PAR PUBLIC ADMINISTRATION REVIEW

Rosemary O'Leary, Editor

Manuel P. Teodoro
David Switzer
Texas A&M University

Public Administration and the Disciplines

Drinking from the Talent Pool: A Resource Endowment Theory of Human Capital and Agency Performance

Manuel P. Teodoro is associate professor at Texas A&M University. His public administration research emphasizes executive behavior, with attention to professions and career systems as political phenomena. His policy research focuses on environmental policy and the ways in which human capital, management, and political institutions condition the implementation of environmental regulations. He also pursues a line of applied research on utility finance and management and has developed advanced methods for assessing rate equity and affordability.
E-mail: mteodoro@tamu.edu

David Switzer is a PhD candidate at Texas A&M University. His work examines how context moderates the effect of organizational structures on performance. He is specifically interested in how factors external to organizations, such as citizen participation and human capital, differentially impact the decision making and performance of private and public organizations. His empirical focus is on environmental policy, investigating how privatization, context, and citizen engagement affect the implementation of environmental policy.
E-mail: dswitzer@pols.tamu.edu

Abstract: *This article advances a resource endowment theory of human capital and performance in government organizations. Building on research on human capital and firm location in business economics and task complexity in public management, the authors argue that an agency's ability to implement policy is determined both by its scale and by the human capital of the population from which it draws its employees. The authors cast labor as a factor of production in public agencies and argue that access to higher-quality labor improves government effectiveness. The effect of human capital on performance is especially pronounced when agencies are charged with the implementation of technically complex tasks. The empirical subject is U.S. municipal water utilities' compliance with the Safe Drinking Water Act. Comparing records of compliance with more and less complex regulatory requirements provides evidence consistent with the general model. The findings carry important implications for public management and policy design.*

Practitioner Points

- A public agency's performance is partly a function of the availability of human capital—that is, educated workers—in the labor market from which it draws workers.
- Larger organizations can leverage available human capital more effectively than smaller organizations.
- The effect of human capital resource availability on performance depends on the complexity of an agency's task: as task complexity increases, so does the importance of human capital for agency performance.
- Agencies that operate in isolated or low human capital labor markets face exceptional challenges in executing complex tasks.
- Managers of smaller agencies seeking to improve performance should look for opportunities to scale up human capital development through collaboration and/or consolidation.

Comparative advantage based on resource endowments is one of the foundational principles of economics: firms emerge and choose their locations based in large part on their access to critical resources. For technically complex industries, human capital is a critical—perhaps *the* critical—factor of production, and in recent decades, a large literature in economics has linked a highly educated labor pool to higher levels of productivity. Highly educated workforces are able to develop new ideas and import them from other areas in ways that less educated labor pools cannot, especially for technically complex industries.

Does human capital affect government agency performance similarly? Unlike most business firms, many government agencies cannot choose their location based on their access to human capital and other resources. Faced with a shortage of educated workers, the St. Louis Health Department cannot relocate to Kansas City, where skilled labor might be more plentiful. Perhaps for this reason, public administration research to this point has largely ignored the impact that access to an educated workforce may have on public organization performance. Human capital availability may constrain or enable public agencies in ways similar to business firms but with profoundly different implications owing to differences in organizational mobility.

Human capital availability may constrain or enable public agencies in ways similar to business firms but with profoundly different implications owing to differences in organizational mobility.

Building on economic research on human capital resources and firm productivity, in this article, we argue that access to an educated labor force improves

Public Administration Review, Vol. 76, Iss. 4, pp. 564–575. DOI: 10.1111/puar.12571.

the performance of public organizations. Following existing research in public administration and business management, we contend that the complexity of an organization's tasks conditions the impact of human capital on performance. Additionally, we posit that the scale of an organization affects its ability to take advantage of available human capital resources. Overall, our theory predicts that access to human capital affects government agency performance and that the effect of human capital increases as the government's task complexity and scale increase.

As an initial test of our theory, this article analyzes municipal compliance with the Safe Drinking Water Act (SDWA), the principal federal law regulating drinking water quality in the United States and a subject of significant attention following the drinking water crisis in Flint, Michigan. The U.S. Environmental Protection Agency (EPA) tasks utilities with the fulfillment of regulations of varying complexity. Some, such as the delivery of a yearly public report on drinking water quality, are relatively simple and do not require an exceptional level of education or expertise. Others involve advanced treatment techniques to remove contaminants from the water supply. We leverage the differences in these requirements, as well as the great variety among municipal water utilities, to test our theory. Just as utilities vary in the quality of surface water or aquifers from which they draw, they also vary in the quality of the workforce available to them. When a utility has the size and resources to take advantage of human capital resources in its labor pool, compliance with the more technically difficult aspects of SDWA regulations improves. When tasks are simpler, or when the utility is so small that it cannot leverage the human capital resources available, increasing human capital availability is not associated with improved performance.

The article begins with a discussion of research in economics that identifies human capital as an important factor of production before moving onto a brief discussion of public administration studies on task complexity and performance. We then advance a new theory of organizational performance that emphasizes the interaction of human capital endowments, organizational scale, and task complexity. The theoretical discussion culminates in a set of hypotheses, which we evaluate with an empirical analysis of municipal compliance with the SDWA. We present our results, discuss their implications, and identify avenues for further investigation.

Human Capital, Task Complexity, and Organizational Performance

"Human capital" is the skills and knowledge possessed by an individual, group, or population that can be put to productive use. Beginning with Nelson and Phelps's (1966) seminal work on human capital and its relationship with technological development, a large literature has developed linking access to human capital to productivity at all levels of aggregation. Nelson and Phelps point to the important impact that human capital—most often measured as a formally educated workforce—can have on productivity, specifically in technologically advanced industries. Nelson and Phelps argue that technological development conditions the effect of human capital on production: when technology is relatively advanced, human capital has a greater impact on productivity. When human capital is high, technologies are adopted faster, and countries with lower levels of development develop more quickly (Nelson and Phelps 1966).

In the decades since Nelson and Phelps's foundational article, voluminous research has explored the effect of access to human capital on economic productivity. At the cross-national level, Benhabib and Spiegel (1994) find that human capital endowments raise countries' technological innovation. Similarly, Sala-i-Martin (1997) and Krueger and Lindahl (2000) find that education positively affects national growth. Recent research has similarly linked regional growth within countries to high human capital endowments in Italy (Scoppa 2007), China (Wei and Hao 2011), and the United States (Rauch 1993; Shapiro 2006; Simon 1998; Simon and Nardinelli 2002).

In addition to direct productivity gains from highly skilled workers, human capital affects regional productivity through knowledge spillover (Lucas 1988; Rauch 1993; Simon 1998). When there is a higher level of education and knowledge, workers interact formally and informally in ways that foster the diffusion of knowledge, leading to a more productive workforce (Rauch 1993).

Recent research has examined human capital from a resource endowment perspective in order to predict firm growth.[1] Research on the effect of human capital resources within a firm's proximity has evolved in two directions: (1) studies connecting the presence of human capital within a geographic area to firms' location decisions and (2) studies linking the availability of human capital to firm performance. In industries in which workers have to develop their own skills in order to perform at a high level, firms tend to cluster together or outsource high-complexity tasks in order to take advantage of the labor pool (Almanzan, De Motta, and Titman 2007; Graf and Mudambi 2005). Empirical studies link human capital resources to firm location choice. Service firm formation increases in areas that have populations with a larger share of college degrees (Acs and Armington 2004). New firms have been found to locate closer to academic research institutions, suggesting that firms attempt to take advantage of knowledge spillovers that may result from universities (Audretsch, Lehmann, and Warning 2005; Hoyman and Faricy 2009). In particular, technology firms tend to locate in areas with highly educated workforces in order to lower the costs of qualified labor (Florida 2002). Economic research also finds that firm growth and survival are correlated with human capital distributions (Acs, Armington, and Zhang 2007; Audretsch and Dohse 2007); critically, this finding holds in the case of knowledge-intensive firms but not for firms in sectors that do not require high levels of skill and education.

Task Complexity and Public Organizations

In contrast with research on business management, the public administration literature has almost nothing to say about human capital from a resource endowment perspective. The recruitment and training of public employees receives perennial attention (e.g., Ballou and Podgursky 1999; Brewer and Selden 2000; Meier and Hicklin 2007; Rainey and Steinbauer 1999; Shaw 2011), but the human capital resource base from which agencies draw their "raw materials" remains little examined. Accordingly, Grissom, Viano, and Selin (2016) call for more careful consideration of supply and demand conditions in public administration labor markets.

However, public administration research has given significant attention to the conditioning effects of task complexity and scale on agency performance. Perrow (1986) recognizes that the difficulty of the tasks that organizations must accomplish shapes the characteristics of the organizations themselves. He argues that when tasks are simple, a "bureaucratic structure," meaning standardization, delegation, and specialization, is efficient. When tasks are more complex, standardization is not as simple; discretion must be given to lower-level employees, and experience and professionalism are more highly valued. Similarly, Bohte and Meier (2001) argue that when tasks are extremely easy or extremely difficult, span of control may not have a large impact on performance. When tasks are moderately difficult, however, span of control has a larger effect on performance. Bohte and Meier's account is instructive for the argument developed here, as it shows that the effect of an organizational variable on performance may be conditioned by task complexity. Organizational scale also has been shown to have independent effects on performance (Andrews and Boyne 2010; Walker and Andrews 2015). The effects of scale are particularly pronounced with respect to American environmental regulation, where the technical complexity associated with compliance presents administrative capacity challenges to smaller governments (Hanford and Sokolow 1987; Weiland 1998).

To summarize, ample research has identified human capital endowments as a factor of production that affects performance, especially when performance relies on advanced technology or complex processes. Public administration research has noted that government agency performance can vary with scale and task complexity, but we are aware of no existing research that connects government agency performance to the availability of human capital in labor markets. Still, government agencies are theoretically subject to the same opportunities and constraints that labor markets present to private firms.

A Resource Endowment Theory of Human Capital

Here we present a resource theory that recognizes access to human capital as an important but conditional determinant of public organization performance. Building on existing models and findings from other fields, we cast human capital as a resource endowment—like a financial or natural resource—on which governments can draw. In this depiction, human capital is a latent resource endowment that is more or less available in a labor market, consistent with the literature on firm performance and location (Acs, Armington, and Zhang 2007; Audretsch and Dohse 2007; Hoyman and Faricy 2009). We argue that human capital availability positively affects agency performance, conditional on the complexity of the task that the agency is responsible for achieving and on the scale of the organization.

The basic idea follows directly from Nelson and Phelps (1966): when human capital is plentiful, agencies may acquire skilled labor at relatively low cost. In order to attain high performance when human capital is relatively scarce, agencies must either compete more vigorously with other organizations for skilled labor, import skilled labor from outside their market, or develop their own skilled labor. All of these alternatives are costly. Moreover, higher human capital in a labor market boosts the productivity of labor within an organization because of knowledge spillovers (Lucas 1988; Rauch 1993; Simon 1998). Consequently, human capital availability in a government's labor market should positively predict agency performance, all else being equal.

However, again following Nelson and Phelps (1966), we argue that the effect of human capital availability on agency performance depends significantly on the complexity of the tasks with which the agency is charged. The more complex the problems faced by the organization, the greater the effect of human capital resources on performance. When the organization faces simple tasks, the impact of human capital availability on performance will be relatively low. When the agency's tasks are more complex, access to a skilled labor pool becomes a far more important predictor of performance.

Advancing beyond the literature on human capital in the private sector, we also argue that the effect of human capital availability is conditional on the scale of the organization. Larger organizations tend to have more resources available to them (Hanford and Sokolow 1987; Scheberle 2004; Weiland 1998), and therefore they enjoy economies of scale in searching for, training, and retaining the human capital available to them (Donahue, Selden, and Ingraham 2000). Scale itself can also affect organizational performance. The same financial resources that allow an organization to find and retain skilled labor also allow the organization to solve problems in ways that are not available to smaller organizations.

The positive effects of scale on performance are conditional on both human capital and task complexity. When an organization is tasked with solving complex problems, the scale of the organization will only be relevant when the organization has access to highly skilled labor. When such labor is not available, the advantages of larger agencies will not translate into meaningful performance gains. As more highly skilled labor becomes available, it is easier for large organizations to leverage the labor pool into improved performance. When tasks are relatively simple, the effect of agency size will be less moderated by access to human capital: facing low-complexity tasks, larger organizations will simply apply resources to the tasks.

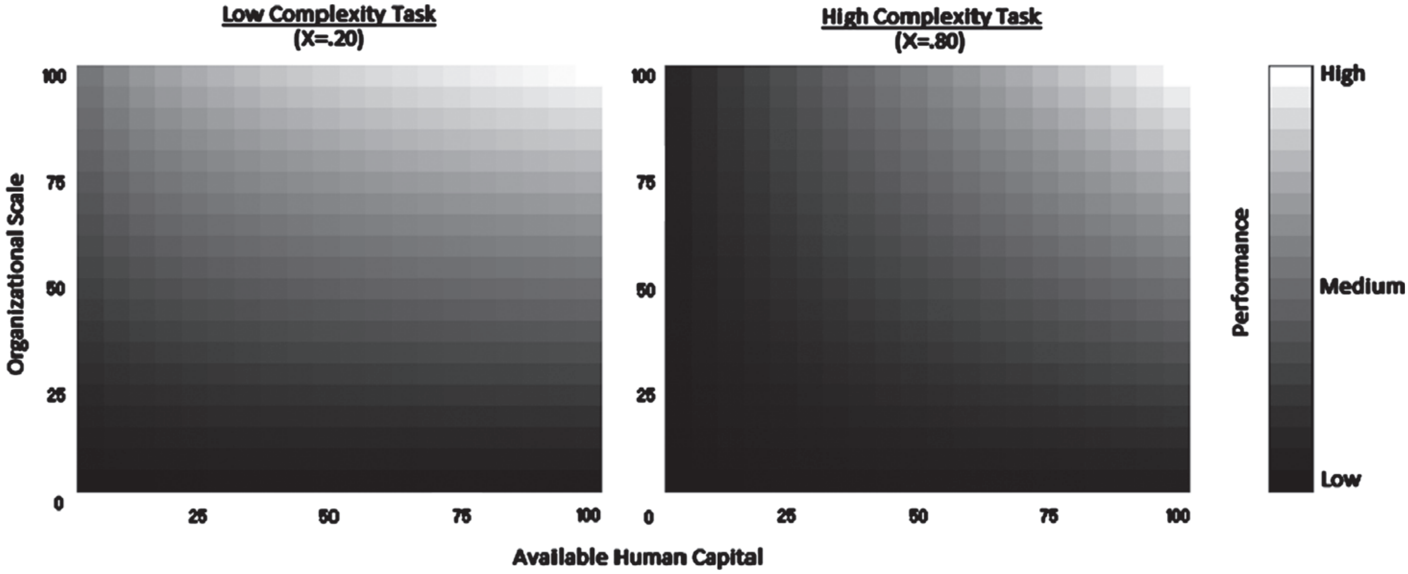
As more highly skilled labor becomes available, it is easier for large organizations to leverage the labor pool into improved performance.

Equation 1 summarizes our resource model of human capital model parsimoniously for a given agency *i,* as follows:

$$P_i = S_i H_i^X + \lambda_i + \varepsilon_i, \quad (1)$$

where P represents performance for a given task, S represents the scale of the organization, H represents the level of human capital in the labor force, and X represents the complexity of the task. The term λ is a vector of other organizational and environmental variables, and ε is an error term. S and H are positive integers, while X continuously ranges between 0 and 1. The model is a simple single-factor production function with variable marginal returns, familiar to any student of microeconomics (Robinson 1954).

This model includes all of the elements of the theory described earlier; for ease of presentation, we illustrate equation 1 graphically in a pair of contour plots in figure 1.[2] The plot on the left models performance for a relatively low-complexity task (X= .20), while



Notes: The figure depicts hypothesized agency performance as a function of capacity (size) and human capital availability for a low-complexity task ($X=.20$, left panel) and a high-complexity task ($X=.80$, right panel). High predicted performance is plotted in white, low performance in black. Predictions are based on equation 1.

Figure 1 Resource Theory of Human Capital and Agency Performance: Hypothesized Expectations

the plot on the right shows performance for a high-complexity task ($X=.80$). Organizational scale (S) is plotted on the y-axis and human capital (H) on the x-axis, with white representing high levels of performance and black representing low levels of organizational performance. Comparing the two plots shows that the effects of S and H are both highly dependent on task complexity. When task complexity (X) is low, as depicted on the left, S is a more important driver of performance than H. But H becomes important in driving performance when X is high, as in the plot on the right of figure 1.

Our theoretical model expands on existing research in a few important ways. First, the public administration literature to this point has not addressed the potential effect that access to human capital may have on organizational performance. While business economics research has recognized that human capital may affect traditional economic metrics such as firm growth, there has been no research on human capital availability and performance in public agencies, where organizational accomplishments are not measured solely by financial success. Second, this theory goes beyond existing research by recognizing the moderating effect that organizational scale may have on human capital availability. Only organizations that have sufficient organizational resources will be able to take advantage of the human capital resource endowments within their labor pool. Finally, previous work in economics linking human capital resources to firm location and performance only considers differences in task complexity across firms and has not to this point considered within-firm differences in task complexity. Performance across multiple dimensions may require different kinds of resources, and our theory allows us to consider how public organizations may leverage human capital in their labor markets pursuant to those tasks.

This theoretical model generates a number of hypotheses about agency performance. We focus on five of them for this initial empirical analysis. All else being equal, our theory predicts the following:

Hypothesis 1: Scale. Performance increases as organizational scale increases.

Hypothesis 2: Human capital. Performance increases as access to human capital increases.

These first two hypotheses predict a straightforward positive relationship between performance and both scale and human capital, consistent with existing research.

Hypothesis 3: Low-complexity tasks. For low-complexity tasks, performance increases as scale increases, unconditionally.

Put simply, hypothesis 3 predicts that "bigger is better" when it comes to low-complexity tasks: if task complexity is low, then performance will increase with scale, regardless of the organization's access to an educated labor pool.

Hypothesis 4a: High-complexity tasks and scale. For high-complexity tasks, performance increases as scale increases, conditional on human capital.

Hypothesis 4b: High-complexity tasks and human capital. For high-complexity tasks, performance increases as human capital increases, conditional on scale.

Hypotheses 4a and 4b represent the conditional effects of scale and human capital for higher-complexity tasks. For these high-X tasks, we expect the effect of S on performance to increase as H increases and the effect of H to increase as S increases.

Data and Models

The empirical subject of this article is American municipal utilities' compliance with the 1974 Safe Drinking Water Act.

The SDWA, amended in 1986 and 1996, regulates drinking water sources and infrastructure in the United States. The SDWA applies to all public water systems in the United States and requires them to meet certain standards in the treatment and distribution of the potable water. These standards set maximum contaminant limits for drinking water and specify allowable treatment technologies. The SDWA also specifies procedures for testing and public reporting of drinking water quality data. National standards are set by the EPA; states then have the opportunity to set their own standards that are at least as stringent as the national standards. These drinking water standards apply to utility facilities, not individual water customers.

Utility compliance with the SDWA is an excellent area in which to test our theory for several reasons. First, U.S. utilities, regardless of organizational or environmental characteristics, are tasked with similar regulatory requirements under the SDWA, but their organizations and environments vary considerably. Municipal water utilities differ greatly in size and in the sources from which they receive their water. They also are located in areas with disparate populations, with large variation in poverty and income, ethnic and racial makeup, and—crucially—education. Further, SDWA compliance avoids simultaneity issues that could arise if our theory were tested in an area such as education or law enforcement. It is difficult to imagine how utilities' SDWA compliance could affect a labor market's level of human capital, at least over relevant time scales.

Additionally, the environmental context provides an interesting case because of the burdens that unfunded mandates of the SDWA and other environmental laws place on local communities (Cimitile et al. 1997; Hanford and Sokolow 1987; Scheberle 2004; Weiland 1998). Under many U.S. environmental programs, the costs of environmental protection often fall to small municipalities, with limited aid from federal and state authorities. Consequently, local capacity and resources—including human capital—play a large role in the implementation of these programs.

Finally, SDWA compliance is useful to the present inquiry because its requirements include both low- and high-complexity tasks. We group violations into two categories. First, *health violations* relate to utilities' ability to control the levels of contaminants in the water supply. Included in this category are maximum contaminant limit violations, which occur when the utility's water contains contaminants above regulatory limits, and treatment technique violations, which occur when a utility fails to follow mandated treatment methods. Unlike other prominent American environmental regulations, the SDWA does not include a routine facility inspection regime to ensure compliance. Instead, the SDWA requires utilities to collect water samples and submit them for laboratory testing. Regulators review test results to check for compliance with contaminant limits. Compliance with the SDWA's health requirements can be a complex job that requires a great deal of technical acumen. Although no specific level of formal education is required for water treatment operations, the job requires a basic understanding of mathematics and chemistry. It is unlikely that personnel without specialized training in the area would be able to fulfill the requirements.

The SDWA also requires utilities to follow certain protocols for testing water, filing reports, and communicating with the public. These include what the EPA calls "monitoring and reporting" violations and "other" violations; the precise requirements differ depending on the size of the utility and the source of its water supply. We label violations of these requirements *management violations.* Compliance with these rules requires no specific advanced training but simply requires fulfilling procedural tasks in a timely manner. SDWA procedural requirements include taking water samples and sending them to the lab for testing, issuing boil water notices, or simply publishing annual water quality reports. The differences between the two types of violations allow us to examine the ways in which task complexity conditions the effects of scale and human capital and to conduct a thorough testing of our hypotheses.[3] We use health compliance to evaluate the effects of human capital availability and scale on high-complexity task performance and management compliance to evaluate low-complexity task performance.

We draw on data from a number of sources. We obtain water utility and compliance data from the Safe Drinking Water Information System (SDWIS) database.[4] The present analysis evaluates the compliance of municipal water utilities serving populations of 500 or more in the years 2010 to 2013. A total of 8,962 municipal water systems are examined here—effectively, all U.S. municipalities that own water utilities and serve populations of 500 or more. In order to make valid comparisons across organizational types and to maximize data availability, we exclude investor-owned utilities and utilities operated by special districts, tribal governments, state governments, and the federal government from the analysis. We draw utility employment data from the 2012 Census of Governments (COG) and demographic, economic, and educational attainment data from the 2012 American Community Survey (ACS) five-year estimates.

The dependent variable in this study is compliance with the SDWA. For the present analysis, we consider a utility compliant if it had no violations of the SDWA over the four years observed. We analyze the two types of violations separately using two dichotomous dependent variables. We code *health compliance* as 1 if a utility had no health violations from 2010 to 2013 and 0 if it had one or more. We code *management compliance* similarly. Descriptive statistics for all variables are reported in table 1. Management violations are far more common than health violations, with 55 percent of utilities having committed no management violations over the four-year period, while 78 percent were fully compliant with health regulations over the same period. Notably, health and management violations are poorly correlated ($\rho = .07$), suggesting that different factors drive the two types of violations.

We measure organizational scale as the number of full-time equivalent employees (FTEs) employed by each municipality in the areas of water and sewer utilities, according to the 2012 COG.[5] Not surprisingly, American water utilities range widely in scale: many of the smallest utilities have only one FTE, while New York City employs 3,870 FTEs. Although the mean number of employees is only 18, the standard deviation of 86.3 indicates great positive skew.[6]

We measure human capital with data on metropolitan area and municipal populations from the ACS. Because our theory posits that human capital in the labor market affects performance, we follow

Table 1 Descriptive Statistics

	Percentage	Mean	Stand Dev	Min	Max
Binary Variables					
Management Compliance	55.04				
Health Compliance	78.02				
Groundwater Supply	59.32				
Purchased Water Supply	20.93				
New System	3.25				
Continuous Variables					
Management Violations		2.42	8.23	0	401
Health Violations		0.83	4.30	0	232
Utility Employees		17.79	86.31	1	3870
% Metro w. Bachelor's		23.17	9.00	5.4	58
Median Income (1000s)		45.50	18.77	12.36	250
% Below Poverty		17.33	9.85	0	67.6
% Hispanic		9.53	15.54	0	99.78
% Black		9.21	17.19	0	99.71
Population Served (1000s)		17.43	117.90	0.50	8000

the existing literature in measuring human capital in the labor force within metropolitan statistical areas (MSAs) (Acs and Armington 2004; Hoyman and Faricy 2009; Rauch 1993; Shapiro 2006; Simon 1998), which more accurately represents the level of human capital available to utilities. City boundaries do not fully represent economic boundaries because labor pools may extend beyond city limits, and therefore human capital within the city labor pool alone may not fully capture the effect of human capital endowments on productivity. Following Hoyman and Faricy (2009), we measure human capital as the percentage of the working-age population with a bachelor's degree or higher, which we believe measures the education desirable for compliance with SDWA regulations better than the percentage of the working-age population with a high school diploma. A college education is neither a necessary nor a sufficient condition for an individual to be capable of completing the tasks required for health compliance with the SDWA. However, the tasks involved in drinking water treatment often require mathematical and technical abilities that are more likely to be found in a highly educated labor market.

City boundaries do not fully represent economic boundaries because labor pools may extend beyond city limits, and therefore human capital within the city labor pool alone may not fully capture the effect of human capital endowments on productivity.

We include a number of control variables for utility characteristics in the analysis. We include a control for whether a utility's major source of water supply is *groundwater* or surface water, coded as 1 for groundwater and 0 for surface water. Groundwater tends to have fewer contaminants than surface water, so utilities that use surface water are expected to be more likely to produce health violations (Wallsten and Kosec 2008). Similarly, we expect that utilities that *purchase* their wholesale water supplies will have fewer health violations, as the wholesale provider is responsible for source quality and treatment processes (Teodoro 2014; Wallsten and Kosec 2008). Neither water source variable is expected to affect management compliance. The age of a system could also be expected to influence SDWA compliance, as older systems may have antiquated technology and therefore be more likely to commit health violations. Unfortunately, the SDWIS contains no information on the exact age of systems. As a next-best alternative, we include a *new system* variable that is coded 1 if the system existed in the system in 1981 (the SDWIS's first year) and 0 if it was entered into the system at a later date. We also include a variable for the size of the *population* served by the utility. After accounting for other relevant variables, we would expect utilities that serve more people to commit more violations because larger utilities will have more extensive distribution and treatment systems, which provide more opportunities for violations.

In addition to data on education, we include a number of control variables from the ACS. Compliance with U.S. environmental regulation has been linked to socioeconomic status and ethnic/racial minorities (Konisky and Schario 2010). Therefore, we control for median household income, the percentage of the population below the poverty level, and the percentages of blacks and Hispanics in the population. We expect that median household income will positively predict SDWA compliance, and higher poverty rates and high-minority areas will negatively predict compliance. Finally, regulation of the SDWA is jointly administered by the EPA and state governments, and regulatory requirements can vary across states. For this reason, we include state dummy variables in all of the models estimated to control for state-level differences in regulatory regimes.

In order to evaluate our hypotheses, we estimate a statistical model with the following general form for each type of compliance:

$$C_i = \alpha_1 + \beta_1 S_i + \beta_2 H_i + \beta_3 S_i H_i + \beta_4 U_i + \beta_5 M_i + \beta_6 T_i + \varepsilon_i, \quad (2)$$

where C represents the likelihood of compliance (0 or 1) for utility i, S represents scale, H represents human capital, U represents utility-level characteristics, M represents municipality characteristics, T is a state dummy, and α and ε are constant and error terms, respectively.

Based on hypotheses 1 and 2, we expect the effects of scale (S) and human capital (H) to be positive—that is, the likelihood of compliance will increase as agency size and labor market human capital increase, independently. We use an interactive model to test the conditional hypotheses 3, 4a, and 4b and therefore include an interactive term and the two constitutive terms (Brambor, Clark, and Golder 2006) to capture the nature of the relationship between the two variables. Under hypothesis 3, the likelihood of compliance with a low-complexity task should increase with S regardless of the value of H. However, hypotheses 4a and 4b predict a moderating relationship between scale and human capital with respect to high-complexity task performance, and so we expect the effects of S and H on SDWA health compliance to depend on their interaction.

Because our measure of compliance is a dichotomous, we estimate logistic regression models.[7] We use a natural log transformation of our measure of scale to more fully represent the effects we are investigating. Because we expect diminishing returns to increases in employment, we anticipate a nonlinear relationship between scale and compliance. For example, we would expect the difference between utilities with 25 and 50 FTEs to be more significant than between utilities with 1,475 and 1,500 FTEs. In order to evaluate our hypothesized conditionality, we estimate models with and without interaction terms. We present four logistic regressions, two each for health and management compliance.[8]

Results

The results of the four models are presented in table 2. The models of greatest interest here are the interactive models (models 2 and 4), although comparison with the direct-effects-only models (1 and 3) also yields useful inferences. Logit coefficients are difficult to interpret directly, especially when estimates include interactions. For this reason, we estimate the marginal effects of both human capital and scale as estimated in models 2 and 4 and plot them in figures 2–4 in order to evaluate the relationships between our major variables and SDWA compliance (Brambor, Clark, and Golder 2006).

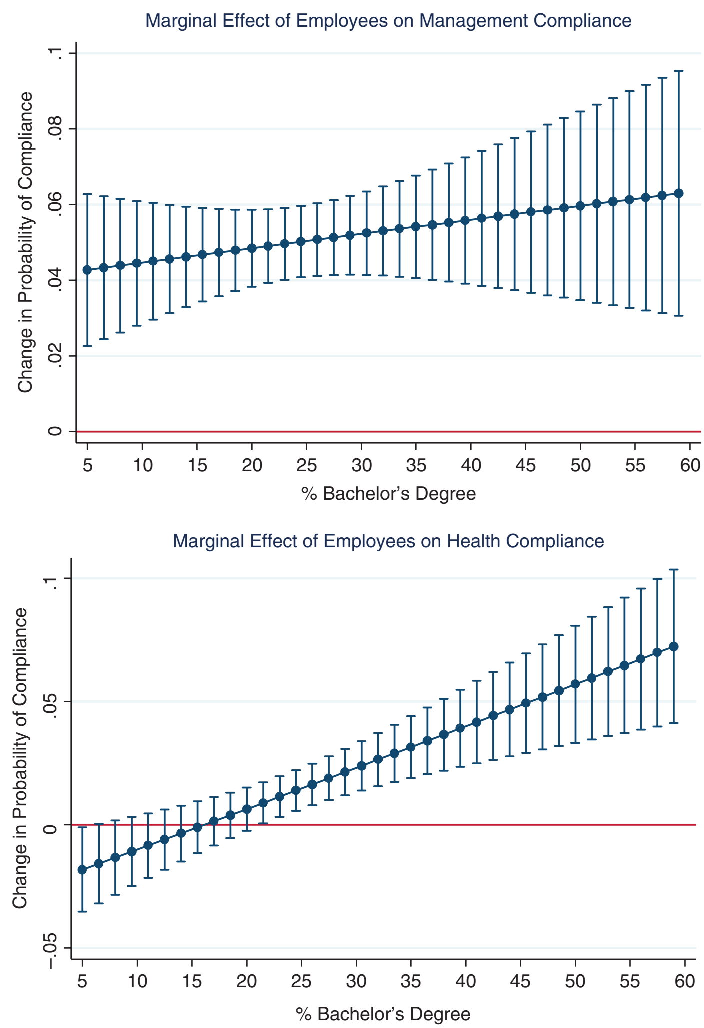
Scale and Human Capital

Beginning with hypothesis 1, which simply posits positive relationships between performance and scale, our analysis yields generally affirmative results. The top and bottom panels of figure 2 show the marginal effects of scale on management and health compliance, respectively, across values of educational attainment in the labor market. We find that scale is positively and significantly related to compliance under almost all conditions, with the exception of health compliance when human capital is low (less than 20 percent metropolitan population with a bachelor's degree). This positive relationship is especially pronounced in models 1 and 3. The results for hypothesis 2 are less consistent. As figure 3 shows, access to human capital has no statistically distinguishable effect on the low-complexity management compliance task, regardless of agency scale. However, human capital availability has a pronounced positive effect on the high-complexity health compliance task, as seen in the lower panel of figure 3. The effect of human capital appears to depend on complexity in a way that the effect of scale does not.

Table 2 Logistic Regression Predicting Compliance with SDWA, 2010–13

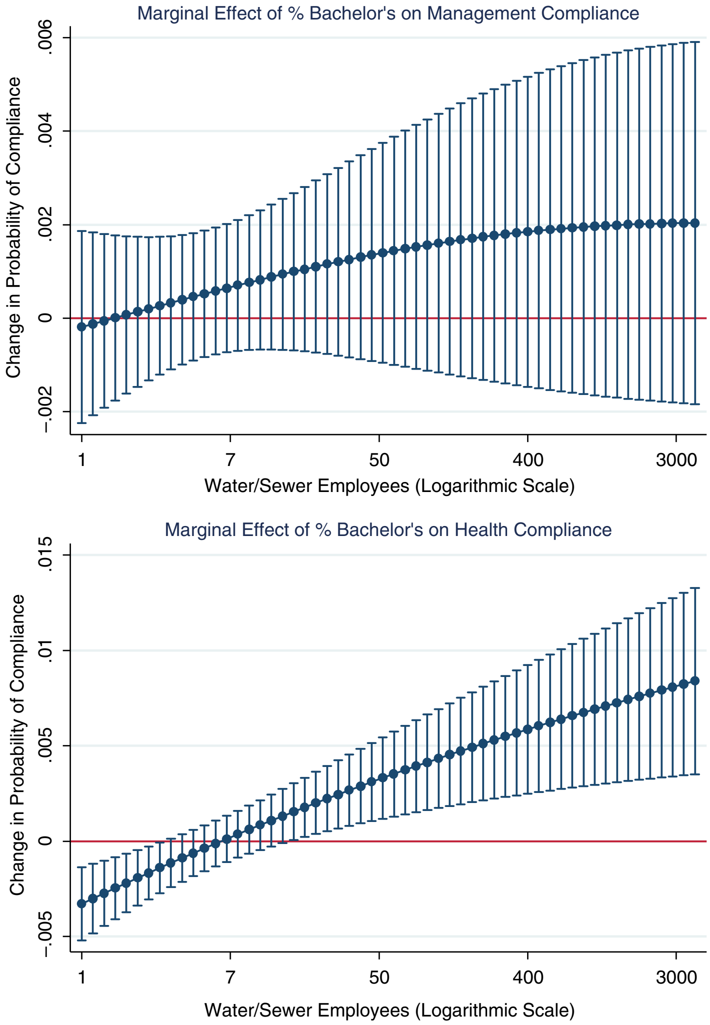
	Management Violations		Health Violations	
	(1)	(2)	(3)	(4)
% Metro w. Bachelor's	0.00	−0.00	0.00	−0.02**
	(0.00)	(0.00)	(0.00)	(0.00)
Logged Employees	0.24**	0.19**	0.08**	−0.17**
	(0.02)	(0.06)	(0.03)	(0.07)
% Metro w. Bachelor's		0.00		0.01**
× Logged Employees Interaction		(0.00)		(0.00)
Median Income (1000s)	0.00	0.00	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
% Below Poverty	−0.00	−0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
% Hispanic	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)
% Black	−0.01**	−0.01**	−0.01*	−0.01*
	(0.00)	(0.00)	(0.00)	(0.00)
Population Served (1000s)	−0.00	−0.00	0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Groundwater Supply	0.28**	0.28**	0.69**	0.69**
	(0.06)	(0.06)	(0.07)	(0.07)
Purchased Water Supply	0.19**	0.19**	0.59**	0.58**
	(0.07)	(0.07)	(0.08)	(0.08)
New System	−0.21	−0.21	−0.18	−0.18
	(0.15)	(0.15)	(0.17)	(0.17)
Constant	−0.71**	−0.63**	0.19	0.64**
	(0.18)	(0.20)	(0.21)	(0.24)
Observations	8962	8962	8962	8962
AIC	10934.35	10935.65	8752.12	8737.77
Log Likelihood	−5408.18	−5407.82	−4317.06	−4308.89
LR-Test(χ^2)	0.71		16.35**	

Note: Standard Errors in parantheses. Models also include state dummy variables.
Significance Levels: ** < 0.01 * < 0.05
Likelihood Ratio Test of whether interactive model improves on no interaction model.



Notes: Figure presents the marginal effect of a one-unit increase in logged employees on the likelihood of SDWA compliance with all other variables at their means. The top panel depicts the marginal effect on management compliance based on model 2; the bottom panel shows the marginal effect on health compliance based on model 4. Vertical bars represent 95 percent confidence intervals.

Figure 2 Marginal Effect of Agency Size on SDWA Compliance



Notes: Figure presents the marginal effect of a one-unit increase in the percentage of the metropolitan area population that has completed a bachelor's degree on the likelihood of SDWA compliance with all other variables at their means. The top panel depicts the marginal effect on management compliance based on model 2; the bottom panel shows the marginal effect on health compliance based on model 4. Vertical bars represent 95 percent confidence intervals.

Figure 3 Marginal Effect of Human Capital on SDWA Compliance

Complexity

The results presented in figure 2 strongly support hypothesis 3, which posits that the effect of scale is always positive for low-complexity tasks. In the management compliance models, the effect of scale is substantively and statistically significant regardless of human capital availability.

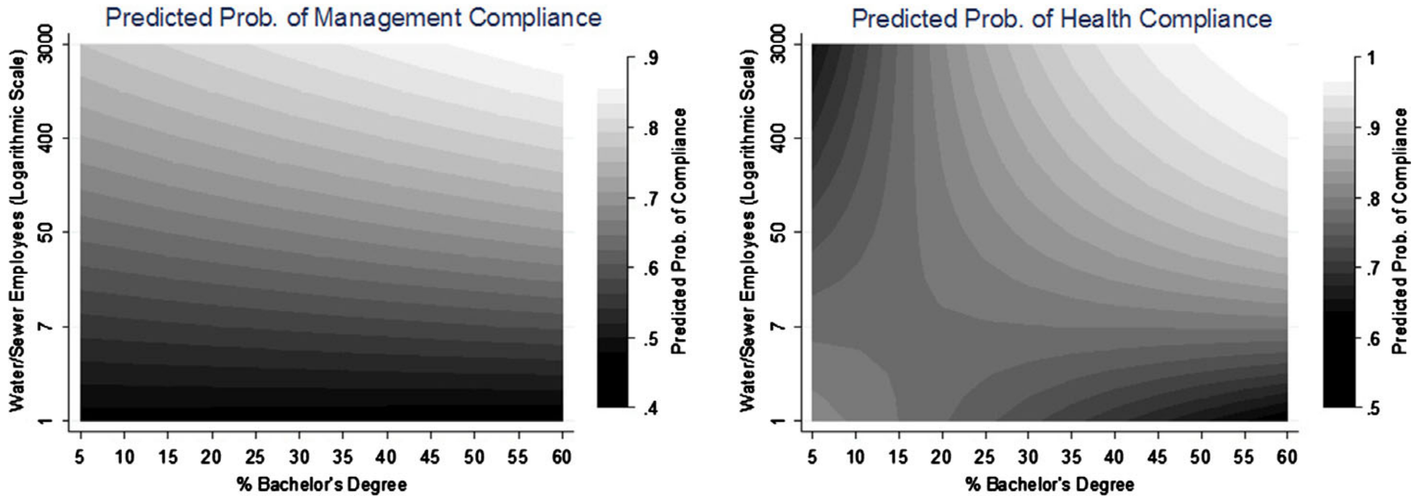
The picture is markedly different for high-complexity SDWA health compliance. Human capital endowment has little relationship with SDWA management compliance, but it appears to be a large factor in SDWA health compliance: human capital availability is positively and significantly correlated with health compliance across the higher values of utility employment, consistent with hypotheses 4a and 4b. Marginal effects plots yield further support for hypotheses 4a and 4b. The lower panel of figure 2 plots the marginal effect of logged employees across labor market educational attainment, showing that the effect of scale on the probability of health compliance is positive and significant only when the labor pool with a bachelor's degree exceeds 20 percent, which approaches the mean of 23.7 percent. An increase in the number of employees is only related to improved health compliance when the labor pool offers a sufficient level of human capital.

The bottom panel of figure 3 offers similar support for hypothesis 4b, which suggests that increases in performance will result from increases in labor pool human capital, conditional on an organizational scale. Organizations that have logged employment over 2.6, which is equivalent to about 13 FTEs (Foxborough, Massachusetts, has 13 FTEs, for example), gain a significant boost in their likelihood of health compliance from increases in the level of human capital in their labor markets. Human capital does not yield this positive effect for smaller utilities. Although Foxborough may not seem large, 13 FTEs is greater than more than what 75 percent of U.S. municipal water utilities employ. Those small agencies are unable to take advantage of the human capital in their labor pool, and yet they make up the majority of U.S. municipal utilities.

The contour plots in figure 4 depict the interaction of scale, human capital availability, and compliance with SDWA management (at left) and health requirements (at right) as generated by models 2 and 4. Comparison of these plots with figure 1, which was generated by our theoretical model, reveals a striking convergence between theoretical predictions and empirical analysis. With low-complexity tasks (where $X = .20$ in figure 1 and management compliance in figure 4), most of the variation in performance occur along the vertical axis, which represents changes in organizational scale. There is very little change in expected performance on low-complexity tasks along the horizontal axis in either the theoretical model represented in figure 1 or the empirical results presented in figure 4. As expected, human capital has little impact on organizational performance with low-complexity tasks.

For high-complexity plots ($X = .80$ in figure 1 and health compliance in figure 4), we see the more complicated, conditional effects of scale and human capital. Perhaps most important for the present analysis, organizational performance with high-complexity tasks is highest when both human capital and scale are high, represented in the upper-right regions of figures 1 and 4.

The complexity–contingent relationship between human capital and performance is further supported by the comparison of the interaction models with their interactionless counterparts. Because the noninteractive models are nested within the interactive models, we can compare across models to determine whether the inclusion of the interaction term improves the fit of the model. The theory advanced here implies that the conditional relationship between human capital and scale occurs only with high-complexity tasks. If true, then the inclusion of an interaction term in a regression model should significantly improve the fit of the health compliance (high task complexity) models but not the management compliance (low task complexity) models. Both fit statistics and formal tests show that the inclusion of the interaction term in model 2 does not significantly improve the fit of the management compliance model over the direct-effects-only model 1. By contrast, the interaction in model 4 markedly improves the fit of the high-complexity health compliance model compared with model 3, yielding a 14-point improvement in the Akaike information criterion (AIC) and a



Notes: Figure shows predicted SDWA management compliance based on model 2 (left panel) and SDWA health compliance based on model 4 (right panel). High predicted compliance is plotted in white, low predicted compliance in black.

Figure 4 Estimated Safe Drinking Water Act Compliance: Empirical Results

likelihood ratio χ^2 of 163.35 compared with the model with direct effects only. In short, our results indicate that performance on high-complexity tasks depends on the interaction of scale and human capital availability in ways that are consistent with our theory.

Controls

The models provide some interesting results for the control variables as well. As expected, groundwater and purchased water supplies positively predict compliance in the health model and, surprisingly, are found to have a significant effect on management compliance. Utilities that began after 1981 are rare in this data set (just 3.3 percent of utilities), so it is not surprising that being a new system does not significantly predict compliance. Total population served does not significantly affect compliance with either type of requirement: after controlling for organizational scale, population served by the utility is unrelated to the likelihood of compliance.

The results for the other demographic variables are especially interesting. Median household income is positively and significantly correlated with health compliance, but it has no significant relationship with management compliance. Poverty rate has opposite effects on the two types of violations, although the variable is statistically insignificant in both models. The percentage black population is negatively and significantly related with both types of compliance, while the percentage Hispanic population not significant in either model. These results potentially hold interesting implications for environmental justice and merit further investigation.

Political Activism, Not Resource Endowment?

It could be argued that the effects of human capital endowments we find are not attributable to differences in the labor pool but rather to the fact that educated populaces are more likely to engage with the organizations providing their drinking water. Higher levels of human and economic growth positively predict political participation (Brady, Verba, and Schlozman 1995), and so more affluent and well-educated people might influence the political process in ways that lead to reductions in environmental risk (Shapiro 2006). If so, the observed relationship between education and health compliance might have little to do with human capital as a resource. The use of metropolitan area educational attainment data partially addresses this possibility, as the educational data used here are for MSAs, not the municipalities themselves. However, the municipalities themselves contribute to the MSA human capital levels, which may drive our results.

In order to account for this alternative hypothesis, we estimate models that control for local educational attainment at the municipal level, which we would expect to predict political engagement in local politics. Table 3 reports the results of these models, and figures 5 and 6 show marginal effects for these models.

We find that the effects of scale, human capital, and task complexity in table 3 remain consistent with the models reported in table 2.[9] Interestingly, the effect of local educational attainment is positive in both models, which indicates that local engagement could affect compliance for both management and health regulations. Future research on this possibility could yield important findings on the relationships between education, government responsiveness, and agency performance.

Discussion

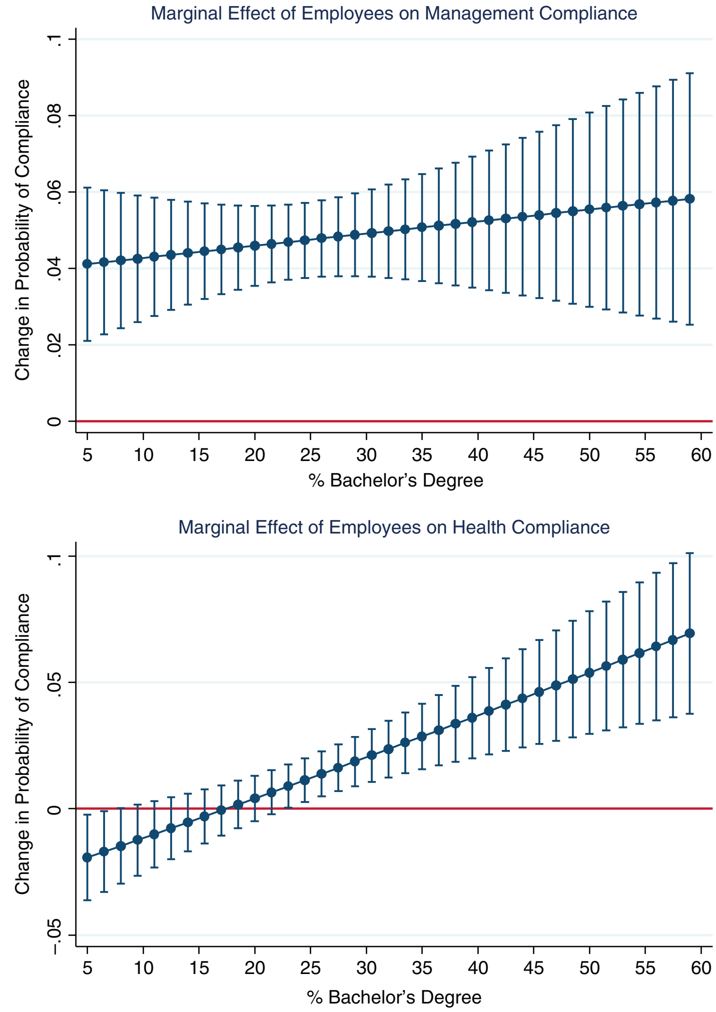
We have advanced a resource endowment theory of human capital and performance in government agencies that posits different effects of human capital availability depending on task complexity and organizational scale. Public organizations face tasks of varying complexity. When tasks are complex and require skilled employees, we argue that access to human capital resources is an important and largely ignored component of government agency capacity. Additionally, when organizations lack scale to take

When organizations lack scale to take advantage of the resources around them, performance may suffer even when high-quality labor resources are available.

Table 3 Logistic Regression Including Municipal Education Levels Predicting Compliance with SDWA, 2010–13

	Management (5)	Health (6)
% Metro w. Bachelor's	−0.00	−0.02**
	(0.00)	(0.01)
Logged Employees	0.19**	−0.18**
	(0.01)	(0.07)
% Metro w. Bachelor's	0.00	0.01**
× Logged Employees Interaction	(0.00)	(0.00)
% Municipal w. Bachelor's	0.01*	0.01*
	(0.00)	(0.00)
Median Income (1000s)	−0.00	0.01
	(0.00)	(0.00)
% Below Poverty	−0.01	0.00
	0.00	(0.00)
% Hispanic	−0.00	−0.00
	(0.00)	(0.00)
% Black	−0.01**	−0.01*
	(0.00)	(0.00)
Population Served (1000s)	−0.00	−0.00
	(0.00)	(0.00)
Groundwater Supply	0.28**	0.69**
	(0.06)	(0.07)
Purchased Water Supply	0.19**	0.58**
	(0.07)	(0.08)
New System	−0.21	−0.18
	(0.15)	(0.17)
Constant	−0.58**	0.71**
	(0.20)	(0.24)
Observations	8962	8962
AIC	10933.62	8735.47
Log Likelihood	−5405.81	−4306.73

Note: Standard Errors in parantheses.
Models also include state dummy variables.
Significance Levels: **<0.01 *<0.05



Notes: Figure presents the marginal effect of a one-unit increase in logged employees on the likelihood of SDWA compliance with all other variables evaluated at their means. The top panel depicts the marginal effect on management compliance based on model 5; the bottom panel shows the marginal effect on health compliance based on model 6. Vertical bars represent 95 percent confidence intervals.

Figure 5 Marginal Effect of Agency Size on SDWA Compliance

advantage of the resources around them, performance may suffer even when high-quality labor resources are available. In the case of American municipal utilities, agency performance depends not only on the rivers and aquifers from which they draw their water but also on the size of the organization and the quality of the talent pool from which they draw their labor.

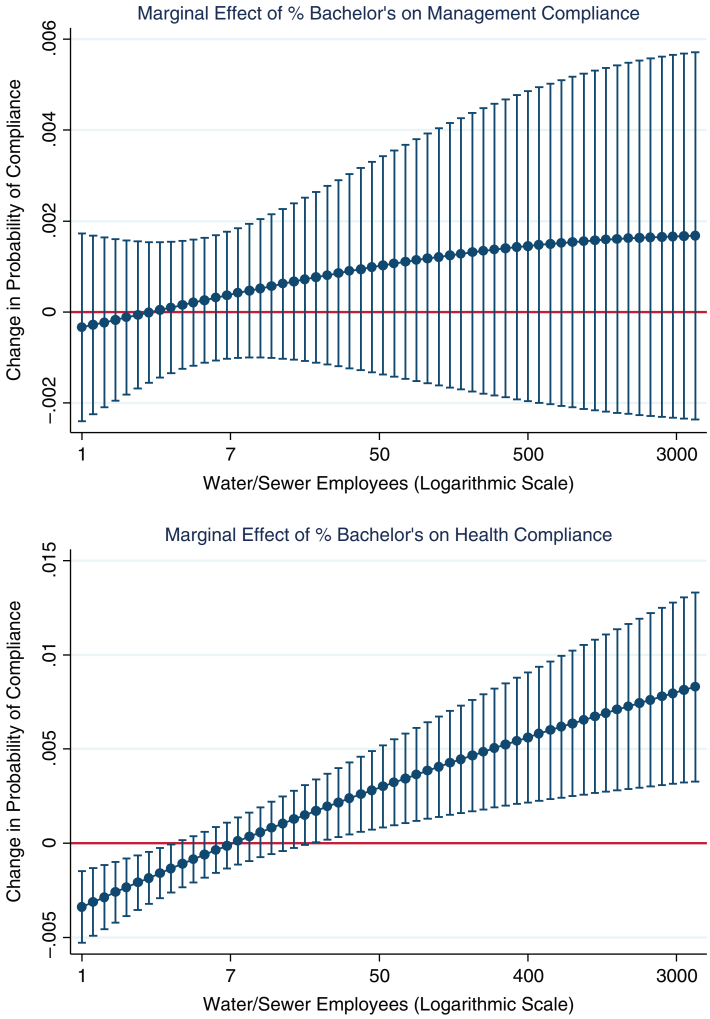
Directions for Future Inquiry

While our theory was tested on regulatory compliance, it is meant to generalize to any context in which agencies of varying size face tasks of varying complexity. Health care, where treatments vary greatly in complexity, is an obvious example: if our theory is correct, then hospital performance with complex specialties such as surgical oncology should be more sensitive to scale and the availability of human capital than less complex treatments such as rehabilitative physical therapy. The theory holds special promise for cross-national comparative analysis of agency performance, especially in policy areas in which disparities in scale and human capital are vast.

The theory offered here is intentionally simple and not intended as an omnibus theory of agency performance. Our theory draws together heretofore neglected or isolated lines of research into a single model. The model's elegance is a virtue, but necessarily sacrifices comprehensiveness. We hope that future researchers will refine, extend, and integrate the model in novel ways.

Conclusion

Our resource endowment theory of human capital holds important implications for the research and practice of public administration. Many, perhaps most, public agencies cannot move to areas with ample human capital, and so special attention should be paid to organizations that perform complex tasks in areas that lack sufficient human capital endowments. Under what conditions are these organizations able to perform well, and what steps do they take to overcome the human capital resource gap? Can effective management mitigate poor human capital endowments? What policy alternatives might alleviate disparities in human capital?



Notes: Figure presents the marginal effect of a 1 percent increase in the percentage of the metropolitan area population that has completed a bachelor's degree on the likelihood of SDWA compliance with all other variables evaluated at their means. The top panel depicts the marginal effect on management compliance based on model 5; the bottom panel shows the marginal effect on health compliance based on model 6. Vertical bars represent 95 percent confidence intervals.

Figure 6 Marginal Effect of Human Capital on SDWA Compliance

Possible interventions include consolidations to increase scale, centralization of high-complexity tasks, support for agency-level human capital investments, and/or privatization of functions that are especially prone to human capital shortages. This challenge is particularly acute in this era of increasing task complexity and ongoing disparities in human capital. We hope that casting human capital as a resource will help lead researchers and policy makers to novel and effective solutions.

Notes

1. See Crook et al. (2011) for a literature review and a meta-analysis of the relationship between within firm human capital and firm performance.
2. Figure 1 bounds S and H at 1 and 100 for ease of presentation, although it is theoretically possible for them to be unbounded at the upper end, especially in the case of scale.
3. Factor analysis validates our categorization of "monitoring and reporting" violations with "other" violations and "maximum contaminant limit" violations with "treatment technique," as reported in the supplemental appendix, which is available in the online version of this article.
4. A 2011 audit of SDWIS found that states tend to underreport violations (GAO 2011) but did not identify any systematic bias in reporting. The present analysis assumes that SDWIS errors are randomly distributed and therefore do not bias estimation. Indeed, underreporting is most likely to inflate error terms in regression analysis, which biases estimates in favor of the null hypothesis but should not cause biased parameter estimation.
5. In many municipalities that operate both water and sewer utilities, the same personnel are assigned to both functions (i.e., an employee might work on the water system sometimes and the sewer system at other times). Because of differences in reporting personnel, many cities that operate water utilities report zero FTE for the water utility but a large number of personnel for the sewer utility. Investigation of selected cases revealed that water personnel had been assigned to the sewer utility for COG reporting purposes. In order to avoid underestimating water employees, we counted all water and sewer FTEs in our measure of organizational scale.
6. For present purposes, it is more appropriate to use a measure of the actual size of the organization as absolute scale rather than a population adjusted measure, such as FTEs per 1,000 residents served. San Diego (California) Water has approximately 1.16 FTEs per 1,000 residents, while Laurelville, Ohio, a town of 570 people has 5.22 FTEs per 1,000. It would erroneous to infer that Laurelville's water utility has greater organizational capacity than San Diego's.
7. Because our dependent variable is a binary constructed from raw count data, we fitted negative binomial regression models as a robustness check. These alternative models generated substantively and statistically similar results; they are reported in the supplemental appendix online.
8. Because there may be multiple utilities within a labor market, we also estimated models with MSA-clustered standard errors to account for the possibility of nonindependent errors. The results, reported in the supplemental appendix online, and are nearly identical to the results reported here.
9. Contour plots for these models are included in the supplemental appendix online.

References

Acs, Zoltan J., and Catherine Armington. 2004. The Impact of Geographic Differences in Human Capital on Service Firm Formation Rates. *Journal of Urban Economics* 56(2): 244–78.

Acs, Zoltan J., Catherine Armington, and Ting Zhang. 2007. The Determinants of New-Firm Survival across Regional Economies: The Role of Human Capital Stock and Knowledge Spillover. *Papers in Regional Science* 86(3): 367–92.

Almanzan, Andres, Adolfo de Motta, and Sheridan Titman. 2007. Firm Location and the Creation and Utilization of Human Capital. *Review of Economic Studies* 74(4): 1305–27.

Andrews, Rhys, and George Boyne. 2010. Capacity, Leadership, and Organizational Performance. *Public Administration Review* 70(3): 443–54.

Audretsch, David B., and Dirk Dohse. 2007. Location: A Neglected Determinant of Firm Growth. *Review of World Economics* 143(1): 79–107.

Audretsch, David B., Erik E. Lehmann, and Susanne Warning. 2005. University Spillovers and New Firm Location. *Research Policy* 34(7): 1113–22.

Ballou, Dale, and Michael Podgursky. 1999. Teacher Recruitment and Retention in Public and Private Schools. *Journal of Policy Analysis and Management* 17(3): 393–417.

Benhabib, Jess, and Mark M. Spiegel. 1994. The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data. *Journal of Monetary Economics* 34(2): 143–73.

Bohte, John, and Kenneth J. Meier. 2001. Structure and Performance of Public Organizations: Task Difficulty and Span of Control. *Public Organization Review* 1(3): 341–54.

Brady, Henry E., Sidney Verba, and Kay Lehman Schlozman. 1995. Beyond SES: A Resource Model of Political Participation. *American Political Science Review* 89(2): 271–94.

Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis* 14(1): 63–82.

Brewer, Gene A., and Sally Coleman Selden. 2000. Why Elephants Gallop: Assessing and Predicting Organizational Performance in Federal Agencies. *Journal of Public Administration Research and Theory* 10(4): 685–711.

Cimitile, Carole J. Victoria S. Kennedy, W. Henry Lambright, Rosemary O'Leary, and Paul Weiland. 1997. Balancing Risk and Finance: The Challenge of Implementing Unfunded Environmental Mandates. *Public Administration Review* 57(1): 63–74.

Crook, T. Russell, Samuel Y. Todd, James G. Combs, David J. Woehr, and David J. Ketchen, Jr. 2011. Does Human Capital Matter? A Meta-Analysis of the Relationship between Human Capital and Firm Performance. *Journal of Applied Psychology* 96(3): 443–56.

Donahue, Amy Kneedler, Sally Coleman Selden, and Patricia W. Ingraham. 2000. Measuring Government Management Capacity: A Comparative Analysis of City Human Resources Management Systems. *Journal of Public Administration Research and Theory* 10(2): 381–411.

Florida, Richard. 2002. The Economic Geography of Talent. *Annals of the Association of American Geographers* 92(4): 743–55.

Graf, Michael, and Susan M. Mudambi. 2005. The Outsourcing of IT-Enabled Business Processes: A Conceptual Model of the Location Decision. *Journal of International Management* 11(2): 253–68.

Grissom, Jason A., Samantha L. Viano, and Jennifer L. Selin. 2016. Understanding Employee Turnover in the Public Sector: Insights from Research on Teacher Mobility. *Public Administration Review* 76(2): 241–51.

Hanford, Priscilla L., and Alvin D. Sokolow. 1987. Mandates as Both Hardship and Benefit: The Clean Water Program in Small Communities. *Publius* 17(4): 131–46.

Hoyman, Michele, and Christopher Faricy. 2009. It Takes a Village: A Test of the Creative Class, Social Capital, and Human Capital Theories. *Urban Affairs Review* 44(3): 311–33.

Konisky, David M., and Tyler S. Schario. 2010. Examining Environmental Justice in Facility Level Regulatory Enforcement. *Social Science Quarterly* 91(3): 835–55.

Krueger, Alan B., and Mikael Lindahl. 2000. Education for Growth: Why and for Whom? Working Paper no. 7591, National Bureau of Economic Research.

Lucas, Robert. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics* 22(1): 3–42.

Meier, Kenneth J., and Alisa Hicklin. 2007. Employee Turnover and Organizational Performance: Testing a Hypothesis from Classical Public Administration. *Journal of Public Administration Research and Theory* 18(4): 573–90.

Nelson, Richard R., and Edmund S. Phelps. 1966. Investment in Humans, Technological Diffusion, and Economic Growth. *American Economic Review* 56(1–2): 69–75.

Perrow, Charles. 1986. *Complex Organizations: A Critical Essay*. New York: McGraw-Hill.

Rainey, Hal G., and Paula Steinbauer. 1999. Galloping Elephants: Developing Elements of a Theory of Effective Government Organizations. *Journal of Public Administration Research and Theory* 9(1): 1–32.

Rauch, James E. 1993. Productivity Gains from Geographic Concentrations of Human Capital: Evidence from the Cities. *Journal of Urban Economics* 34(3): 380–400.

Robinson, Joan. 1954. The Production Function and the Theory of Capital. *Review of Economic Studies* 21(2): 81–106.

Sala-i-Martin. 1997. I Just Ran Four Million Regressions. Working Paper no. 6252, National Bureau of Economic Research.

Scheberle, Denise. 2004. *Federalism and Environmental Policy*. Washington, DC: Georgetown University Press.

Scoppa, Vincenzo. 2007. Quality of Human and Physical Capital and Technological Gaps across Italian Regions. *Regional Studies* 41(5): 585–99.

Shapiro, Jesse M. 2006. Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital. *Review of Economics and Statistics* 88(2): 324–35.

Shaw, Jason D. 2011. Turnover Rates and Organizational Performance: Review, Critique, and Research Agenda. *Organizational Psychology Review* 1(3): 187–213.

Simon, Curtis J. 1998. Human Capital and Metropolitan Employment Growth. *Journal of Urban Economics* 43(2): 223–43.

Simon, Curtis J., and Clark Nardinelli. 2002. Human Capital and the Rise of American Cities. *Regional Science and Urban Economics* 32(1): 59–96.

Teodoro, Manuel P. 2014. When Professionals Lead: Executive Management, Normative Isomorphism and Policy Implementation. *Journal of Public Administration Research and Theory* 24(4): 137–64.

U.S. Government Accountability Office (GAO). 2011. *Drinking Water: Unreliable State Data Limit EPA's Ability to Target Enforcement Priorities and Communicate Water Systems.* Washington, DC: U.S. Government Printing Office. GAO-11-381.

Walker, Richard M., and Rhys Andrews. 2015. Local Government Management and Performance: A Review of the Evidence. *Journal of Public Administration Research and Theory* 25(1): 101–33.

Wallsten, Scott, and Katrina Kosec. 2008. The Effects of Ownership and Benchmark Competition: An Empirical Analysis of U.S. Water Systems. *International Journal of Industrial Organization* 26(1): 186–205.

Wei, Zheng, and Rui Hao. 2011. The Role of Human Capital in China's Total Factor Productivity Growth: A Cross-Provincial Analysis. *Developing Economies* 49(1): 1–35.

Weiland, Paul S. 1998. Environmental Regulations and Local Government Institutional Capacity. *Public Administration Quarterly* 22(2): 176–203.

Supporting Information

A supplemental appendix may be found in the online version of this article at http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1540-6210.