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The Political Economy of School Reform

by

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Abstract

Despite all the rhetoric about school reform, there are few signs of substantive change. One source of the delay in changing the system may be opposition by interest groups that do not expect to gain from reform. The authors use distance function methodology to simulate deregulation of urban school districts in Texas and thereby identify the probable winners and losers of educational reform. The simulation indicates that parents and students in school districts that are poor and have a relatively high proportion of minority students have little to gain from deregulation because they are already using their inputs more efficiently than wealthier school districts with fewer minority students. Furthermore, the potential gains from deregulation increase as property wealth and expenditures per student increase. The simulation also indicates that 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 <u>A Nation at Risk: The Imperative for Educational Reform</u> (Gardner et al, 1983), Americans have become increasingly concerned about improving primary and secondary education in the United States. 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 recently developed models of performance to simulate public school reform and thereby to reveal the conflicting interests of various groups concerned with education.

Excluding programs that call simply for an infusion of money, educational reforms come in two basic flavors--reforms that redistribute resources among schools and reforms that redistribute resources within schools. Reforms that redistribute resources among schools produce unambiguous consequences for the educational interest groups because these measures would not require changes in standard operating procedures, and substantial economic research demonstrates that they would have little systematic effect on school quality (see, for example, Hanushek 1986). Taxpayers who expect an increase in tax liabilities would rationally oppose reform, while taxpayers who expect a decrease in tax liabilities would rationally support it. Teachers, administrators, and other school personnel in jurisdictions scheduled to receive additional funds would rationally support reform; school personnel in jurisdictions that would lose revenues would rationally oppose reform.

The consequences of redistributing resources within schools are much less obvious. Necessarily, some types of personnel will be employed less or more under the new regime. One would expect that personnel groups that are currently over-employed relative to their compensation would anticipate losses in employment after reform and would rationally oppose it. Personnel groups that are currently under-employed relative to their compensation could expect to be in greater demand after reform and would rationally support it. To the extent that the redistribution of resources within schools changes educational outcomes, one would also expect parents to support reforms that improve their schools. Furthermore, if relative school quality is capitalized into property values, one would expect homeowners to support reforms that improve the relative standing of their schools. However, it is not clear which personnel groups are currently under-employed and which personnel groups are over-employed, relative to their compensation, nor is it clear which schools would experience relative improvements in quality.

Using an indirect output distance function, we simulate reform of public school districts in Texas to identify the winners and losers from a deregulation policy that allows school districts to reallocate their resources. We find that most school districts could allocate their resources more effectively than the status quo, perhaps because the Texas state legislature heavily regulates the schools, and therefore that regulation adds substantially to the cost of education in Texas.[1] The simulation indicates that school administrators, teachers and professional staff (such as counselors) are likely to lose employment through deregulation while teacher

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

aides are likely to gain employment. The simulation also suggests that school deregulation could widen the gap between rich and poor school districts because students and parents in affluent areas of the state would be more likely to benefit from deregulation than would students and parents in poorer parts of the state.

These results suggest that reform will remain an important issue because it benefits large, politically influential groups of parents. However, reform will continue to be difficult to achieve because teachers and other members of the educational establishment are better organized than the parents who are likely to benefit from reform.

The Model

We model educational decision-making under the status quo and under deregulation using the direct and indirect output distance functions, respectively. We choose distance functions over the more familiar cost or production functions for several reasons. First, unlike cost functions which presume cost-minimizing behavior, a distance function has no embedded behavioral objective and, therefore, lends itself well to analyses of the public sector. Furthermore, public sector officials may be trying to maximize output given available resources rather than trying to minimize the cost of producing a given level of output, suggesting that a production-function approach would be more appropriate than a cost-function approach. However, because production functions are single-output representations of technology, they have limited use in modeling multi-output technologies. The direct output distance function allows us to employ a production-function approach in a multi-output setting, and the indirect output distance function allows us to introduce a budget constraint into the multi-output technology.

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

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

where χ_f is a vector of fixed input quantities, χ_v 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, $P(\chi_f,\chi_v)$.[2] As in a regulated environment, the input vector $\chi=(\chi_f, \chi_v)$ 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 are budget-constrained but are free to choose their variable inputs as long as they satisfy the budget constraint. Shephard (1974) defines the indirect output distance function as

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

where c is total variable cost, p_v is a vector of variable-input prices, and $1/\lambda$ is the maximum amount all outputs can be expanded and still be feasible given the indirect (budget-constrained) production possibilities set, $IP(\chi_f,p_v/c)$. $IP(\chi_f,p_v/c)$ is the largest production possibility set allowing χ_v to vary but satisfy the budget constraint ($p_v'\chi_v \leq c$).

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

Figure 1 illustrates the direct and indirect output distance functions for a typical school district that produces two outputs. The set $P(\chi_f, \chi_v)$, which describes the best practice technology under the status quo, gives all possible combinations of the two outputs that can be produced with the given input bundle (χ_f, χ_v). 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, $P(\chi_f, \chi_v)$, holding the mix of outputs constant. This is equal to the ratio OA/OU, where U represents the maximum output feasible within $P(\chi_f, \chi_v)$, given the observed output mix and input bundle (i.e., the status quo). This ratio is interpreted as a measure of technical efficiency.

The set $IP(\chi_f, p_v/c)$, 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_v). The school district is allowed to choose variable inputs as long as χ_v satisfies the budget constraint, so in this case $P(\chi_f, \chi_v)$ will be a subset of $IP(\chi_f, p_v/c)$. The indirect output distance function tells us how far the observed output bundle is from the frontier of the indirect or budget-constrained (deregulated) technology, $IP(\chi_f, p_v/c)$. In this figure, that 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.[3] Equivalently, values of one indicate that the particular school district is technically efficient in the sense of Farrell (1957).[4]

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:

$$p_v' \chi_v \le c \Rightarrow ID_o(\chi_f, p_v/c, y) \le D_o(\chi_f, \chi_v, y). \tag{3}$$

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 if school districts are allowed to choose any budget-satisfying input bundle

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[3] Formally,

$$D_o(\chi_f,\chi_v,y) \le 1 \Longleftrightarrow y \in P(\chi_f,\chi_v)$$
$$D_o(\chi_f,\chi_v,y) = 1 \Longleftrightarrow y \in Isoq\ P(\chi_f,\chi_v)$$

$$ID_o(\chi_f, p_v/c, y) \le 1 \Longleftrightarrow y \in IP(\chi_f, p_v/c)$$
$$ID_o(\chi_f, p_v/c, y) = 1 \Longleftrightarrow y \in Isoq\ \ IP(\chi_f, p_v/c)\cdot$$

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

divided by the maximum potential output achievable using the initial vector of inputs:

$$GAIN = ID_o(\chi_f,\ p_v/c,\ y)/D_o(\chi_f, \chi_v, y). \tag{4}$$

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 OU/OT.

The Data

We apply the distance-function approach described in the previous section to a sample of 134 urban Texas school districts operating in 1989. The sample includes all urban 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. 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 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):

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

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.[5] We present these equation estimates in Table 1.[6]

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 the distance function methodology is not designed for negative outputs, we transform the value-added residuals into tractable output measures by adding 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

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[5] 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, estimated the output measures simultaneously using the standard SAS package for seemingly unrelated regression (SUR).

[6] 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.

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,

$$STUINPUT_{i,g} = \hat{\alpha}_g + \sum_{j=1}^{3} \hat{\delta}_{j,g}\, ETHNICITY_i + \hat{\delta}_{4,g}\, SES_i + \hat{\delta}_{5,g}\, XCOHORT_{i,g} + \sum_{j=6}^{9} \hat{\delta}_{j,g}\, TEAMS87_{i,j,g-2}. \tag{7}$$

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.[7]

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.

The Empirical Results

We calculate $D_o(\chi_f, \chi_v, y)$ and $ID_o(\chi_f, p_v/c, y)$ for each school district in

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[7]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.

our sample using the nonparametric linear programming approach described in the appendix. In calculating $D_o(\chi_f,\chi_v,y)$, all inputs are treated as fixed by the regulations. In calculating $ID_o(\chi_f,p_v/c,y)$, 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 the appendix. Input prices are assumed fixed at the observed salary levels. 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 $D_o(\chi_f,\chi_v,y)$, $ID_o(\chi_f,p_v/c,y)$ and GAIN ($ID_o(\chi_f,p_v/c,y)/D_o(\chi_f,\chi_v,y)$) in Table 3. On average, $D_o(\chi_f,\chi_v,y)$ is 0.965, $ID_o(\chi_f,p_v/c,y)$ is 0.931, and 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 0.964. That is, on average, school districts could increase achievement (as measured by value added) by 3.5 percent if they used their initial input bundle efficiently, and an additional 3.6 percent if they could reallocate inputs efficiently.[8]

[8] In a related study using a larger sample of Texas school districts, 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 difference in samples as well as the differences in technique. The sample used here is more homogeneous because it excludes non-urban school districts. Increased homogeneity tends to increase technical efficiency because technical efficiency is a relative concept.

Assuming constant returns to scale, a potential 3.6 percent gain in output from reallocating personnel inputs implies that deregulated school districts could reduce personnel expenditures by 3.6 percent without reducing output. 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_v^*), 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.[9] An input is said to be earning economic rents when that input's price exceeds its marginal product or, equivalently, when it is over-utilized relative to its compensation.

Table 4 describes the aggregate effects of deregulation on the 134 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 ($p_j \chi_{vj}^*$), 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 equalled 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

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

output distance function. Recall that the indirect output distance function indicates that school districts could increase output by an average of 6.9 percent (1-.931) 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 6.9 percent. For each school district, the minimum personnel expenditure needed to achieve the initial output level in a deregulated environment would be $ID_o(\chi_f, p_v/c, y) \bullet VARCOST$. As before, the optimal variable-input vector (χ_v^*) 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 ($ID_o(\chi_f, p_v/c, y) \bullet p_j \chi_{vj}^*$), 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 $48.4 million without reducing output from initial levels. The simulation indicates that expenditures on teachers could decrease by 8 percent (or $40.5 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 68 percent ($19.8 million) to maintain initial output levels. Apparently, teachers, administrators, and support staff are earning economic rents, while teacher aides are severely under-utilized.

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 16 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 over-utilize education professionals. Comparing the initial variable-input vector, (χ_v), to the optimal variable-input vector, (χ_v^*), reveals that nearly 30 percent of the school districts would respond to deregulation by increasing teacher employment, indicating that teachers are under-utilized in those jurisdictions. A similar proportion of jurisdictions would increase hiring of professional staff. Although administrators as a class are substantially over-utilized, 18 school districts would hire more administrators if allowed to do so.

Parents, students, and other area residents, like school district personnel, 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 23 school districts are already as efficient as they would be under deregulation while 111 school districts would gain from deregulation. On average, the school districts that would gain from deregulation have fewer minority students, fewer students receiving reduced-price lunches, higher property values, and somewhat higher expenditures per pupil than school districts that would not gain from deregulation.[10] 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 property wealth and expenditures. Apparently, school inefficiency is a luxury good. Poor schools cannot afford to be inefficient.

Our simulation indicates that the primary beneficiaries of school deregulation would be teacher aides and affluent, white school districts.

[10] 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.

Groups that would not gain from deregulation include the education professionals and 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.

Anecdotal evidence appears consistent with the predictions of the simulation. The primary proponents of school deregulation programs such as school choice have been businesses and affluent parent groups, although recently some groups speaking for minorities and the poor have endorsed school choice (Chubb and Moe 1990). Most teachers' organizations appear firmly opposed to reforms that do not involve more money for education (Finn 1992). School administrators appear to favor reforms such as site-based management that offer them more control over resources. There is little evidence about the opinions of teacher aides or professional staff.

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. While we feel that our measures of school district output--gains in average test scores net of student characteristics--are very reasonable, one might also wish to include other types of outputs such as graduation rates, school continuation rates or some measure of labor-force outcomes.

Conclusions

To identify the probable winners and losers of educational reform, we simulate the deregulation of urban 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.

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. 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.

References

Aitkin, M., and N. Longford (1986), "Statistical Modeling Issues in School Effectiveness Studies," Journal of the Royal Statistical Society, A (149, pt. 1): 1-26.

Boardman, Anthony E., and Richard J. Murnane (1979), "Using Panel Data to Improve Estimates of the Determinants of Educational Achievement," Sociology of Education 52 (April): 113-21.

Callan, Scott J., and Rexford E. Santerre (1990), "The Production Characteristics of Local Public Education: A Multiple Product and Input Analysis," Southern Economic Journal 57(2):468-80.

Chubb, John E., and Terry M. Moe (1990), Politics, Markets, and America's Schools (Washington, D.C.: Brookings Institution).

Fare, Rolf, Shawna Grosskopf, and C.A. K. Lovell, (1985), The Measurement of the Efficiency of Production, (Boston: Kluwer-Nijhoff Publishing).

Farrell, M.J. (1957), "The Measurement of Productive Efficiency," The Journal of the Royal Statistical Society, Series A 120(3): 253-81.

Finn, Chester E. (1992), "The Education Empire Strikes Back," Wall Street Journal, December 16: A14.

Gardner, David P. *et al.* (1983), A Nation at Risk: The Imperative for Educational Reform. A Report to the Nation and the Secretary of Education, United States Department of Education, by The National Commission of Excellence in Education (Washington, D.C.: Government Printing Office).

Grosskopf, Shawna, Kathy Hayes, Lori Taylor, and William Weber (1992), "Budget-Constrained Frontier Measures of Fiscal Equality and Efficiency in Schooling," Federal Reserve Bank of Dallas Research Paper, no. 9206.

Hanushek, Eric A. (1986), "The Economics of Schooling: Production and Efficiency in Public Schools," Journal of Economic Literature 24 (September):1141-76.

__________ and Lori L. Taylor (1990), "Alternative Assessments of the Performance of Schools," The Journal of Human Resources 25(2):179-201.

Shephard, R.W. (1970), Theory of Cost and Production Functions (Princeton, New Jersey: Princeton University Press)

__________ (1974), Indirect Production Functions (Meisenheim am Glan, Germany: Verlag Anton Hain).

Texas Education Agency (1987), Texas Educational Assessment of Minimum Skills, Volume II: Performance by School District, Austin, Texas.

__________ (1989), Texas Educational Assessment of Minimum Skills, Volume II: Performance by School District, Austin, Texas.

Texas Research League (1989), Bench Marks 1988-89 School District Budgets in Texas, Austin, Texas.

Technical Appendix

There are several ways to calculate $D_o(\chi_f, \chi_v, y)$ and $ID_o(\chi_f, p_v/c, y)$. 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 $k' = 1, \ldots, K$ we calculate

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

subject to

$$\begin{aligned}
\sum_{k=1}^{K} z_k y_{km} - \theta y_{k'm} &\geq 0, m = 1, \ldots, M \\
\sum_{k=1}^{K} z_k \chi_{kf} &\leq \chi_{k'f}, f = 1, \ldots, F \\
\sum_{k=1}^{K} z_k \chi_{kv} &\leq \chi_{k'v}, v = F+1, \ldots, N \\
z_k &\geq 0, k = 1, \ldots, K
\end{aligned}$$

and

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

subject to

$$\begin{aligned}
\sum_{k=1}^{K} z_k y_{km} - \lambda y_{k'm} &\geq 0, m = 1, \ldots, M \\
\sum_{k=1}^{K} z_k \chi_{kf} &\leq \chi_{k'f}, f = 1, \ldots, F \\
\sum_{k=1}^{K} z_k \chi_{kv} &\leq \chi_v, v = F+1, \ldots, N \\
z_k &\geq 0, k = 1, \ldots, K \\
\sum_{v=F+1}^{N} p_{k'v} \chi_v &\leq c_{k'}.
\end{aligned}$$

The intensity vector z serves to construct convex combinations of the data to form the reference sets $P(\chi_f, \chi_v)$ and $IP(\chi_f, p_v/c)$. The restriction that the intensity variables be nonnegative allows the technology to exhibit constant returns to scale.[1] These problems are solved for each school district in our sample: in all we calculate 268 linear programming problems. For details, see Fare et al (1985).

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

Table 1

Output Estimation

	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	0.006	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	$38,700	3748	$30,409	$52,920
TEACH_PAY	23,098	1592	20,205	29,509
SUP_PAY	27,196	2496	21,736	37,101
AIDE_PAY	9,581	1491	6,898	14,109
Fixed Inputs				
$STUINPUT_3$	140.5	24.4	63.9	177.8
$STUINPUT_5$	188.7	24.9	99.6	239.3
$STUINPUT_9$	359.8	22.8	281.4	406.6
$STUINPUT_{11}$	368.0	20.2	310.1	417.9
MAINT	367.0	118.0	141.8	736.7
Outputs (Value-added test scores by grade)				
$OUTPUT_3$	676.3	26.2	568.5	749.5
$OUTPUT_5$	615.8	22.4	538.8	680.2
$OUTPUT_9$	428.8	21.3	377.6	487.1
$OUTPUT_{11}$	415.9	11.3	383.4	440.9
Costs and Enrollment				
VARCOST/ENROLL	$1,839.9	252.7	$1,299.1	$2,676.6
ENROLL	2,677.5	1,213.5	1,010.0	4,995.0

Table 3

Summary of Simulation Results
Mean Values
(Standard Deviation)

	Total	Gainers	Non-Gainers
$D_o(\chi_f, \chi_v, y)$	0.9654 (0.037)	0.9583 (0.036)	1.0000 (0.000)
$ID_o(\chi_f, p_v/c, y)$	0.9310 (0.049)	0.9167 (0.041)	1.0000 (0.000)
GAIN	0.9641 (0.031)	0.9567 (0.028)	1.0000 (0.000)
Observations	134	111	23

Table 4

How Deregulation Affects Sample Spending on Personnel

Expenditures: (in millions)	Teachers	Administrators	Staff	Aides	Total
Status quo	$498.1	$75.9	$56.5	$29.2	$659.6
Deregulation, maintaining initial expenditure levels	493.6	64.0	48.8	53.2	$659.6
Deregulation, maintaining initial output levels	457.6	59.4	45.3	49.0	$611.3

Note: Rows may not sum due to rounding.

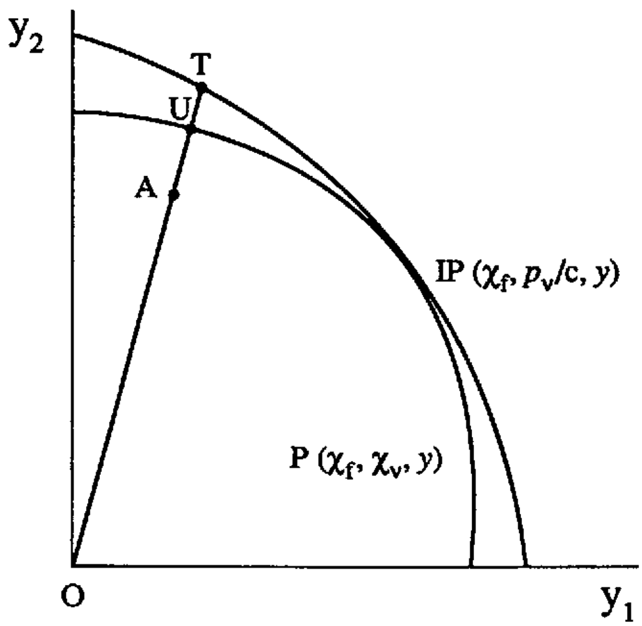
Table 5

Mean Characteristics of
Gainers and Losers from Deregulation

	Gainers	Losers
VARCOST	$1,867.30 (23.49)	$1,707.84 (50.21)
STATE AID PER STUDENT	$1,472.54 (52.55)	$2,092.14 (87.28)
NONWHITE	27.02 (2.26)	59.85 (8.03)
SES	26.05 (1.84)	56.01 (6.82)
ENROLLMENT	2728.19 (119.96)	2432.65 (190.99)
MARKET VALUE PER STUDENT	$191,761 (13,818)	$78,271 (9347)
EXPENDITURES PER STUDENT	$3,334.34 (65.91)	$2,851.17 (47.37)
OBSERVATIONS	111	23

Note: Standard errors are in parentheses.

Direct and Indirect Distance Functions



ID_o (χ_f, p_v/c, y) = OA/OT. D_o (χ_f, χ_v, y) = OA/OU.

Figure 1

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