On the Political Economy of School Deregulation

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Abstract

Deregulation is a basic component of school reform. Without deregulation, schools could not respond to the incentive changes at the heart of more sophisticated reform proposals. Therefore, understanding the effects of deregulation on various interest groups provides insight into the political dynamics of the broader reform debate.

In this paper, we simulate the likely impacts of deregulation. The simulation indicates that parents and students in poor school districts with a relatively high proportion of minority students are resource constrained rather than bounded by regulation in pursing better education for their students. The potential gains from deregulation increase as property wealth and expenditures per student increase. The simulation also indicates that in regulation-constrained school districts, many education professionals are extracting rents (in terms of excess employment) from the current system, and that deregulation and incentives for increased efficiency would lead many school districts to substitute teacher aides for teachers, administrators, and professional staff.

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In the decade since the publication of A Nation at Risk: The Imperative for Educational Reform (Gardner et al., 1983), Americans have become increasingly concerned about improving education. Many types of reform have been proposed to address these concerns. Yet, despite all the rhetoric, few signs of substantive change are evident. In part, the delay in changing the school system reflects uncertainty about the relative efficacy of the various reform proposals. But in the minds of many of the reformers, too much of the delay reflects opposition from interest groups that do not expect to benefit from reform (for example, see Chubb and Moe 1990).

In this paper, we use simulation techniques to examine the distributional consequences of a basic component of educational reform -- eliminating regulations on the allocation of school personnel. Without deregulation, schools would be unable to respond to the incentives offered by more sophisticated reform proposals such as voucher plans or site-based management. Thus, understanding the effects of deregulation on various interest groups provides insight into the political dynamics of the broader reform debate.

A priori, we expect that some schools efficiently allocate their resources despite the regulations. Producing higher educational outcomes at these schools would require additional expenditures. We refer to these schools as resource constrained. The remaining schools are regulation constrained. We expect that deregulation would lead to a reallocation of resources and higher educational outcomes at these schools. For the regulation-constrained schools, we also expect that some types of personnel are earning economic rents from the status quo and would be employed less intensively after reform. Necessarily, other types of personnel would be employed more intensively.

Classifying schools and personnel types in this way reveals the likely supporters and opponents of reform. Residents of regulation-constrained school districts would logically support deregulation, as would personnel groups that would be employed more intensively in the absence of regulation. Residents of resource-constrained school districts are likely to favor reforms that redistribute resources over reforms that deregulate schools. Furthermore, if relative differences in school quality are capitalized into property values, then residents of resource-constrained school districts might oppose deregulation because it would erode their position relative to regulation-constrained school districts. Finally, one would expect that personnel groups that are currently overemployed relative to their compensation would anticipate losses in employment after deregulation and would rationally oppose it.

Our simulated deregulation of public school districts in Texas indicates that most school districts are regulation constrained rather than resource constrained, a conclusion that is perfectly consistent with the state legislature's tendency to micromanage education.[1] The simulation also indicates that school administrators, teachers and professional staff (such as counselors) are likely to lose employment through deregulation, while teacher aides are likely to gain employment. Finally, the simulation reveals that resource-constrained school districts differ significantly from regulation-constrained districts. In general, resource-constrained school districts have a greater proportion of minority and low income students, less property wealth per pupil and lower per pupil expenditures.

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[1] For example, the legislature sets hiring standards, maximum class sizes and teacher compensation schedules.

These results suggest that reform will remain an important issue because it benefits large, politically influential groups of parents. However, even basic reforms like deregulation may continue to be difficult to achieve because teachers and other members of the educational establishment are better organized than the likely beneficiaries of such reform.

I. The Literature

A substantial literature illustrates inefficiencies in the education system. Eric A. Hanushek's 1986 survey of the literature on educational production functions overwhelmingly concludes that expenditures are uncorrelated with student achievement gains. Cost function studies and data envelopment analyses also indicate that the system is inefficient (see, for example, Bessent et al. 1982, Färe, et al. 1989 or Callan and Santerre 1990).

The literature also points to regulation as one of the sources of inefficiency. For example, despite considerable evidence that smaller class sizes and more-educated teachers do not promote achievement (Hanushek 1986), governments like the Texas state legislature continue to regulate class sizes and teacher credentials.

Fortunately, by exploiting the characteristics of our theoretical model, we can infer from data observed in a regulated environment how resources could be allocated if the regulations were removed. This technique allows us to make three important contributions to the literature. First, we simulate a deregulated environment and measure the potential outcome gain over the status quo, thereby differentiating between the resource-constrained school districts (those that are unable to improve via deregulation) and the regulation-constrained school districts (those that would improve with deregulation). Second, we examine community characteristics to determine if particular types of school districts are disproportionately classified as regulation constrained and therefore harmed by regulation. Finally, to support our conjectures concerning impediments to reform, we use information on the deregulated personnel allocation to measure the extent of economic rents accruing to school district personnel from the status quo

II. The Model

We model educational decision-making under the status quo and under deregulation using the direct and indirect distance functions, respectively. Distance functions accommodate agents seeking to maximize output in both a regulated environment with input constraints and a deregulated environment with merely a budget constraint. This approach also allows for the status quo resource allocation to be nested within the budget constrained resource allocation so that the deregulation can be appropriately simulated.

Although most analyses of education use either a cost or production function approach, we feel neither of these is appropriate for the problem at hand. First, cost function estimation presumes that the decision maker is attempting to minimize cost, while public sector officials are trying to maximize output. Because production functions are single-output representations of technology, they have limited use in modeling multioutput education technologies. In neither case can the cost or production function provide a straightforward and comparable simulation of the status quo and deregulated environment.

To model the regulated status quo, we use the direct output distance function. As described by Shephard (1970), the direct output distance function can be defined as

$$D_o(\chi_f,\chi_\nu,y) = \min\{\theta : y/\theta \in P(\chi_f,\chi_\nu)\}, \tag{1}$$

where χ_f is a vector of fixed input quantities, χ_ν is a vector of variable input quantities, y is a vector of output quantities, and $1/\theta$ gives the proportion by which all outputs can be expanded and still remain feasible given the direct production possibilities set, $P(\chi_f,\chi_\nu)$.[2] As in a regulated environment, the input vector $\chi=(\chi_f, \chi_\nu)$ is treated as exogenously determined in this description of technology. We assume that administrators initially face this technology under the regulated organizational structure.

We use the indirect output distance function to model a deregulated educational environment in which administrators face a budget constraint but are free to choose their variable inputs as long as they satisfy that budget constraint. Shephard (1974) defines the indirect output distance function as

$$ID_o(\chi_f,\ p_\nu/c,\ y) = \min\{\lambda : y/\lambda \in IP(\chi_f,\ p_\nu/c)\}, \tag{2}$$

where c is total variable cost, p_ν is a vector of variable-input prices, and $1/\lambda$ is the maximum proportion by which all outputs can be expanded and still be feasible given the indirect (budget-constrained) production possibilities set, $IP(\chi_f,p_\nu/c)$. The set $IP(\chi_f,p_\nu/c)$ is the largest production possibility set allowing χ_ν to vary while satisfying the budget constraint ($p_\nu'\chi_\nu \le c$).[3]

Figure 1 illustrates the direct and indirect output distance functions for a typical school district that produces two outputs. The set $P(\chi_f,\chi_\nu)$, which describes the best practice technology under the status quo, gives all possible combinations of the two outputs that can be produced with the

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[2] By definition, all of the elements of the χ and y vectors are contained in the nonnegative real line.

[3] This interpretation of $IP(\cdot)$ was first established in Färe and Shephard (1980).

regulated input bundle (χ_f, χ_ν). Suppose that a particular school district has observed output bundle A, which it produces from its given input bundle χ_A. The direct distance function tells us how far that observed bundle is from the frontier of the direct technology, $P(\chi_f, \chi_\nu)$, holding the mix of outputs constant. The direct distance function $(D_o(\chi_f, \chi_\nu, y))$ equals the ratio OA/OU, where U represents the maximum output feasible within $P(\chi_f, \chi_\nu)$, given the observed output mix and input bundle (i.e., the status quo). The inverse of this ratio $(1/\theta)$ can be interpreted as a measure of technical efficiency.

The set $IP(\chi_f, p_\nu/c)$, which describes the deregulated technology, gives all the possible combinations of two outputs that can be produced given the school district's budget constraint (c) and variable-input prices (p_ν). The school district is allowed to choose variable inputs as long as χ_ν satisfies the budget constraint. Because $IP(\chi_f, p_\nu/c)$ offers more choices than $P(\chi_f, \chi_\nu)$, $P(\chi_f, \chi_\nu)$ is a subset of $IP(\chi_f, p_\nu/c)$. The indirect output distance function $(ID_o(\chi_f, p_\nu/c, y))$ tells us how far the observed output bundle is from the frontier of the indirect or budget-constrained (deregulated) technology, $IP(\chi_f, p_\nu/c)$. In Figure 1, $ID_o(\chi_f, p_\nu/c, y)$ equals the ratio OA/OT.

The direct and indirect distance functions have several useful properties. They take on values less than or equal to one as long as y is feasible. Values of one indicate that observed output is on the boundary of the respective production possibility set.[4] Equivalently, values of one

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[4] Formally,

$$D_o(\chi_f, \chi_\nu, y) \leq 1 \Leftrightarrow y \in P(\chi_f, \chi_\nu)$$
$$D_o(\chi_f, \chi_\nu, y) = 1 \Leftrightarrow y \in Isoq\ P(\chi_f, \chi_\nu)$$

$$ID_o(\chi_f,\ p_\nu/c,\ y) \leq 1 \Leftrightarrow y \in IP(\chi_f,\ p_\nu/c)$$
$$ID_o(\chi_f,\ p_\nu/c,\ y) = 1 \Leftrightarrow y \in Isoq\ \ IP(\chi_f,\ p_\nu/c)^{\cdot}$$

indicate that the particular school district is technically efficient in the sense of Farrell (1957).[5]

Because relaxing constraints necessarily allows for greater potential output, allowing school districts to choose inputs subject to a budget constraint instead of facing the initial, regulated input vector may increase their output. We can simulate the potential increase from deregulation by exploiting the relationship between the direct and indirect output distance functions:

$$p_{\nu}'x_{\nu} \leq c \Rightarrow ID_{o}(x_{f}, p_{\nu}/c, y) \leq D_{o}(x_{f}, x_{\nu}, y). \tag{3}$$

The relationship reflects the fact that a deregulated school district could always choose the input bundle it uses under the status quo and potentially could increase output in a deregulated environment.

For this analysis, we measure the gains in potential output from this simulated deregulation as the ratio of the maximum potential output achievable in the deregulated environment (y/λ), divided by the maximum potential output achievable in the regulated environment (y/θ):

$$GAIN = D_{o}(x_{f}, x_{\nu}, y)/ID_{o}(x_{f}, p_{\nu}/c, y). \tag{4}$$

Thus, the measure of gain from deregulation represents additional potential output above and beyond that which could be achieved by becoming technically efficient given the initial allocation (in the sense of Farrell). In Figure 1, GAIN is represented by OT/OU.

The school district represented in Figure 1 as point A is an example of a regulation-constrained observation. The potential output lost due to regulation for this school district is measured by OT/OU (GAIN). If a school

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[5] In fact, the direct output distance function is the reciprocal of Farrell output-increasing technical efficiency.

district is observed at a point like T, then it is termed resource constrained because it is unable to improve on its resource allocation in response to deregulation. That is, the school district's resource decisions have not been changed by the regulation, and the only way to increase educational outcomes is to provide additional resources, perhaps through reform that redistributes revenues among school districts.

The next step is to develop a technique for measuring GAIN. First we must obtain measures of inputs, input prices and outputs as well as the budget constraint for a set of observations. Then we need to compute the values of D_o and ID_o for each observation in the data set.

The Data

We apply the distance-function approach described in the previous section to a sample of 144 urban Texas school districts operating in 1989. The sample includes school districts with enrollments between 1,000 and 5,000 for which complete data were available. We restrict the sample to urban school districts of moderate size because we wanted to choose a subset of school districts with a common educational technology.[6] Anecdotal information suggests that very large and very small school districts face substantially different production technologies. Data on school district inputs come from the Texas Research League. We extract estimates of school district outputs and quasi-fixed inputs that are beyond school district control from data provided by the Texas Education Agency.

Our data on school district inputs includes four variable inputs -- administrators (AD), teachers (TEACH), professional support staff (SUP) and

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[6] As the empirical appendix illustrates, the analysis is robust to a number of data specifications.

teaching aides (AIDE) -- and one quasi-fixed capital input -- operating and maintenance expenditures (MAINT). The input price data consists of average annual salaries paid to school administrators, teachers, support staff and teacher aides. Because we consider the capital input as quasi-fixed and beyond school district control in the short run, the relevant measure of the budget each school district faces is the total cost per student of hiring the four personnel inputs.

The literature on measuring school effects has reached a broad consensus that the most appropriate measure of schooling product is the marginal effect of the school on educational outcomes (see, for example, Hanushek 1986, Hanushek and Taylor 1990, Aitkin and Longford 1986 or Boardman and Murnane 1979). We use student achievement on a battery of test scores as the relevant educational outcome and extract the marginal effect of schools by following the value-added residuals techniques described in Hanushek and Taylor and Aitkin and Longford.

Thus, we estimate school district output, using Texas Educational Assessment of Minimum Skills (TEAMS) scores in mathematics, reading and writing; data on changes in cohort size; and demographic data on the racial and socioeconomic composition of the student body (Texas Education Agency 1987, 1989). For each of four grade levels--3rd, 5th, 9th and 11th--we estimate the value added by the school district according to equation (5):

$$TEAMS89_{i,g} = \alpha_g + \sum_{j=1}^{3} \delta_{j,g} ETHNICITY_{i,j} + \delta_{4,g} SES_i + \delta_{5,g} XCOHORT_{i},g + \sum_{j=6}^{8} \delta_{j,g} TEAMS87_{i,j,g-2} + \epsilon_{i,g}, \quad g=3,5,9,11, \tag{5}$$

where $TEAMS89_{i,g}$ is the average total TEAMS score for school district i for grade level g in 1989, $TEAMS87_{i,j,g-2}$ is the average TEAMS score in subject j (reading, writing and mathematics) for the same cohort two years earlier, $ETHNICITY_{i,j}$ is the fraction of the student body of school district i that is Asian, black or Hispanic (respectively), SES_i is the fraction of the student body of school district i that is receiving free or reduced-price lunches (the best available proxy for socioeconomic status), $XCOHORT_{i,g}$ is the percentage change in the size of the grade g cohort between 1987 and 1989 (a control to prevent schools from improving their average score by shedding students), and the estimated residual, $\epsilon_{i,g}$, represents the average value added in school district i in grade g.[7] We present these equation estimates in Table 1.[8]

Estimating school outputs as equation residuals generates output measures that represent deviations from the state average. School districts that add less value than the state average have negative output measures. Because our computational technique is not designed for negative outputs, we transform the value-added residuals into tractable output measures by adding

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[7] We expected a correlation between school effects across grade levels in the same school district and, therefore, a cross-equations correlation between the error terms. We found that the correlations between error terms were surprisingly low (in the neighborhood of 0.20) but significant, and therefore we estimated the output measures simultaneously using the standard SAS package for seemingly unrelated regression (SUR).

[8] These estimates are calculated using all 604 Texas school districts for which we had test data. This approach greatly increases the degrees of freedom with which OUTPUT and STUINPUT are measured. In restricting the sample for further analysis to medium-sized, urban school districts, we implicitly assume that the coefficients of equation 5 are stable across all sub-samples of our data.

the estimated value of the intercept from each equation to the value-added residual for that equation. Therefore, y is measured by:

$$OUTPUT_{i,g} = \hat{\alpha}_g + \hat{\epsilon}_{i,g}. \tag{6}$$

In addition to estimates of marginal school effects, equation 5 also yields estimates of predicted achievement for school districts. In this setting, predicted achievement is attributable to student body characteristics that are beyond school district control in the current period. Formally,

$$\begin{aligned} STUINPUT_{i,g} = \sum_{j=1}^{3} \hat{\delta}_{j,g}\, ETHNICITY_i + \hat{\delta}_{4,g}\, SES_i + \hat{\delta}_{5,g}\, XCOHORT_{i,g} \\ + \sum_{j=6}^{8} \hat{\delta}_{j,g}\, TEAMS87_{i,j,g-2}. \end{aligned} \tag{7}$$

Thus, the $STUINPUT_{i,g}$ measures the contribution of home and previous school production, which we treat as quasi-fixed inputs (χ_f), i.e., inputs over which the school district has no control. Our proxy of the value added by the school district, $OUTPUT_{i,g}$ from equation 6, is achievement purged of the effects of home production and earlier achievement-test gains.[9]

Table 2 includes descriptive statistics for each of the four variable school district inputs, one fixed school district input, four fixed household inputs, four outputs, enrollment and costs. These statistics, especially the means and standard deviations, indicate that teacher-pupil ratios vary less than the ratios of the other types of personnel to enrollment, reflecting perhaps de facto restrictions on class size. Personnel expenditures per pupil (VARCOST) vary from a low of about $1,300 to a high of nearly $3,000 per year.

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[9] We note that this general technique was also employed by Callan and Santerre (1990) to arrive at a measure of educational quality. However, Callan and Santerre did not have access to pretest information and, therefore, were unable to derive a value-added quality measure.

The Empirical Results

We calculate $D_o(\chi_f, \chi_\nu, y)$ and $ID_o(\chi_f, p_\nu/c, y)$ for each school district in our sample, using the nonparametric linear programming approach described in the technical appendix. In calculating $D_o(\chi_f, \chi_\nu, y)$, all inputs are treated as fixed by the regulations. In calculating $ID_o(\chi_f, p_\nu/c, y)$, we allow the school district to hypothetically choose the levels of the four types of personnel, subject to a budget constraint equal to the total personnel expenditure per pupil observed in the school district. We solve for the optimal variable input levels as part of the problem (see appendix). Input prices are assumed fixed at the observed salary averages, and the technologies are assumed to exhibit constant returns to scale.[10] For both direct and indirect output distance functions, a school district is judged efficient (i.e., its students are reaching best practice achievement levels, given its resources) if the value of the distance function is one. Inefficient school districts will have measures less than one. These school districts are not reaching best practice achievement levels.

We report summary statistics for $(D_o(\chi_f, \chi_\nu, y))^{-1}$, $(ID_o(\chi_f, p_\nu/c, y))^{-1}$ and GAIN $(D_o(\chi_f, \chi_\nu, y)/ID_o(\chi_f, p_\nu/c, y))$ in Table 3. On average, the maximum proportion by which output could be expanded under regulation, $(D_o(\chi_f, \chi_\nu, y))^{-1}$ is 1.032. Under deregulation, the average maximum proportion by which output could be expanded, $(ID_o(\chi_f, p_\nu/c, y))^{-1}$ is 1.074. The average potential gain from allowing school districts to choose variable inputs subject to budget constraints rather than taking their initial variable input levels as fixed is 1.041. That is, on average, school districts could increase value added by 3.2 percent $((D_o(\chi_f, \chi_\nu, y))^{-1} - 1)$ if they used their initial input bundle

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[10] As the empirical appendix indicates, relaxing this assumption leads to qualitatively similar results.

efficiently and an additional 4.1 percent if they could reallocate inputs efficiently.[11] Given constant returns to scale, a potential 4.1 percent gain in output from reallocating personnel inputs implies that deregulated school districts could reduce personnel expenditures by 4.1 percent without reducing output. Regulation-constrained school districts could increase their output by 4.9 percent, on average, if the regulations were removed. Thus, the simulation suggests that regulations on resource allocation add substantially to the cost of education in Texas.

Because solving the indirect output distance function yields the variable input vector each school district would choose if it were not subject to the initial regulatory environment, (χ_{ν}^{*}), we can also use it to identify the personnel groups that would gain and lose employment under deregulation and the distribution of economic rents in the initial allocation.[12] An input is said to be earning economic rents when that input's price exceeds its marginal product or, equivalently, when it is overutilized relative to its compensation.

Table 4 describes the aggregate effects of deregulation on the 144 school districts in our sample. The first line of table 4 gives the total initial expenditures on each of the four variable inputs. The second line of the table illustrates how school districts would redistribute their initial budgets after deregulation. The expenditures for each personnel category represent optimal input quantities multiplied by the (given) input prices

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[11] In a related study using parametric estimation techniques, Grosskopf, Hayes, Taylor and Weber (1992) find a greater degree of inefficiency (on the order of 25 percent for the indirect output distance function case). We attribute the difference in magnitudes of technical inefficiency to the differences in technique.

[12] The optimal variable input vector is the solution to problem A2 in the technical appendix.

($p_j \chi_{\nu j}^*$), summed across all school districts in the sample. The third line of the table indicates how deregulated school districts would allocate their expenditures if their variable budget equaled the minimum amount necessary to achieve the initial output level in a deregulated environment. We determine the minimum-variable-cost budget by exploiting the properties of the indirect output distance function. Recall that the indirect output distance function indicates that school districts could increase output by an average of 7.4 percent by becoming technically efficient in a deregulated environment. Assuming constant returns to scale, this implies that the school districts could maintain their initial levels of output and decrease personnel expenditures by 7.4 percent. For each school district, the minimum personnel expenditure needed to achieve the initial output level in a deregulated environment would be $ID_o(\chi_f, p_\nu/c, y) \cdot$VARCOST. As before, the optimal variable-input vector (χ_ν^*) indicates the optimal mix of inputs under deregulation (assuming constant returns to scale). Thus, the expenditures for each personnel category represent optimal input quantities multiplied by the (given) input prices and scaled by the value of the indirect output distance function ($ID_o(\chi_f, p_\nu/c, y) \cdot p_j \chi_{\nu j}^*$), summed across all school districts in the sample.

One conclusion we draw from this simulation is that there are substantial economic rents to protect from school reform. Comparing lines 1 and 3 in Table 4, one can see that deregulated school districts could reduce their aggregate personnel expenditures by $49.6 million without reducing output from initial levels. The simulation indicates that expenditures on teachers could decrease by 9 percent (or $41.3 million), expenditures on administrators by 21 percent and expenditures on professional support staff by 20 percent without reducing student achievement, provided that expenditures on teacher aides increased. Because teacher aides are highly productive relative to their compensation, expenditures on aides would need to increase by 67 percent ($20.4 million) to maintain initial output levels. Apparently, teachers, administrators and support staff are earning economic rents, while teacher aides are severely underutilized.

A second conclusion we draw from the simulation is that as a group education professionals are rational to oppose school deregulation. The current dissatisfaction with student achievement makes it likely that school districts would respond to deregulation by increasing output, subject to their initial budget constraints. Comparing lines 1 and 2 in Table 4 indicates that if initial funding levels were maintained but schools were deregulated, school districts would reallocate resources away from teachers, administrators and professional staff and toward teacher aides. While expenditures on teachers would decline less than 1 percent, expenditures on administrators and professional support staff would decline 15 percent and 14 percent, respectively.

A third conclusion we can draw from the simulation is that the consequences of deregulation are not monolithic. Total employment of teachers, administrators and professional staff would decline if school districts were allowed to reallocate resources, but the simulation does not imply that all school districts overutilize education professionals. Comparing the initial variable-input vector, (χ_ν), to the optimal variable-input vector, (χ_ν^*), reveals that nearly 30 percent of the school districts would respond to deregulation by increasing teacher employment, indicating that teachers are underutilized in those jurisdictions. A similar proportion of jurisdictions would increase hiring of professional staff. Although administrators as a class are substantially overutilized, 21 school districts would hire more administrators if allowed to do so.

Like school district personnel, parents, students and other area residents have an interest in school reform. The simulation also allows us to identify the household characteristics of school districts that would change under deregulation. We hypothesize that voters would favor deregulation in school districts where the simulation indicates that output would increase under deregulation (or expenditures would fall). Because many people expect relative school quality and school taxes to be capitalized into property values, and because school districts that did not improve under deregulation would see their relative quality/tax positions deteriorate, we also predict voter opposition in school districts that the simulation indicates would not improve with deregulation.

We find an interesting pattern in the distribution of school districts that would and would not gain from deregulation (Table 5). Our simulation indicates that 25 school districts are resource constrained and are already as efficient as they would be under deregulation, while 119 school districts would gain from deregulation. On average, the school districts that would gain from deregulation (regulation-constrained districts) have fewer minority students, fewer students receiving reduced-price lunches, higher property values and higher expenditures per pupil than school districts that would not gain from deregulation (resource-constrained districts).[13] Furthermore, the amount by which a school district would gain from deregulation is a decreasing function of that district's state aid and an increasing function of its

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[13] Student's t-tests of the difference between means for these household characteristics indicate that school districts that would gain from deregulation are significantly different from school districts that would not gain.

property wealth and expenditures. One would expect the resource-constrained districts to support reform that redistributes resources across districts rather than the within-district reallocation induced by deregulation.

Our simulation indicates that the primary beneficiaries of school deregulation would be teacher aides and affluent, white school districts. Groups that would not gain from deregulation include the education professionals and resource-constrained school districts, which are typically poorer, minority school districts. Therefore, we expect that school deregulation would be more popular among affluent, white parents and teacher aides than among poorer, minority parents or education professionals. In fact, some anecdotal evidence suggests that the primary supporters of school reform proposals such as school choice have been businesses and affluent parent groups, while most of the teachers' organizations have firmly opposed reforms that do not involve more money for education (Finn 1992).

Care must be taken in interpreting our results however. Recent surveys regarding school choice via a voucher system have found that minority urban residents are supporters of vouchers (Lieberman 1993). We emphasize that our deregulation results correspond to greater choice with respect to resources used in the production of education and do not reflect the outcome of greater demand-side choice. Because the student inputs entering the distance function are treated as fixed, the simulation does not model demand-side choice. We also point out that the deregulation simulation is relative to the best practice technology currently employed by school districts operating in the public sector. Since private and public schools may produce a different mix of educational public goods(for example, private schools might promote religious themes while public schools might promote cultural diversity and integration), the deregulation simulation does not measure how well the public schools in our sample would perform if they operated as private schools outside the confines of the public sector.

This simulation is fairly conservative in the sense that school districts are only allowed to reallocate within the bounds of their initial personnel budgets, given average personnel salaries. Because we assume that all teachers are paid the average salary in their school district, we do not allow for the substitution of less experienced teachers for more experienced (and presumably more expensive) teachers. Because Hanushek (1986) found no systematic correlation between expensive teacher characteristics--like educational attainment and experience--and student achievement gains, such substitutions could be cost effective. On the other hand, we do allow for reallocation across individual schools within a school district.

The simulation also represents *potential* changes in school district allocations. If school districts are sufficiently insulated from market forces, they may not respond to deregulation by reallocating resources to maximize their output. However, the reasonably low level of technical inefficiency in the initial allocation suggests that school districts do face some incentives to operate on the production possibilities frontier and, therefore, that our approach is a credible simulation of school district behavior after deregulation.

We also note that, as with any analysis, there may be room for improvement. We would like to replicate the simulation using data on individual schools rather than school districts, and incorporating data on private schools. While we feel that value added in basic skills is a reasonable measure of school district output, one might also wish to include other types of outputs such as graduation rates, school continuation rates or some measure of labor-force outcomes.

However, as the empirical appendix demonstrates, the estimation is fairly robust to a number of alternative model specifications. These alternative models check for robustness with respect to analyzing nonurban as well as urban school districts, allowing school districts to face a variable returns to scale technology, allowing enrollment outside the range of 1,000-5,000 students, and using average TEAMS scores rather than values added as the measures of school district output.[14] The Spearman correlation coefficients for the rank of the school district GAIN score across the various models indicated a significant positive correlation. Significant differences between resource-constrained and regulation-constrained school districts persist across the alternative specifications. For all of the alternative models, resource-constrained school districts have a greater proportion of poorer, minority students than regulation-constrained school districts.

Conclusions

To identify the distributional consequences of a basic component of educational reform, we simulate the deregulation of 144 school districts in Texas by using a distance-function methodology. This approach allows us to model school districts as producers of a vector of net improvements in student achievement, given student characteristics. By comparing the direct and indirect distance functions, we can simulate the potential gains in achievement from removing restrictions on the use of school district personnel while requiring that school districts remain within the financial constraints of their initial budgets.

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[14] For comparability, all of these alternative specifications maintain the same number of inputs and outputs.

Our simulation indicates that there are substantial differences in the consequences of school reform for different educational interest groups. Parents and students in school districts that are poor and have a relatively high proportion of minority students have little to gain from deregulation. These schools seem to be resource constrained rather than regulation constrained. On average, they are already using their inputs more efficiently than wealthier school districts with fewer minority students. In contrast, school districts that would gain from deregulation tend to have relatively few minority students, relatively few poor students and substantial property wealth per pupil. Furthermore, the potential gains from deregulation increase as property wealth and expenditures per student increase. Therefore, we would expect that affluent parents would prefer educational reforms that deregulate schools, while poorer parents, who are less likely to gain from deregulation, would prefer educational reforms that redistribute schooling resources among schools.

Our simulation also indicates that deregulation and incentives for increased efficiency, would, on average, lead many school districts to substitute teacher aides for teachers, administrators and professional staff such as guidance counselors. Apparently, many education professionals are extracting rents (in terms of excess employment) from the current system. Therefore, it is rational for these groups to oppose educational reform.

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Technical Appendix

There are several ways to calculate $D_o(\chi_f, \chi_\nu, y)$ and $ID_o(\chi_f, p_\nu/c, y)$. Here we use the nonparametric linear programming approach, which is closely related to data envelopment analysis (DEA). In this approach, we exploit the reciprocal relationship between Farrell technical efficiency and the distance functions. Specifically, for each school district i = 1,.....I, we calculate

$$(D_o(\chi_{i'f}, \chi_{i'\nu}, y_{i'}))^{-1} = \max_{\theta, z} \theta \tag{A1}$$

subject to

$$\begin{aligned}
\textstyle\sum_{i=1}^{I} z_i y_{im} - \theta y_{i'm} &\geq 0, m = 1, \ldots, M \\
\textstyle\sum_{i=1}^{I} z_i \chi_{if} &\leq \chi_{i'f}, f = 1, \ldots, F \\
\textstyle\sum_{i=1}^{I} z_i \chi_{i\nu} &\leq \chi_{i'\nu}, \nu = F + 1, \ldots, N \\
z_i &\geq 0, i = 1, \ldots, I
\end{aligned}$$

and

$$(ID_o(\chi_{i'f},\ p_{i'\nu}/c_{i'},\ y_{i'}))^{-1} = \max_{\lambda, z, \chi_\nu} \lambda \tag{A2}$$

subject to

$$\begin{aligned}
\textstyle\sum_{i=1}^{I} z_i y_{im} - \lambda y_{i'm} &\geq 0, m = 1, \ldots, M \\
\textstyle\sum_{i=1}^{I} z_i \chi_{if} &\leq \chi_{i'f}, f = 1, \ldots, F \\
\textstyle\sum_{i=1}^{I} z_i \chi_{i\nu} &\leq \chi_\nu, \nu = F + 1, \ldots, N \\
z_i &\geq 0, i = 1, \ldots, I \\
\textstyle\sum_{\nu=F+1}^{N} p_{i'\nu} \chi_\nu &\leq c_{i'}.
\end{aligned}$$

The intensity vector z serves to construct convex combinations of the data to form the reference sets $P(\chi_f, \chi_\nu)$ and $IP(\chi_f, p_\nu/c)$. The restriction that the intensity variables be nonnegative allows the technology to exhibit constant returns to scale.[1] Note that the choice variables for the direct distance function (A1) are θ and z, while the choice variables for the indirect distance function problem (A2) are λ, z and χ_ν. The prime notation denotes data for the observation (school district) under evaluation; thus $\chi_{i'\nu}$ refers to the observed vector of personnel inputs for school district i'. On the other hand, χ_ν in the third set of constraints for the indirect distance function problem (A2) is a variable for which we solve.

Problems A1 and A2 are solved for each school district in our sample. For details, see Färe et al. (1988, 1993) or Färe and Grosskopf (1993).

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[1] Variable returns to scale may be imposed by adding the constraint that the sum of the intensity variables equals one.

Table 1

Output Estimation
(Standard Errors)

	3rd Grade	5th Grade	9th Grade	11th Grade
Intercept	676.37 (27.97)	616.90 (25.70)	431.21 (31.25)	417.63 (20.55)
$TEAMS87_{math,j}$	0.03 (0.06)	0.03 (0.04)	0.08 (0.03)	0.24 (0.03)
$TEAMS87_{reading,j}$	0.08 (0.06)	0.12 (0.05)	0.27 (0.08)	0.25 (0.04)
$TEAMS87_{writing,j}$	0.15 (0.05)	0.17 (0.04)	0.17 (0.04)	0.02 (0.02)
ASIAN	0.45 (0.71)	0.49 (0.61)	0.31 (0.55)	0.30 (0.35)
BLACK	-0.01 (0.11)	-0.13 (0.10)	-0.23 (0.09)	-0.24 (0.06)
HISPANIC	-0.01 (0.08)	-0.003 (0.07)	-0.09 (0.07)	-0.15 (0.04)
$XCOHORT_j$	-.48 (0.10)	-0.38 (0.09)	-0.40 (0.06)	-0.35 (0.05)
SES	-0.75 (0.11)	-0.57 (0.10)	-0.28 (0.09)	-0.17 (0.06)

Notes: System-weighted R-square is 0.4510.
Number of observations is 604.

Table 2

Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Variable Inputs				
AD	0.006	0.002	0.001	0.014
TEACH	0.060	0.005	0.046	0.078
SUP	0.005	0.002	0.001	0.011
AIDES	0.009	0.005	0.001	0.030
Variable Input Prices				
AD_PAY	$38,612	3659	$30,409	$52,920
TEACH_PAY	23,008	1595	20,166	29,509
SUP_PAY	27,049	2491	21,736	37,101
AIDE_PAY	9,514	1492	6,898	14,109
Fixed Inputs				
$STUINPUT_3$	140.5	23.8	63.9	177.8
$STUINPUT_5$	188.8	24.3	99.6	239.3
$STUINPUT_9$	359.7	22.5	281.4	406.6
$STUINPUT_{11}$	368.2	20.0	310.1	417.9
MAINT	361.1	116.3	141.8	736.7
Outputs (Value-added test scores by grade)				
$OUTPUT_3$	676.7	25.6	568.5	749.5
$OUTPUT_5$	616.3	22.0	538.8	680.2
$OUTPUT_9$	429.1	21.2	377.6	487.1
$OUTPUT_{11}$	416.3	11.5	383.4	440.9
Costs and Enrollment				
VARCOST/ENROLL	$1,827.1	250.6	$1,299.2	$2,676.7
ENROLL	2,637.9	1,225.1	1,010.0	4,995.0

Table 3

Summary of Simulation Results
Mean Values
(Standard Deviation)

	Total	Regulation Constrained	Resource Constrained
$(D_o(\chi_f, \chi_\nu, y))^{-1}$	1.032	1.039	1.0000
	(0.038)	(0.039)	(0.000)
$(ID_o(\chi_f, p_\nu/c, y))^{-1}$	1.074	1.090	1.0000
	(0.057)	(0.051)	(0.000)
GAIN	1.041	1.049	1.0000
	(0.035)	(0.033)	(0.000)
Observations	144	119	25

Table 4

How Deregulation Affects Sample Spending on Personnel

Expenditures: (in millions)	Teachers	Administrators	Staff	Aides	Total
Status quo	\$525.0	\$79.8	\$59.15	\$30.6	\$694.5
Deregulation:					
constant cost	520.7	67.5	51.0	55.2	\$694.5
constant output	483.7	62.8	47.4	51.0	\$644.9

Note: Rows may not sum due to rounding.

Table 5

Mean Characteristics of Regulation-Constrained and Resource-Constrained School Districts

	Regulation Constrained	Resource Constrained
VARCOST	\$1,855.37 (22.46)	\$1,692.42 (47.50)
STATE AID PER STUDENT	\$1,511.69 (51.20)	\$2073.20 (81.93)
EXPENDITURES PER STUDENT	\$3,297.40 (62.84)	\$2850.84 (43.50)
NONWHITE	26.50 (2.14)	57.14 (7.62)
SES	26.23 (1.73)	53.68 (6.47)
MARKET VALUE PER STUDENT	\$185,260 (13,089)	\$80,024 (8,764)
OBSERVATIONS	119	25

Note: Standard errors are in parentheses.

Empirical Appendix

Effects on Total Personnel Expenditures
(in millions)

	N	Teachers	Administrators	Staff	Aides
Model I					
Status Quo	**144**	**525.0**	**79.8**	**59.1**	**30.6**
Deregulation:					
constant cost	144	520.7	67.5	51.0	55.2
constant output	144	483.7	62.8	47.4	51.0
Model II					
Status Quo	**144**	**525.0**	**79.8**	**59.1**	**30.6**
Deregulation:					
constant cost	144	511.9	76.7	53.9	50.3
Model III					
Status Quo	**314**	**1041.9**	**148.9**	**114.4**	**66.7**
Deregulation:					
constant cost	314	1023.2	134.9	101.6	112.1
constant output	314	949.8	125.4	94.2	103.6
Model IV					
Status Quo	**314**	**1041.9**	**148.9**	**114.4**	**66.7**
Deregulation:					
constant cost	314	1036.3	145.4	104.1	83.4
Model V					
Status Quo	**425**	**3681.3**	**496.8**	**453.2**	**222.8**
Deregulation:					
constant cost	425	3664.5	472.2	399.2	318.0
constant output	425	3364.8	434.0	366.3	292.5
Model VI					
Status Quo	**425**	**3681.3**	**496.8**	**453.2**	**222.8**
Deregulation:					
constant cost	425	3646.5	488.7	397.6	321.1
constant output	425	3490.5	468.2	380.3	307.4

Notes:	Model I:	As reported in text, constant returns to scale (CRS), enrollment 1,000-5,000, urban school districts.
	Model II:	Variable returns to scale (VRS), enrollment 1,000-5,000, urban school districts.
	Model III:	CRS, enrollment 1,000-5,000, urban and non-urban school districts.
	Model IV:	VRS, enrollment 1,000-5,000, urban and non-urban school districts.
	Model V:	CRS, no upper bound on enrollment, urban and non-urban school districts.
	Model VI:	CRS, TEAMS average scores (rather than value added) for output, no upper bound on enrollment, urban and non-urban school districts.

Empirical Appendix cont.

Mean Characteristics of Regulation-Constrained (G) and Resource-Constrained (NG) School Districts

	Model I		Model II		Model III	
	G	NG	G	NG	G	NG
GAIN	1.049	1.00	1.012	1.00	1.046	1.00
VARCOST	1855.4	1692.4	1845.9	1776.4	1882.1	1703.8
STATE AID PER STUDENT	1511.7	2073.2	1534.8	1809.5	1558.2	2067.5
EXPENDITURE PER STUDENT	3297.4	2850.8	3259.8	3112.3	3255.6	2846.5
NONWHITE	26.50	57.14	26.22	46.89	32.14	57.54
SES	26.23	53.68	26.29	43.66	32.51	54.15
OBSERVATIONS	119	25	105	39	284	30

	Model IV		Model V		Model VI	
	G	NG	G	NG	G	NG
GAIN	1.016	1.00	1.050	1.00	1.026	1.00
VARCOST	1874.1	1810.9	1868.5	1723.9	1867.1	1743.4
STATE AID PER STUDENT	1569.6	1827.5	1542.7	2095.6	1541.3	2014.6
EXPENDITURE PER STUDENT	3224.0	3171.7	3229.7	2872.0	3232.5	2906.6
NONWHITE	31.98	50.08	34.96	68.09	34.76	64.35
SES	32.33	47.99	32.40	62.26	32.28	58.34
OBSERVATIONS	269	45	391	34	384	41

Direct and Indirect Distance Functions

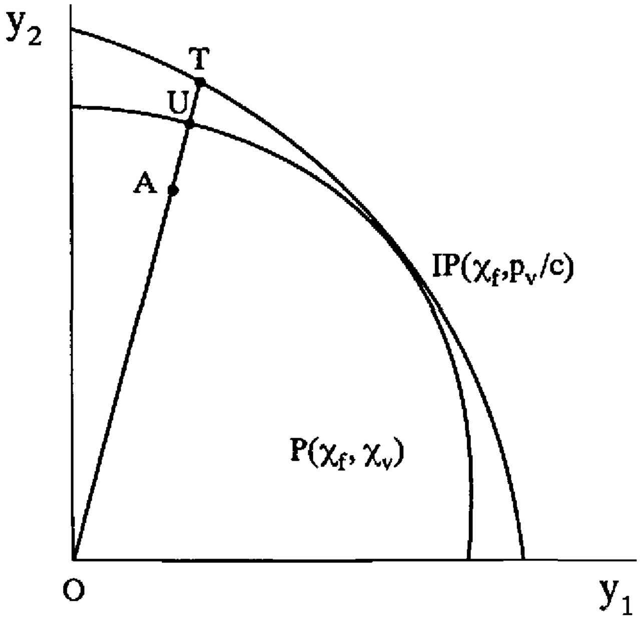

Figure 1

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