed due to district closure	1.36	3.34	0.00	29	5.14

distribution. Twenty-eight districts were closed more than 2 weeks. Logic suggests that the relationship between days missed and student performance is likely to be subject to a threshold effect. Missing a single day of class is unlikely to cause major problems for teachers or students. To account for such a threshold, we recalculated this variable to include days missed only if the period of closing constituted more than 1 week of school (i.e., 6 or more days); 60 districts met this criterion.[4]

The two environmental shocks affected some of the same districts. Of those districts in the study, 20% were hit by both shocks whereas 67.1% were hit by at least one of the shocks.[5] Because these measures of the extent of shocks sustained are somewhat collinear and because we shall try to explain the response to the shocks via interactive effects, we estimate the impact of these shocks both separately and also together in the same equation. The results are highly similar, although the impact of Katrina students is lessened by its collinearity with the Rita or days measure.[6]

O: Outcome Measures

Although school systems, like almost all public organizations and public programs, have multiple goals and thus are subject to multiple performance indicators, certain objectives are defined by the political environment as more important than others (O'Toole & Meier, 2004). By one lower standard, the schools were a clear success; 46,000 students were absorbed and damaged schools reopened. But Texas schools also operate under an elaborate accountability system using a standardized test called the Texas Assessment of Knowledge and Skills (TAKS). The TAKS is a criterion-based standardized test given in Grades 3 through 8 and also used as an exit exam. This latter instrument is a high-stakes test, and students must pass it to graduate from a Texas high school. Aggregate pass rates on the TAKS are the centerpiece of the accountability system, and the examination results are without question the most visible indicator of performance used to assess the quality of

schools. The release of annual TAKS scores is front-page news throughout the state, and poor aggregate performance on the TAKS can result in penalties, including state takeover of the district.

Because the "official" TAKS pass rate, known as the accountability subset, permits students to be excluded from the test if the student is enrolled in special education, has limited English skills, or has not resided in the district for a sufficient time period, we do not use the official rate in our analysis. Rather, we use the pass rate for *all* students in the district. This is especially important in picking up the impact of the Katrina students, because many of them might have changed districts after the late October deadline and thus might be excluded from the accountability subset. Because the overall pass rate we use includes all students, the pass rates are lower than those officially used to rate and evaluate districts. For the 2005-2006 school year, the average TAKS pass rate when all students are included was 66.4% with a standard deviation of 10.9%; the all-pass rates are normally distributed and range from 31% to 96%.

Many of the other performance indicators used to assess schools are not particularly valuable in the present study because the measures are not likely to be sensitive to environmental shocks or were not collected in time. College preparation indicators such as SAT or ACT scores, for example, are not available for approximately 1 year after TAKS test results are released; in addition, performance on such indicators reflects only the age cohort that is taking the test in any given year. Two other possible performance indicators are available: the "commended" pass rate and school attendance. The commended pass rate is based on a much higher test score; to illustrate, in the average district only 9.9% of students passed all tests at the commended level of performance. Because this measure is affected by a much smaller number of students and the overwhelming majority of students do not meet this standard, the influx of students and the missed days is unlikely to have much impact. Attendance results are tightly clustered with a mean of 95.9% and a standard deviation of 0.7%. This lack of variation means finding impacts for any variables, including the hurricanes, will be difficult. Although the analysis in this article will therefore focus primarily on the TAKS results, we shall also note in passing any impacts on these two other measures.

Control Variables

Our theory specifies an autoregressive model, and that fits well the logic undergirding the notion of environmental shocks. Our analysis therefore includes the 2005 TAKS pass rate in all models that estimate 2006 performance impacts.[7] The posthurricane TAKS results are thus assessed relative to

the prehurricane TAKS results (a before–after research design). Although such an estimation controls for the history of the school district by incorporating it in this lagged dependent variable, other changes in school district resources or constraints could also affect performance for 2006. To control for these factors, we include five measures of resources and three measures of constraints. These variables are taken from the extremely well developed education production function literature and have demonstrated validity in scores of studies (Hanushek, 1996; Hedges & Greenwald, 1996).

Schools and school districts clearly vary in how difficult it is to educate their students. Some districts have homogeneous student populations from upper-middle-class backgrounds. Students such as these are quite likely to do well in school regardless of what the school does (see Burtless, 1996). Other districts with a large number of poor students, and a highly diverse student body will find it more difficult to attain high levels of performance because the schools will have to make up for a less supportive home environment and deal with more complex and more varied learning problems (Jencks & Phillips, 1998). Our three measures of task difficulty are the percentages of students who are Black, Latino, and poor. The last-mentioned variable is measured by the percentage that is eligible for free or reduced-price school lunch. All three measures should be negatively related to performance.

Although the linkage between resources and performance in schools has been controversial (see Hanushek, 1996; Hedges & Greenwald, 1996), a growing literature of well-designed longitudinal studies confirms that like other organizations, schools with more resources generally fare better (Finn & Achilles, 1999; Nye, Hedges, & Konstantopoulos, 1999; Wenglinsky, 1997). Five measures of resources are included. The average teacher salary, per student instructional spending, and class size are directly tied to monetary resources. The average years of teaching experience and the percentage of teachers who are not certified are related to the human resources of the school district. Class size and noncertified teachers should be negatively related to student performance; teacher experience, instructional funding, and teacher salaries should be positively related to performance. All eight of these measures are change, or differenced, measures—that is, they measure the change in the variable from 2005 to 2006. All impact of the variables' levels (thus if resources act as a stock of capital rather than a flow) should be reflected in the lagged dependent variable.[8]

Findings

Do unanticipated negative shocks result in performance drops? Table 2 presents our findings, developed via OLS multiple regression, for the impact of the two environmental shocks on the Texas school districts. These shocks are estimated

Table 2. Environmental Shocks and Student Performance: The Impact of Students and Missed Class Days

Independent Variable	Slope	Slope	Slope
Students	−0.479* (1.84)	–	−0.437* (1.68)
Days missed	–	−0.138* (2.36)	−0.131* (2.23)
Lagged pass rate	0.928* (80.47)	0.928* (80.58)	0.928* (80.70)
Change in teacher salary	0.000 (0.98)	0.000 (0.85)	0.000 (0.91)
Instruction funds	0.136* (1.65)	0.137* (1.67)	0.134 (1.64)
Black students	0.139 (0.84)	0.020 (0.13)	0.129 (0.79)
Latino students	−0.149 (1.32)	−0.179 (1.59)	−0.163 (1.45)
Poor students	−0.005 (0.13)	−0.008 (0.22)	−0.006 (0.17)
Class size	−0.654* (2.98)	−0.758* (3.42)	−0.732* (3.31)
Teacher experience	0.069 (0.40)	0.089 (0.52)	0.064 (0.37)
Noncertified	−0.034 (1.09)	−0.035 (1.14)	−0.032 (1.02)
n	703	703	703
R^2	.91	.91	.91
F	735.05	737.55	672.53
SE	3.21	3.21	3.21

Note: Dependent variable = All-students TAKS pass rate. Values within parentheses are *t* scores. TAKS = Texas Assessment of Knowledge and Skills.
*$p < .05$ (one-tailed test).

separately (columns 1 and 2) as well as simultaneously in the same equation (column 3). By counting only those districts that missed more than 1 week of school, the collinearity between the two shock variables is reduced and the two different single-shock estimations are relatively similar. The third column with both shock measures included in the model shows that a 1 percentage point increase in Katrina students (as a percentage of the student body) is associated with a drop in the TAKS all-pass rate scores of 0.437% ($p < .05$, one-tailed test). Although some of this drop might have been the result of the originally enrolled students not doing well as the result of more crowded classes and other factors, this effect size is the equivalent of 43.7% of Katrina evacuees failing the TAKS (in contrast to the statewide average of 33.6%). The maximum total impact of Katrina students on district performance, based on the maximum of 5.42% evacuee students, is approximately 2.4 points on the TAKS pass rate.[9]

The missed-class-days variable has a similar negative and statistically significant impact on TAKS scores. Each additional day (above 5 total days) that schools were closed is associated with a decline in TAKS scores of 0.131 percentage points on the pass rate. Based on the largest value of days closed (29), the maximum impact on performance in districts suffering from closed schools is estimated to be approximately 3.1 points.[10] The remaining factors

in the equation are generally consistent with past research. Clearly the autoregressive term dominates the equation; it especially does so given the limitation to districts with 500+ students. This point is reflected in the extremely high coefficient of determination accounting for 91% of the variance in 2006 TAKS scores. Of the differenced measures, only class size reaches the .05 level of statistical significance; an increase in class size from 2005 to 2006 was associated with a predictable drop in TAKS scores.

Estimating the performance results of the hurricane shocks raises the important theoretical question of how the districts responded to the shocks and whether there were factors operating that could have (or in some districts did) mitigate(d) these negative results. An analysis of the residuals from the equations in Table 2 confirms that the hurricane-affected districts include both positive and negative residuals; some districts were able to take one or both shocks and still outperform expectations. East Chambers Independent School District, for example, was closed for 12 days and had slightly more than 1% of its study body as Katrina students, yet the district scored 6.9 percentage points above the regression line.

The parsimonious theory of public management that we use (see equation (4) above) implies that districts might mitigate shocks in one or more of three fashions—through the stabilizing effects of structural (and other) elements, the operations of management in supporting and reinforcing performance-related operations, and/or the inertia that carries established practices forward into the future (past performance). The easiest explanation to consider is that for past performance. Prior performance is already in the model as part of the autoregressive estimation; for past performance to matter more than it does in Table 2, it would have to interact with either or both of the shock variables in such a manner that high-performing districts would be less affected by the shock than low-performing districts. We tested this idea (analysis not shown), but the impact of past performance as interacted with the two shocks was not sufficient to overcome the negative impacts.

If high levels of prior performance do not mitigate the negative impact of environmental shocks, then structure and management are the two logical possibilities. With regard to structure, Sorenson's (2003) assessment of the computer workstation industry suggests that vertical integration can be a key to dealing with a turbulent environment. Vertical integration is enhanced by a strong central management team that can take the results from various subunits and determine what lessons the organization might learn. In the present case, greater central management capacity permits a set of decisions to be made concerning how to evaluate the incoming students,[11] which schools can be assigned the evacuee students, what resources have to be shifted to the needed schools, how one can restructure curricula to make up for missed

days, and what resources need to be procured from outside the district. By using central management to make these decisions and perform these tasks, the district does not pull school-level personnel away from the day-to-day operations of the district.

To measure central management capacity, which represents a structural resource that might mitigate the performance impacts of negative shocks, we use the percentage of total staff that are assigned to central office administration. Texas school districts are relatively lean in terms of central office administration; the mean for all districts in the study is 1.34%, with a standard deviation of 0.63%. Because this is a measure of personnel assignment and organizational design rather than a measure of management activity per se, this measure is best interpreted as a stabilizing or structural variable (S).[12]

Why is the percentage of central office administration a good measure of managerial capacity? First, this is a relatively common measure that has been used with some merit in a variety of empirical studies of organizations (Dalton, Todor, Spendolini, Fielding, & Porter, 1980). Second, in our discussions with school district officials, they consistently stress that they need central office capacity to deal with the tough problems of truancy, dropouts, and programs for at-risk students. Our own analysis shows that even with extensive controls, the size of the central office bureaucracy is positively associated with attendance and African American student performance and negatively related to dropouts. Third, a study of responses to major budget cuts (Meier & O'Toole, 2009) shows that having central office capacity is positively associated with a series of decisions that minimize the impact of these cuts.

To determine if management capacity afforded by central structure can mitigate the negative impact of either or both of the unexpected arrival of students or the missed school days, we interacted this variable with each of the hurricane shocks. These results are presented in Table 3. Such interactive models induce a fair amount of collinearity and fundamentally change the interpretation of coefficients. The standard errors normally used to determine statistical significance need to be recalculated as one determines the marginal impact of the shocks given the level of managerial capacity. To illustrate, the slope for days of school closed now depends on the value of managerial capacity, and this can be determined by taking both the slope for the days of school and the interaction term (from column 3):

$$-0.222 \times \text{Days} + 0.095 \times (\text{Days} \times \text{Administration})$$

grouping the terms, gives us

$$[-0.222 + (0.095 \times \text{Administration})] \times \text{Days}$$

Table 3. Administrative Capacity Can Overcome the Impact of Environmental Shocks

Independent Variable	Slope	Slope	Slope
Students	−0.901 (1.60)	–	−0.864 (1.53)
Days missed	–	−0.233 (1.54)	−0.222 (1.47)
Central administration	0.381* (1.71)	0.454* (2.30)	0.328 (1.46)
Students × Administration	0.442 (0.96)	–	0.434 (0.94)
Days × Administration	–	0.101 (0.78)	0.095 (0.73)
Lagged pass rate	0.929* (80.80)	0.928* (80.73)	0.928* (80.81)
n	703	703	703
R^2	.91	.92	.92
F	617.58	619.18	531.84
SE	3.21	3.20	3.20

Note: Dependent variable = All-students TAKS pass rate. Values within parentheses are *t* scores. Equations also control for change in teachers salaries, per student instructional funds, class size, teachers' experience, noncertified teachers, Black students, Latino students, and poor students. TAKS = Texas Assessment of Knowledge and Skills.
*$p < .05$ (one-tailed test).

We can then use this equation to draw a line that will show the impact of a day of school lost at various levels of administrative capacity (see Figure 1). This figure, which also displays the 95% confidence limits, indicates that at low levels of administrative capacity, the impact of missing a day of class is negative and statistically significant. As the level of central administration increases, however, this negative impact becomes less and essentially becomes statistically indistinguishable from zero at approximately 1.0% of central administrators. One can set the slope equation equal to zero and get a point estimate of when the negative impact ceases (i.e., has a slope of zero); this occurs when central office administrative is equal to 2.33% of total employment. The equation actually shows a positive slope at very high levels of central administration, but this can be ignored for two reasons: those values are not statistically different from zero, and only a small percentage of districts have central administration percentages that high (48 of the 703). The logical conclusion is that as central administrative capacity grows, it gradually eliminates the negative impact of the environmental shock on performance.[13]

Table 3 also shows that central management capacity has a similar impact on the shock of Katrina evacuee students (see also Figure 2). The impact of evacuee students is strongly negative and statistically significant at low levels of managerial capacity but declines in impact as central administration

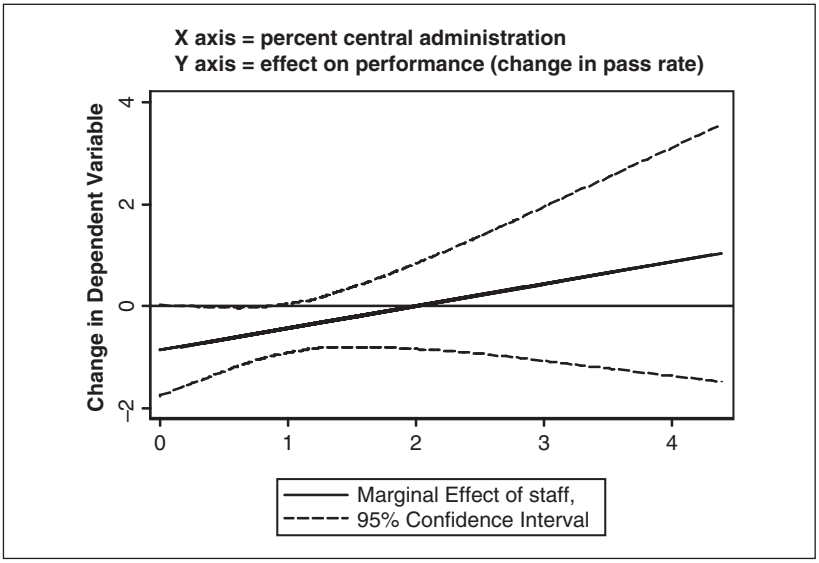

Figure 1. The marginal impact of Katrina students contingent on managerial capacity

increases. The point prediction of zero impact is estimated to be approximately 1.99% central office staff (relatively similar to the Days impact). Again the positive slope predictions are never statistically different from zero and cover only 93 of the 703 total districts. In short, central management capacity appears to mitigate the negative impacts of the hurricanes.

If structure can mitigate the impact of environmental shocks, is it possible that management can do so as well? Although several measures of management have been developed by others using the Texas data sets, most of these measures are either for external relations (i.e., they apply to the environmental portion of the model) or are ambiguous as to whether they refer to internal or external management (e.g., the Meier & O'Toole, 2002, salary residual measure of management quality). The one internal management measure is an indirect one: O'Toole and Meier (2003) contend that employee stability reflects, among other things, the ability of and effort by managers to manage human resources and thus retain employees. They then show that employee stability is positively related to organizational performance for a variety of performance indicators. They contend that their measure of employee stability, the percentage of teachers who remain in the organization from one year to the next, reflects the preservation and enhancement of human capital in the

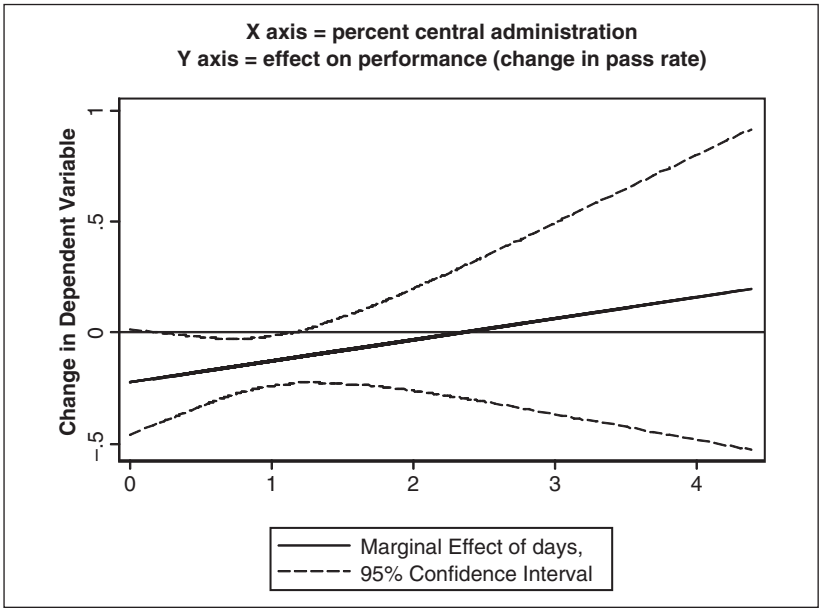

Figure 2. The marginal impact of missed school days contingent on managerial capacity

organization. The teacher stability measure has a mean of 84.4% and a standard deviation of 4.8%; it ranges from 63.6% to 97.4%.

We use this measure to tap an aspect of human resources management in the districts. Greater teacher stability and the expertise and experience it brings means that the teaching function can operate with little supervision in times of crisis. It likely also means a better ability to handle new problems such as poorly prepared displaced students or a change in curricula. Table 4 shows regression results with the interactions between teacher stability and the hurricane shocks. Figures 3 and 4 show the marginal effects of the shocks contingent on various levels of teacher stability. Although the contingent relationships for turnover are not as strong as those for management capacity, they show a reduction in the negative impacts of crises. To illustrate, let us assume a high-turnover district with a stability measure of 75%. Figure 3 (and the resulting calculations) shows that the predicted impact of a 1 percentage point increase in Katrina students for this district is a drop of 0.86 percentage points on the TAKS, a statistically significant impact (a more precise graph would show the significance level touching the zero point at approximately this level). This impact decreases to zero as the stability of the

Table 4. Management of Human Resources Can Overcome the Impact of Environmental Shocks

Independent Variable	Slope
Students	−4.154 (0.92)
Days missed	−1.091 (1.02)
Teacher stability	−0.044* (1.69)
Students × Teacher Stability	0.049 (0.83)
Days × Teacher Stability	0.011 (0.90)
Lagged pass rate	0.932* (77.19)
n	703
R^2	.91
F	528.99
SE	3.21

Note: Dependent variable = All-students TAKS pass rate. Values within parentheses are *t* scores. Equations also control for change in teachers' salaries, per student instructional funds, class size, teachers' experience, noncertified teachers, Black students, Latino students, and poor students. TAKS = Texas Assessment of Knowledge and Skills.
*$p < .05$ (one-tailed test).

teacher force increases (the point estimate for zero is 92.67). Using the same 75% figure for days of school missed, we can predict that each additional day of closed schools (above 5) results in a drop of 0.25 percentage points in TAKS scores, again a statistically significant impact (Figure 4). Similar to the Katrina impact, this negative impact gradually drops to be indistinguishable from zero. In this case the point estimate for zero is 98.1, which is beyond the range of the variable (the maximum is 97.4), but the important point is not that the predicted line crosses zero necessarily but that the slope becomes statistically indistinguishable from zero.

Conclusion

Two hurricanes occurring within close succession in the same region of North America unquestionably constitute a pair of natural disasters. They also provide entrée for natural-experiment analysis of the impacts of unanticipated negative shocks on the performance of public organizations—in particular, public organizations that are not charged with disaster-related missions but must seek nonetheless to achieve other important policy goals in the face of substantial disruption.

Such major shocks entering organizational systems are likely to carry performance repercussions. Anecdotal evidence from earlier studies bolsters such a supposition, and a formal model of public management and performance,

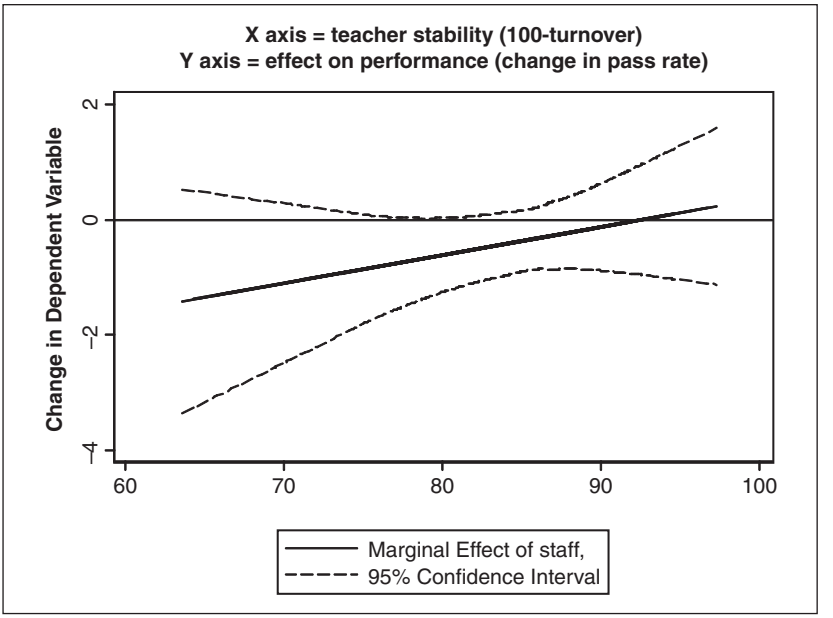

Figure 3. The marginal impact of Katrina students contingent on teacher stability

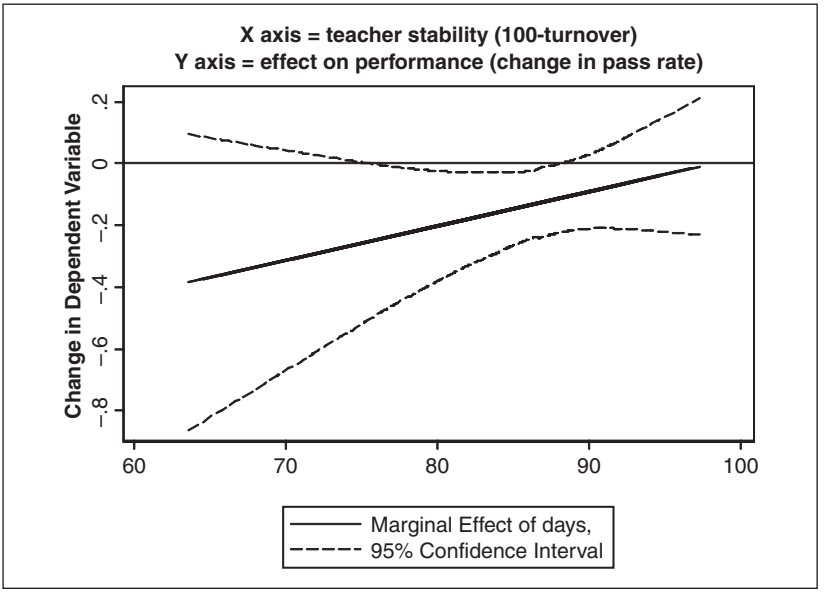

Figure 4. The marginal impact of missed school days contingent on teacher stability

used as a basis for the present investigation, also postulates as much. In this investigation, two distinct interval-level measures of unanticipated shocks were used to examine the question and estimate the extent to which the hypothesis is supported. Indeed, with appropriately specified models, both measures of shocks from the hurricanes on public educational systems show negative and statistically significant effects on student performance—especially on the most salient and appropriate criterion commonly used to assess school district success. This result is consistent, whether estimations include either or both of the variables tapping shocks.

As the analyses of residuals from these equations indicate, nonetheless, this pattern does not hold across all the districts. Some public organizations overperform in the face of unexpected disruption and some dramatically underperform. What makes for the difference? And, in particular, can aspects of organization and management mitigate the effects of large-scale negative shocks?

Building from the simplified model sketched in equation (4), we reestimate the relationships by including, in succession, a measure that taps structural-stabilizing capacity in the organizations (relative size of central management staff) and another that draws from an aspect of internal human resources management (stability in the teaching corps). When these structural and management variables, aspects of the M and S terms contained in equation (4), are interacted with the measures of the intensity of negative environmental shocks, the negative impacts of the hurricane-related shocks on performance are eliminated. More precisely, at higher levels of either central staff capacity or teacher stability, school districts dealing with disturbances from Katrina and Rita see no significant reductions on their all-pass rate that are attributable to the unexpected shocks.

With the data at hand, it is not possible to establish firmly whether one of these two mitigating features is more important in protecting the core educational production process from disruption. Plausible cases and anecdotal evidence from the districts can be found for both, and the statistical evidence that might sort between the two is inconclusive. What can be said is that either or both of organizational structure and internal management (M_1, in the shorthand of the O'Toole–Meier model) can dissipate the performance-related impacts of unexpected shocks in the system.

In earlier work, Meier and O'Toole (2001, 2003) had demonstrated that externally oriented networking by management can have positive impacts on performance and that certain aspects of managerial and frontline stability can help as well (O'Toole & Meier, 2003). They have also presented evidence that the buffering function can support performance and that internal

management can protect core tasks from unpleasant budgetary drops (Meier & O'Toole, 2008, 2009). The current set of findings complements these earlier studies, because the results here show both that unexpected negative shocks carry performance implications and also that organization and management matter in mitigating these performance expectations.

Public management therefore offers multiple possibilities for defending core functions: protecting organizational systems from even the intrusion of potentially disruptive influences, establishing structural features that can respond to and reduce the impact of intrusions that are experienced, and also operating via managerial tasks and systems to dissipate shocks and support performance. Externally oriented management matters, but even internally focused managerial behavior and structure can provide support for continued production in the face of environmentally driven difficulties.

Do these findings mean that public organizations should hire more central staff? Unfortunately, direct management implications must be more nuanced than this simple injunction. The evidence supports the notion that bolstering management capacity in this fashion can help in protecting against the occasional albeit very disruptive disaster. But it may be that other types of unexpected and unpleasant disturbances can be best dealt with in other ways, and therefore additional research on management in and of disasters in public organizations is clearly needed.

In addition, adding central staff is not free—larger management capacity involves opportunity costs during more placid times: people and financial resources that could be put to other salient uses. Indeed, the more usual concern is that upper reaches of especially large bureaucratic units clog communication channels, slow down and diffuse decision making, and render organizational processes more sclerotic (e.g., Light, 1995). Certainly, such results are not inevitable; and this analysis of organizations that are highly professionalized and not particularly top-heavy indicates that in such settings the typical caricature is both unenlightening and misleading. How to balance the advantages of management capacity against such opportunity costs and potential bureaucratic pathologies is therefore a question that must be addressed with due consideration of the types and expected frequencies of possible disasters, the costs associated with building substantial central capacity and other context-specific, clearly relevant considerations.

Evidence elsewhere (O'Toole & Meier, 2003) as well as the finding of the present study support the notion that frontline personnel stability, which helps to stabilize organizational patterns, can offer assistance in stabilizing performance. The earlier work shows clear positive impacts in more typical

circumstances, whereas this study shows performance contributions when disruptions occur. It seems clear therefore that stable teacher employment patterns are desirable. Astute human resources management can contribute to more stability in the front lines, so bolstering this managerial function can pay stabilizing, and thus performance, dividends. But fully systematic explorations of the forces influencing stability in this and other specialties of public employment are warranted. Further research therefore can help to sort out the determinants of teachers' (and others') stability and thus provide additional direct implications for public management.

It is sometimes impossible to avoid the fire and rain conjured from the complex and often turbulent settings within which public programs must operate. But when the blazes ignite and the deluge pours forth, public management of the right sort may be able to douse the threatening flames, fashion the requisite dikes, and thereby enable sunny performance days ahead. This study suggests that storing organizational capacity at the central office level and investing in human resources to reduce turnover are two practical approaches to dealing with environmental shocks.

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Notes

1. All data are taken from the official records of the Texas Education Agency.
2. That fatality figure does not count those who died in the evacuation. The evacuation snarled traffic for several days; adequate supplies of gasoline and water were not available on the evacuation routes; and one busload of senior citizens perished in a fire. The problems associated with the evacuation of the Texas Gulf Coast led to a reassessment of procedures for major evacuations.
3. Using the entire set of 1,043 districts, including the smaller ones, has only modest impact on the results. In that case, the weaker of the two influences, the "Katrina" coefficient (explained shortly), fails to attain statistical significance (the direction and final results still hold). The results for the "Rita" coefficient remain unchanged.
4. The results using all the days were very similar but were affected more by collinearity, because many of the Katrina evacuee districts were closed for the Rita evacuation but did not sustain physical damage that would have prevented them from opening the following week.
5. Here we count as districts affected by one or both shocks any district with a nonzero value for enrolling Katrina evacuee students or sustaining a period of at least 6 days of closure due to Rita.
6. The hurricane-affected districts are not appreciably different from those not affected. Both the Katrina and the Rita districts actually had lower revenues per pupil but higher teacher salaries (for Katrina) and larger class sizes. These differences are in part a result of the hurricane-affected districts being in the part of the state where wages are likely to be higher.
7. The equations in all tables were also estimated using a 3-year average of prior TAKS scores rather than just the previous year. The 3-year average tends to underestimate the district's record because the TAKS was a new exam created in 2003 and there is a positive trend in overall scores as districts and students got used to the new exam. The results of this estimation were generally the same as those presented but showed a slightly larger impact of the hurricane because it underestimated the prior performance of the district.
8. The hurricane-affected districts did not do better as the result of an influx of aid. Instructional expenditures per student go up by $645 in districts affected by Katrina (vs. $658 for all districts) and $533 in the Rita districts (vs. $661 for all other districts). The influx of additional state or federal funds was overwhelmed by the total number of new students who arrived.
9. The impact of Katrina might have been larger, but the majority of evacuee students were distributed in a ring of school districts in the Houston metropolitan area that are generally fairly high performing and are known for talented instruction. The districts with Katrina students, for example, had a TAKS pass

rate of 62.8 in 2005 compared to 61.1 for all other districts. They achieved this despite having lower revenues per pupil ($8,643 vs. $8,945) and higher student-to-teacher ratios (14.3 vs. 12.7).

10. The use of the TAKS exam as the most sensitive performance indicator is corroborated by the results for the commended pass rate. The respective coefficients for the model in column 3 for that equation were −.184 for the Katrina students and −.039 for the days missed. Both were significant but only at the .10 level. The commended rate impact of both shocks is about one third the size of the impact on the overall TAKS pass rate. The attendance equations show no impact for the missed class days, and a coefficient of −.034 for the Katrina students (significant at the .10 level). The attendance impacts are tiny and thus need not be considered in detail.
11. Hurricanes aside, many of the districts regularly receive a large number of students after the start of the school year because the families of migrant workers return to Texas after working harvests further north. The Houston Independent School District, for example, starts the school year with approximately 176,000 students and has a peak enrollment of 210,000 students in November. These evaluation systems are generally administered by central management in order to avoid disrupting the schools.
12. One might also interpret this variable as embedded slack, as Sorenson (2003) would.
13. The findings are not the result of districts with greater central office capacity simply being wealthier districts. The correlation between central office bureaucracy and property tax wealth per student is .03 (not significant). There is a positive correlation between revenues per student (which include state and federal funds) and central office bureaucracy of .26, but for districts with 1,500 students or more this correlation is an insignificant .04. The measure is the percentage of employees in the central office bureaucracy, which is likely why the measure is unrelated to district wealth. Similarly, teacher turnover is not related to school district wealth.

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Bios

Kenneth J. Meier is the Charles H. Gregory Chair in Liberal Arts at Texas A&M University. He also directs the Project for Equity, Representation and Governance, the Texas Educational Excellence Project, and the Carlos Cantu Hispanic Education and Opportunity Endowment and holds a joint appointment as a Professor of Public Management at the Cardiff University School of Business, Wales, United Kingdom.

Laurence J. O'Toole, Jr. is the Margaret Hughes and Robert T. Golembiewski Professor of Public Administration in the Department of Public Administration and Policy at the University of Georgia. His research focuses on issues of policy implementation in complex institutional settings, the impact of public management on government performance, networks and public management, intergovernmental and interorganizational relations, and environmental and educational policy and management.

Alisa Hicklin is an assistant professor of political science at the University of Oklahoma. Her research agenda includes projects on public management, education policy, racial inequities, and student success in higher education.