

**The Many Faces of Span of Control: Organizational
Structure Across Multiple Goals**

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Forthcoming, *Administration and Society*.

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Abstract

After an extended hiatus, scholars of public administration have again begun to investigate organizational structures such as span of control. As an extension of this literature, we propose that public bureaucracies are typically faced with multiple goals creating potential conflicts due to structural choices. In other words, administrators optimal span of control for one goal may not be optimal for another goal. If this is the case, maximizing one goal through structural changes may lead to decreases in performance of another goal. Findings from a pooled time-series analysis of nearly 600 public bureaucracies provide some evidence that structural changes designed to improve performance on one goal may hinder performance on others. The results from our analysis also demonstrate a functional form for the span of control relationship that is very different from the one suggested by recent theoretical work. This unexpected finding suggests that further theoretical work needs to be done in order to understand the effect of span of control on organizational outcomes.

Introduction

Kenneth Meier and John Bohte have recently reinvigorated the seemingly moribund debate on span of control and the optimal manager / subordinate relationship. They offer a theory concerning the impacts and determinants of span of control and test these using data from educational organizations (Meier and Bohte 2000; Bohte and Meier 2001). The findings from these studies suggest that manager / subordinate ratios, along with other structural influences on production, deserve considerably more attention than they have received in modern research on administration.

In this replication and extension of Meier and Bohte's work, we argue that public organizations have multiple goals and, therefore, face potential conflicts when attempting to maximize one goal through manipulation of structure. We assess the potential for conflict with data from a sample of over 500 Texas school districts over a four-year period.

Span of Control and Multiple Goals

Meier and Bohte (2000) offer the first general theory on the functional form of the span of control / performance relationship for organizations. They hypothesize a quadratic relationship in which initial increases in span of control produce increases in organizational performance, though at a decreasing rate of return. By illustrating the potential non-linear impacts of span of control, these authors make an important contribution to the discussion of structural influences on performance. Like earlier works, though, their analysis is incomplete because it considers the impact of structure on only a *single organizational goal*. The voluminous scholarship on public sector bureaucracy presents considerable evidence, however, that organizations are often asked to meet multiple goals (See reviews of this literature in Fottler 1981; Meyer 1982; See also Rainey 1993; 1997; Moe 1989; 1990). Thus, we suggest that attempts to these goals may require different structural choices by bureaucracies and their political principals. In other words, there may be an optimal span of control

for the production of one goal, but this may not be optimal for the production of another goal within the same organization.

Figure 1 illustrates the functional form as suggested by Meier and Bohte (2000). Increasing spans of control, according to the authors, allow for greater specialization, enhancing efficiency and performance. Eventually, however, large manager / employee ratios impede managers ability to communicate, coordinate, and supervise. As ratios increase past a certain point, then, performance decreases at an increasing rate. This relationship also implies that the optimal level of span of control can be empirically estimated, through either changing levels of span of control within a single organization and assessing the change in performance, or by analyzing several similar organizations with different levels of span of control.

[FIGURE 1 ABOUT HERE]

Not considered by Meier and Bohte, though, is the fact that organizations also produce several different outcomes. These different outcomes may require different degrees of specialization or coordination, which in turn would should lead to different optimal levels of span of control for these outcomes. Using the functional form suggested by Meier and Bohte (2000), Figure 1 illustrates how maximizing one goal through the manipulation of span of control can cause conflict by potentially decreasing performance on another goal when the relationship is non-linear. Consider goal 1 to be a goal that requires relatively low levels of specialization, and goal 2 to require higher levels of specialization. Increasing span of control up to 50 increases performance for both goals, since they would both benefit from increased specialization. Increasing span of control after 50, the optimal level for goal 1, continues to increase performance on goal 2, but decreases performance for goal 1. The area between 50 and 75, then, is a zone of conflict where administrators of organizations must weigh the importance of the each goal when attempting to maximize performance through structural changes. The two goals could share the optimal level of span of control, but if the effect of

span of control on goals is conditional on the nature of the resources required to produce goals, then there will likely be a conflict.

Data and Methods

In order to extend Meier and Bohte's (2000; 2001; 2002) work we use their data set which is comprised of Texas school districts with enrollments of over 500 students, spanning the years from 1994 to 1997.¹ Their research focused on the single goal of achievement on a basic academic assessment test, the Texas Assessment of Academic Skills (TAAS). Texas, though, requires schools to measure several performance indicators, TAAS pass rates, attendance rates, and dropout rates. These criteria are used in the Academic Excellence Indicator System (AEIS), which ranks school districts according to performance. An alternative measure of performance measure used in the AEIS is performance on college entrance exams. Student performance on college entrance exams represent a districts' ability to prepare students for a college education. To assess differing impacts on multiple organizational goals, we compare previous findings from analyses of TAAS scores with new models of alternative school district goals. Specifically, these include minimizing dropout rates and achievement on the Scholastic Aptitude Test (SAT).

Each model is estimated as a pooled time series. All models use an estimator that removes fixed effects and corrects for unit influence by year. The fixed effects estimator alleviated problems of serial correlation and requires fewer assumptions about the error structure (Baltagi 1995: 11-12). Diagnostic tests indicated a small degree of heteroskedasticity across the panels, but the unequal error variance was not sufficient to bias standard errors. We use tobit regression for the analysis of

¹ In order to have a comparable sample across our difference measures of performance, we restrict their sample to districts with the SAT performance measure. This diminishes the sample by 84 districts per year. We are still left with a sizeable sample, and the results of our analysis on TAAS performance are essentially the same as the results from the model presented by Meier and Bohte (2000). The main difference is that we do not find evidence of a non-linear effect for the student / teacher measure. Even though we do not find a non-linear relationship, the results from both analyses show that increasing class size will decrease performance across the range of class size in these data.

the dropout measure because the measure is truncated, since several districts reported a dropout rate of zero (see Long 1997).

Dependent Variables

The dependent variables in the analyses represent three organizational goals shared by school districts. The first is the measure employed by Meier and Bohte—the ability of a district to impart basic skills to students. As in their analyses, we measure it as the percent of all students who pass the TAAS examination. Over the past decade, these tests have become one of the most important accountability measures for Texas school districts (Popan 2001; Grogan 2001; Boser 1999; National Research Center 1999).

The second goal in our analysis is district's ability to prepare students to successfully take college entrance exams. Numerous scholars suggest that, beyond basic skills, inspiring and preparing children to attend college is also a high priority in many districts (Hayes, Wolfer, and Wolf 1996; Bracey 1991; Thomson 1978; Owen 1999). We measure success in this endeavor as the average score on the SAT in a district.

The final goal is decreasing dropout rates. Over the years, districts across the nation have seen decreases in dropout rates, but dropouts are still a significant problem in many areas. Dropout rates vary dramatically across districts and across different subgroups in the student population. Hispanic students, for instance, have a dropout rate that is nearly twice as high as Anglo students (Faliciano 2001). A recent study (Arein and Berliner 2002) also finds that high stakes testing might increase dropout rates; suggesting an apparent goal conflict between the two goals. In order to create a performance measure where an increase in the value of the measure correlates with increased performance, we subtract the dropout measure that school districts are required to report from 100.²

² The dropout measure from the Texas Education measure ranges from 0 to 9 percent. We transformed this measure by subtracting it from 100, changing the range from 91 to 100, with 100 meaning perfect performance on this goal.

As noted above, all three performance measures are part of the AEIS, thus are measured in a comparable manner across Texas districts.

Independent Variables

We use the same set of independent variables used by Meier and Bohte (2000), including four measures of span of control. Meier and Bohte argue that school districts are multi-tiered organizations that encompass numerous managerial levels. To capture this multi-tiered nature, they develop four variables to measure span of control within school districts, which we in turn use in our analysis. The first measure of span of control is the ratio of school-level to district level administrators. The second span of control measure is the ratio of teachers to school-level administrators across the district.³ The third indicator of span is the ratio of students to teachers. This is a measure of the ability of teachers to coordinate and run classes. The final span of control measure is average school size. This is a macro-level indicator, which has the previous three measures nested within it. Rather than measuring the ability to coordinate activity at any one level of the organization, school size measures the coordination within, among, and between the major production units within the district. Potential for goal conflict would be evident if at any point in the range of these four measures, there is an opposite relationship for different outcomes. Referring back to Figure 1, conflict between goal 1 and goal 2 occurs between the values of 50 and 75 since the relationship between outcome and span of control is opposite between these points. To test for a non-linear relationship, squared terms for all the span of control measures were created and included in the regressions.⁴

³ In both the school / district administrators and teacher / school administrators measures administrators are the total number of administrators, not just the superintendent and principals. As a reviewer suggested, this is not the traditional concept of span of control where there is 1 manager to several subordinates. Principals, though, can utilize other administrators, such as vice principals, to help monitor subordinates. Assistant superintendents, along with other district level staff, can serve the same role for superintendents in monitoring school level administrations. These measures could be reconstructed to conform with traditional notions of span of control, but we choose to stay consistent with Meier and Bohte's formulation of these measures for replications sake.

⁴ Squaring an independent variable and including it in an OLS regression estimates a quadratic relationship between the independent variable and dependent variable. If the squared variable is significant, then there is evidence of a

In our analysis, we also control for additional influences on educational performance, including the nature of organizational inputs (students) and available resources. The measures of student characteristics are the percentage of students who qualify for free or reduced lunch programs, and the percentage of African Americans and the percentage of Hispanics enrolled in the district. The measures designed to capture resources include per-pupil instructional costs, teacher salaries, and teacher experience.⁵

Findings

Table 1 presents the findings from our analysis of the impact of structural factors on the three different organizational goals. Focusing on the span of control variables, the model for TAAS performance shows that all four span of control indicators have a significant impact on TAAS pass rates. For both the SAT and dropout performance, three of the span of control measures are significant, with only the school to district level administrator measure failing to reach statistical significance for these models. Comparing the effects across goals allows us to assess the potential for conflict between goals.

[TABLE 1 ABOUT HERE]

For two of the span of control measures, the school / district level administrator and student / teacher ratios, we find no evidence of goal conflict. First, the coefficients for the school / district level managers are insignificant in the dropout and SAT performance models. We cannot, therefore, make a definitive statement concerning whether there is potential for conflict between these two goals and TAAS performance. Alternatively, student / teacher ratio has a significant, negative, linear

non-linear relationship. This technique can both predict a non-linear, monotonic relationship, or non-monotonic relationship where the effect changes signs depending on the value of the independent variable (such as the relationship that is shown in Figure 1).

⁵ For a more detailed description the literature concerning these control variables, see Meier and Bohte (2000).

effect on both TAAS and dropout performance.⁶ The relationship between the student / teacher ratio and SAT performance is negative and non-linear. Moreover, this relationship is monotonic, meaning that it is predicted to be negative across the range of the measure. As with the school / district administrator measure, the results from this measure do not offer any evidence of a potential for conflict, since decreasing class size would always increase performance, regardless of performance measure.

The impact of the teacher / administrator ratio measure, on the other hand, shows potential for conflict across the three goals. This measure is positive and linearly related to both TAAS and SAT performance. This relationship shows that there is no evidence for the potential for conflict between these two goals. In other words, increasing this measure across its range always produces increases in performance for both goals. However, the non-linear relationship between the teacher / administrator measure and dropout rates, as indicated by the significant squared term, points to a potential for conflict. Figure 2 shows the relationship between this measure and the three goals. Increasing rates up to a 23.3 to 1 ratio of teachers to school-level administrators increases performance on the TAAS and SAT, but decreases performance for the dropout goal. After that point, further increases produce increased performance in all three areas. This finding provides initial evidence that there may be an optimal span of control for the production of one goal, but this may not be optimal for the production of other goals within the same organization.

[FIGURE 2 ABOUT HERE]

The coefficients for school size also indicates the potential for conflict. Figure 3 shows the conflicting nature of the relationship between this span of control and the three goals. For TAAS and dropout performance, the relationship is opposite from the one hypothesized by Meier and Bohte (2000), with initial increases in school size producing decreases in performance for these two goals.

⁶ Meier and Bohte hypothesized that certain span of control relationships would be linear across the range across organizations. This would be evident if the squared term was not significant. Non-significant squared terms, then,

As the graph shows, there is potential for conflict until average school size reaches 665 students.⁷ Dropout performance still continues to decrease after this point, but decrease in performance is marginal. Alternatively, SAT performance improves with initial increases in school size. Increased values of the measure produce increases in performance up to 902 students, after which the trend reverses itself. Clearly, then, there is potential for potential for goal conflict if administrators attempt to maximize one of these goals through the manipulation of structure. Attempts to maximize SAT through school size will produce a decrease in TAAS and dropout performance, at least until the average school size reaches 673 students. Again, this relationship highlights the difficulties faced by public organizations that attempt to optimize multiple goals. Although a district might equally value all three goals, attempting to maximize one may negatively affect one or both of the other goals.

[FIGURE 3 ABOUT HERE]

Discussion and Conclusion

We began this essay with the proposition that different levels of specialization or coordination required to produce certain goals should lead to span of control having different impacts on different organizational goals, which in turn creates potential for goal conflict. That is, increasing performance on one goal through the manipulation of structure may lead to a decrease in performance on another goal. To test this, we analyzed the effect four measures of span of control on three different outcomes in school districts. We found potential for conflict associated with two of these measures, teacher / administrator ratios and school size. If administrators or political principals had no control over span of control within their organization, then these findings would be meaningless. Administrators, though, can and do make choices regarding structure.

For instance, when deciding how to deal with growth in the student population school and district administrators, as well as school boards and voters in bond elections, make choices between

were dropped from the model.

building new classrooms in existing schools or building new schools. Building new classrooms would increase school size, while building new schools would decrease school size. Our findings suggest building classrooms in existing schools might improve college entrance exam performance, by increasing average school size, but decrease performance for TAAS and dropout goals. Conversely, building new schools may be beneficial for TAAS and dropout performance, but detrimental for SAT performance. To complicate matters further, the decision to build new schools or to build new classes affects teacher / administrator ratios. Building new schools would likely decrease the teacher / administrator variable, which could increase or decrease performance depending on the goal. These findings illustrate the importance of considering the multiple goals faced by public agencies when studying bureaucracy.

Thus, past conclusions about the “optimal” span of control for school districts or any other public bureaucracy have been somewhat misleading, since public organizations and public managers pursue multiple goals. In the case used in this study, the state of Texas requires districts to pursue multiple goals through the AEIS. Our analysis suggests that for these goals there are numerous optimal manager / subordinate ratios, perhaps one for every goal. While it is certainly difficult for most large organizations to be this flexible with regard to structure, this conclusion does suggest that successful managers and organizations must search for structural arrangements that most closely approximate the “optimal” for the greatest number of goals. A fruitful next step, then, for research on span of control might be to investigate such multi-optimal structural choices.

The second conclusion that we draw from these findings has less to do with structure and multiple goals and more to do with the specific character of each span of control. We find that several span of control relationships are contrary to Meier and Bohte’s (2000) theory. A quick comparison of Figure 1 with Figures 2 and 3 reveals that their theoretical form is opposite of the

⁷ This is the same relationship found in Meier and Bohte (2000), although they misinterpreted the critical value for the first derivative as being a maxima when it was in fact a minima.

empirical form in several cases. Meier and Bohte proposed that organizational performance would increase with larger spans of control, though at a decreasing rate, until a certain optimum, at which point performance would begin to decline. Our findings suggest, however, that initial increases in span of control lead to decreases in performance in certain situations, as shown with the relationship between school size and TAAS and dropout performance. The variance in form may be a function of differing impact of economies of scale across these goals, or maybe different combinations of specialization and coordination required for different goals. As Simon (1945) argued, span of control interacts with other organizational features, such as specialization of tasks, making it impossible to formulate simple principals regarding optimal structures. Meier and Bohte advance the understanding of this organizational feature, but it appears that their theory still may not completely capture the complexity of the effect of span of control in organizations.

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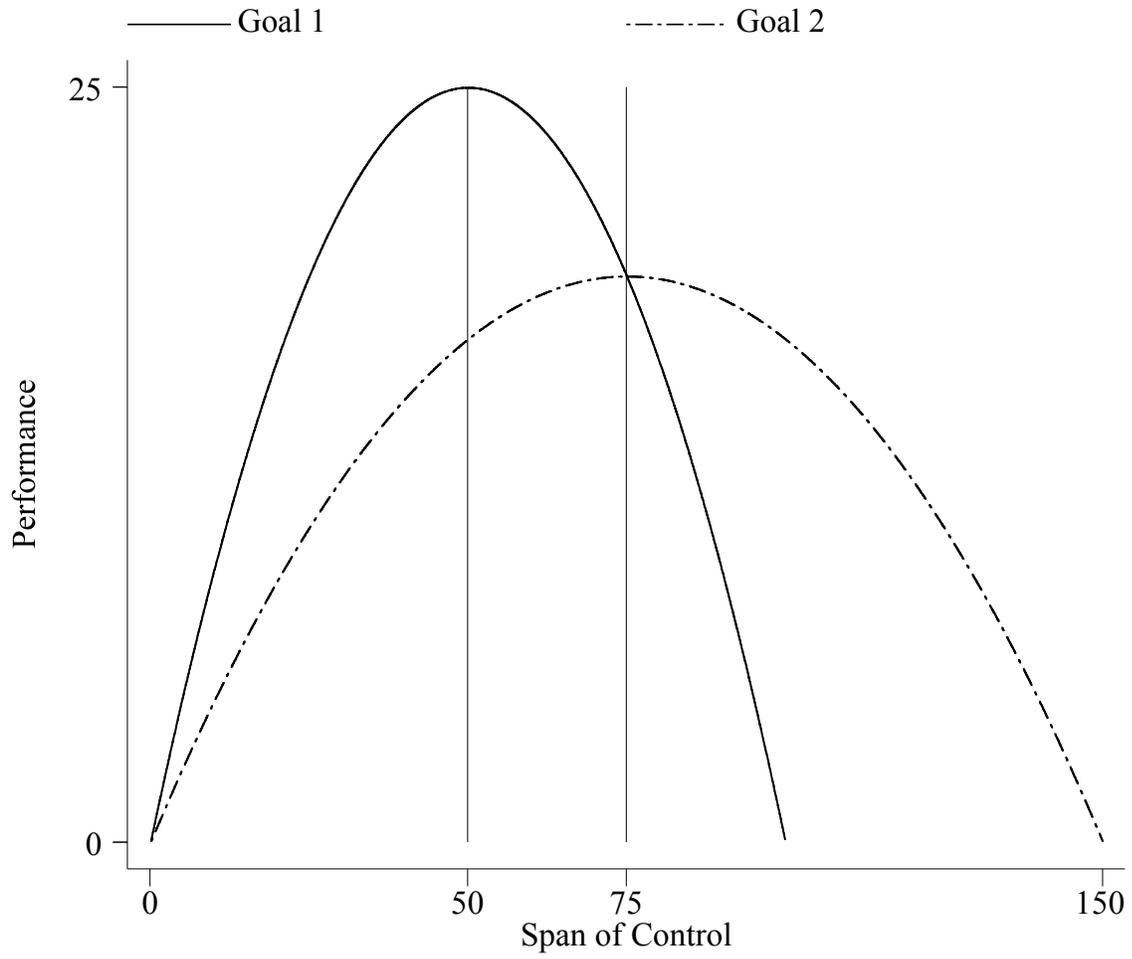


Figure 1. Theory of Span of Control With Multiple Goals

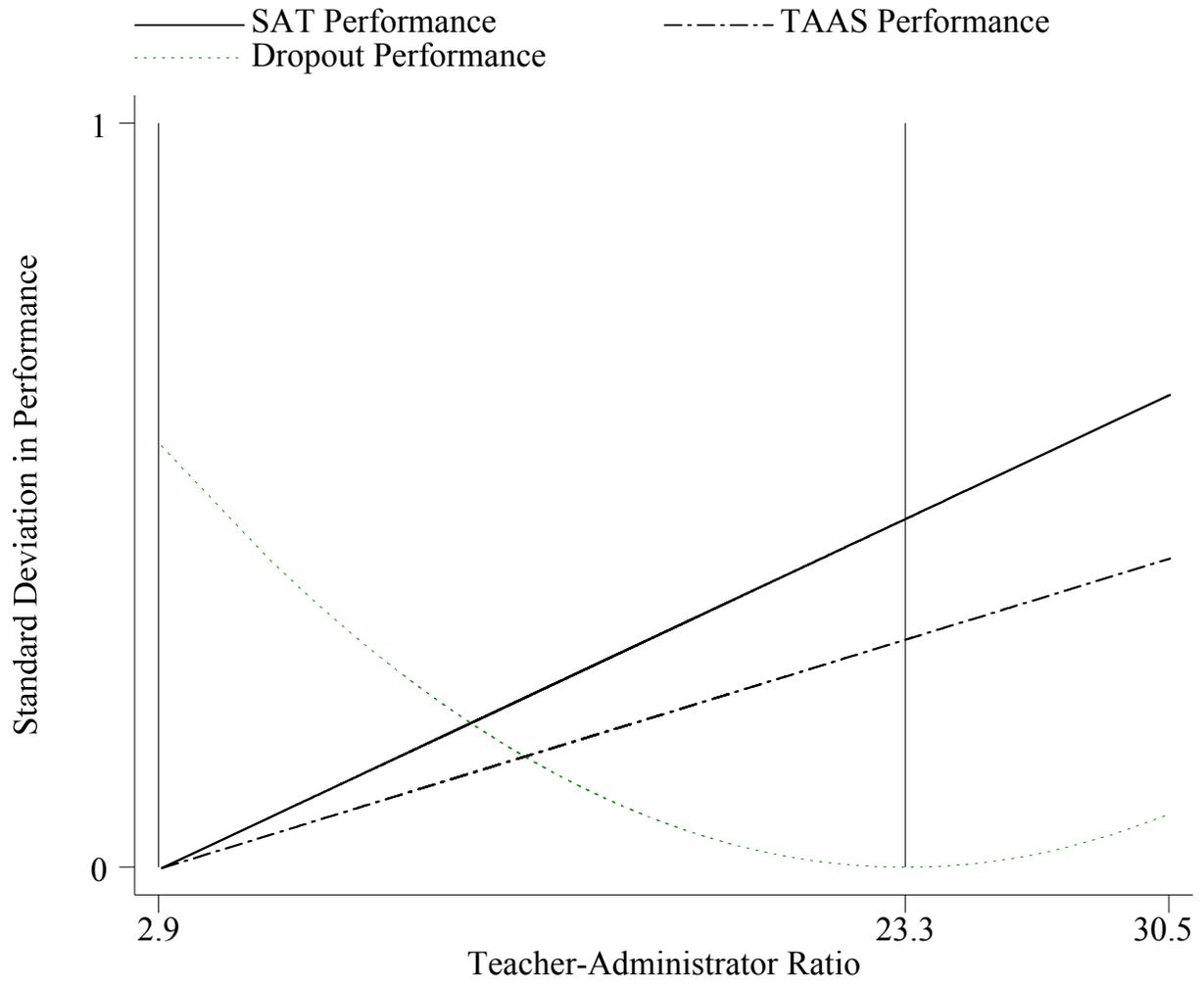


Figure 2. Teacher / Administrator Ratio and Performance

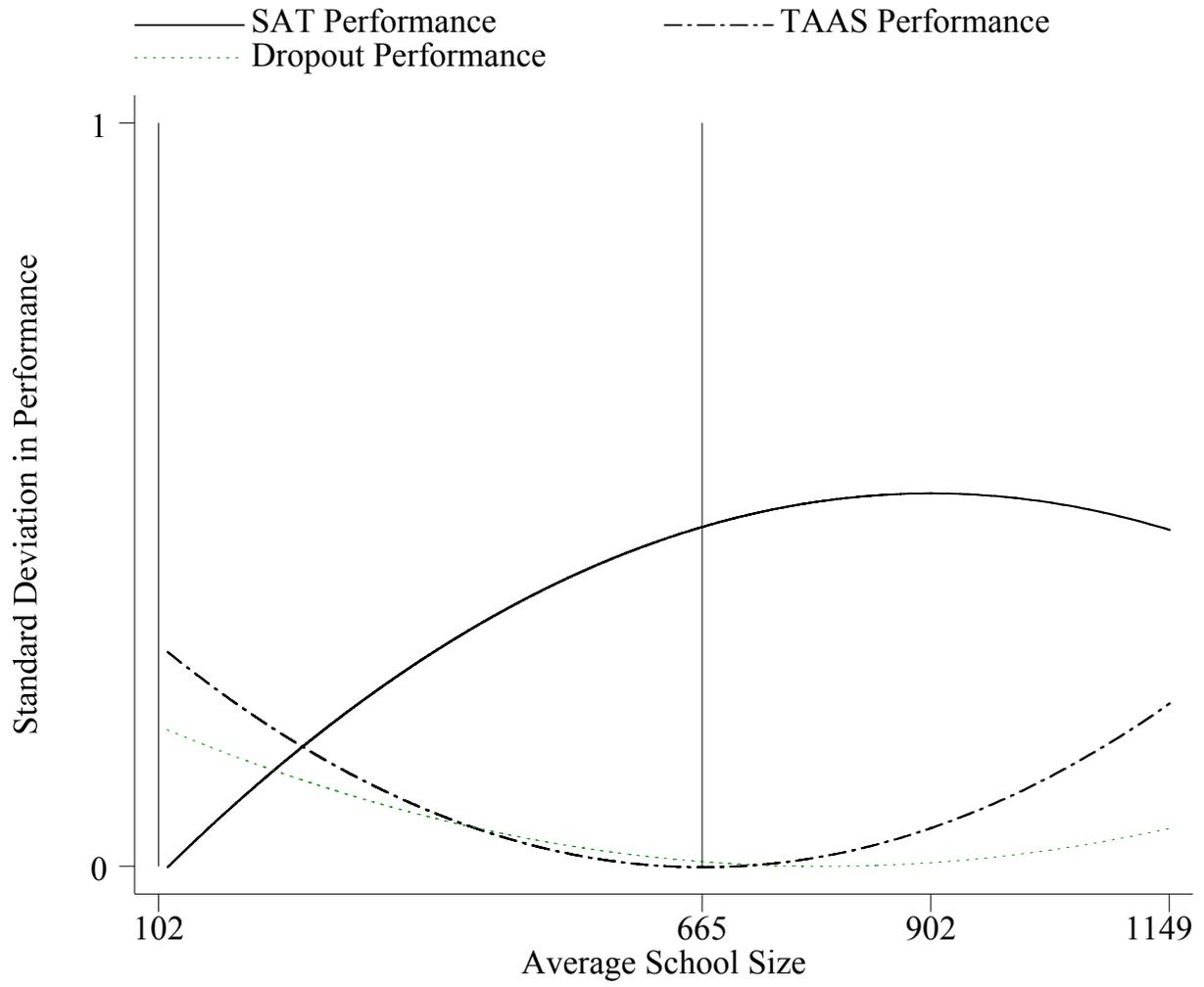


Figure 3. School Size and Performance

Table 1. Impact of Span of Control on Multiple Organizational Goals

Independent Variables	TAAS Performance	SAT Performance	Dropout Performance ^a
Span of Control Measures			
School / District Administrators	0.237 (2.06)	-0.125 (0.12)	0.028 (1.58)
Teacher / Administrator	0.192 (3.59)	1.944 (3.99)	-0.134 (3.29)
Teacher / Administrator Squared	----	----	0.003 (2.24)
Student / Teacher	-0.558 (3.66)	-28.109 (2.32)	-0.086 (3.65)
Student / Teacher Squared	----	0.735 (1.82)	----
School Size	-0.016 (4.23)	0.122 (3.46)	-0.001 (2.26)
School Size Squared	0.00001 (3.72)	-0.00007 (2.25)	0.0000008 (1.68)
Control Variables			
Percent Low-Income Students	-0.278 (18.24)	-1.738 (12.52)	-0.018 (7.63)
Percent Black Students	-0.239 (16.34)	-0.337 (2.53)	-0.004 (1.90)
Percent Hispanic Students	-0.099 (8.98)	0.093 (0.92)	-0.002 (1.40)
Teacher Salary	0.001 (5.62)	0.000 (0.14)	0.000 (1.65)
Instructional Expenditures	0.000 (0.57)	-0.008 (1.59)	-0.000 (2.55)
Teacher Experience	0.449 (4.42)	6.339 (6.84)	-0.051 (3.25)
Constant	59.805 (19.05)	1,074.721 (11.53)	102.170 (180.33)
Observations	2375	2375	2375
Adj R ²	0.72	0.48	Pseudo R ² 0.074
F(15, 2359)	399.8	144.7	LR χ^2 (15) 551.4

Numbers in parentheses are absolute t-scores

a. Tobit regression is used for this model. The coefficients for tobit regression can be interpreted in the same manner as coefficients for OLS regression.