Pergamon

Economics of Education Review 22 (2003) 193–201

Economics of Education Review

www.elsevier.com/locate/econedurev

School district size and student performance

Donna Driscoll [a], Dennis Halcoussis [a], Shirley Svorny [a,*]

[a] *California State University, Northridge, CA 91330-8245, USA*

Received 20 July 2000; accepted 22 October 2001

Abstract

This paper examines the impact of district size on student academic performance using 1999 school level data provided by the California Department of Education. A production function is estimated, with the California Academic Performance Index (a weighted average of Stanford 9 test scores) as the dependent variable. Controlling for characteristics of the student population and other environmental factors, including class and school size, district size appears to hinder educational achievement, having its biggest impact on middle school student performance. The results from California point toward reducing school district size, along with school and class size at the elementary level, as potentially important to educational reform.

JEL classification: L320

Keywords: Economies of scale; Educational economics

1. Introduction

Although numerous studies have examined the determinants of academic outcomes in primary and secondary schools, few have considered the impact of school district size. This ignores what may be an essential determinant of program quality.

This paper examines the impact of district size on student academic performance at the school level in California. District size can have two confounding impacts on performance. First, if district level decisions limit local school autonomy, the heterogeneous needs of pupils in large districts will not be met. Fiscal controls at the district level may discourage or constrain innovation in program choice and resource use. In large districts, communication and coordination problems are likely to reduce accountability. It will be relatively difficult for parents to make their concerns known. This top-down structure may have a negative impact on academic achievement. Alternatively, there may be advantages of size. A centralized administration may allow large districts to spend relatively greater amounts of money on classroom instruction.[1] If this is true, district size will be associated with relatively higher levels of academic achievement.

To examine the relationship between district size and student performance, we use 1999 school level data provided by the California Department of Education.[2] The database is well suited to tests of the impact of district size; there is significant heterogeneity in district size among California schools (see Fig. 1). The large number of big districts allows tests of economies of size far beyond those in previous studies. In California, approxi-

* Corresponding author. Tel.: +1-818-677-4504; fax: +1-818-677-6264.

E-mail address: shirley.svorny@csun.edu (S. Svorny).

[1] Streifel, Foldesy and Holman (1991) and Fox (1981) both report administrative economies as consolidation unites small districts under one administrative unit.

[2] Data are available at www.cde.ca.gov

0272-7757/02/$ - see front matter
doi:10.1016/S0272-7757(02)00002-X

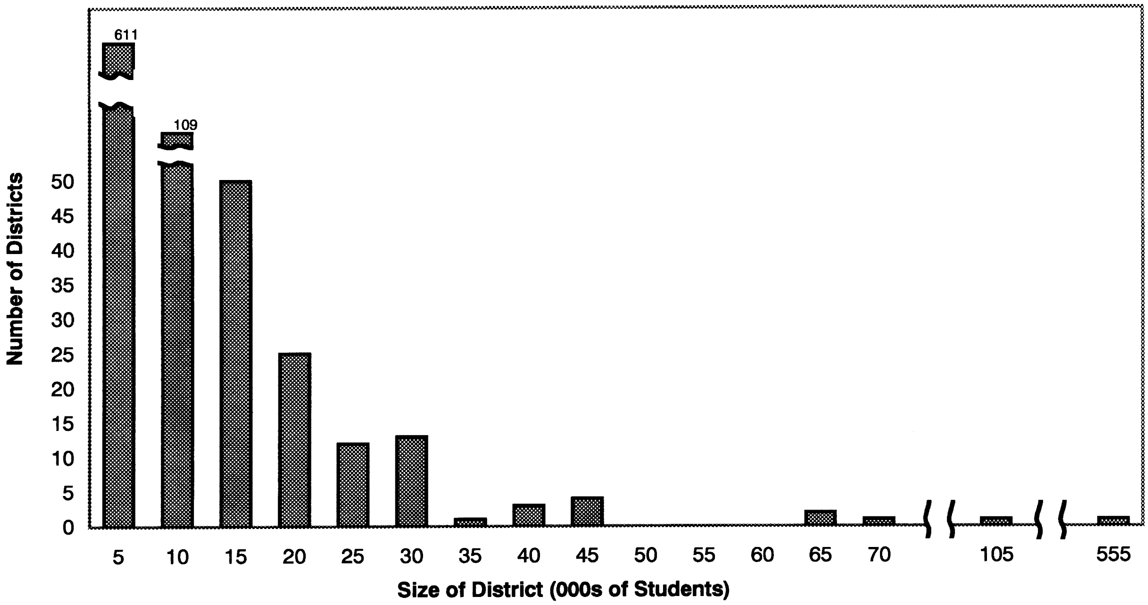

Fig. 1. Distribution of School District Size (1999 API Reported Enrollments)

mately 1 out of 6 schools are in districts with more than 40,000 students. One in twelve schools in California are in the massive Los Angeles Unified School District (nearly 600,000 students tested).

The database offers the opportunity to examine class, school, and district size effects; no other study includes all three. This data also allows us to estimate regressions for elementary, middle, and high schools separately. Estimating regressions for each type of school separately allows a test for potentially increasing economies as students move from elementary to secondary schools. An important innovation in this study is that we include population density as a regressor. District size and population density are correlated. If population density is not included, the observed effects of district size on academic achievement are related to both population density and district size.

After controlling for characteristics of the student population and other environmental factors, we find evidence consistent with the hypothesis that district size hinders educational achievement. Students in larger school districts have lower scores on standardized tests.

2. School district consolidation

Between 1940 and 1990, the number of US school districts fell dramatically through consolidation. Many of the unions were between small, rural districts. Consolidations reflected the widespread acceptance of the premise that small districts lack fiscal efficiency and professional leadership (Strang, 1987).

Strang argues that it was the expansion of the state's role in education that led to larger and more bureaucratic district structures in the United States. He notes that professional educators, linked to state departments of education, campaigned for consolidation. Parental opposition was overcome by financial incentives that favored consolidation. According to Streifel et al. (1989), a common incentive has been to provide additional state funding to schools in districts that consolidate.

Strang points to the conflict between central and local control. From a bureaucratic perspective, centralized organizations facilitate the flow of influence. At the same time, linkages to the community, along with the ability to match services to meet local needs, are lost.

It is that link that modern reformers seek to restore by breaking up large urban school districts. This is not so easily accomplished. The 1969 effort to decentralize New York City schools was generally ineffective in transferring power from central authorities to local communities (Lederman, Frankl, & Baum, 1987). Similar problems have plagued reform efforts in the Los Angeles Unified School District.

Dissatisfied with nominal decentralization, residents in some areas of Los Angeles have petitioned to break up the mammoth district. Officials of the Los Angeles Unified School District are frustrated by calls to break up the district. The *Los Angeles Times* quoted LAUSD Board of Education President Genethia Hayes as having said, "If someone could tell me definitively that smaller districts are better than larger districts, then I would entertain a conversation" (Sauerwein, 1999). President Hayes is unlikely to ever get the definitive answer she seeks. The empirical work in this paper is a step in the direction of evaluating the role of district size in student achievement.

3. Previous work

The idea that school district size might systematically affect student performance is consistent with the growing literature on the relationship between public sector institutional arrangements and outcomes (Moe, 1984). Size has the potential to influence the choice of organizational structure and, therefore, incentives of the various participants, operational conditions, and outcomes.

This idea is addressed with respect to school districts in Bidwell and Kasarda (1975). Discussing the literature on organizational structure, Bidwell and Kasarda note the "centrality of size as a 'prime mover' of variation in the morphology of organizations" (p. 69). It is likely that attributes of school district organization that are related to school district size affect the education production process and, therefore, students' academic achievement.

The theory behind identifying the optimal size for a school district parallels that for the firm. As with a firm, it is likely that per capita costs of production initially fall as school districts grow. Producing services for thousands of households allows a sharing of school buildings. It also permits full use of labor inputs, eliminating the cost of running classrooms that are half empty. As a result, average costs fall to a level that makes such services more affordable.

At some point, however, as the number of residents served increases, it is thought that per capita costs of production start to rise. Most relevant to this paper, the traditional literature on the firm emphasizes the communication and coordination problems inherent in a large service provider. Being too big leads to inefficiencies in service provision and management. Agency costs are thought to increase as entities grow in size. These are the costs associated with getting employees to act in the interest of a firm's owners or stockholders or, for a public school, the students and voters. The further removed employees are from the oversight of those whose interests are being served, the more it is thought they will be able to shirk, putting their own interests before those they are hired to serve.

With respect to public education, a bigger district makes it difficult for both educators and parents to evaluate and improve the educational production process. Because size facilitates top down planning, it is likely to limit local input into curriculum choice. Observable "efficiencies" due to uniformity in larger districts may be at the expense of unique programs aimed at dealing with problems distinct to certain communities. The loss of individual school autonomy associated with district size may hinder education and student achievement.

Writing more than 30 years ago, Werner Hirsch (1968) set forth basic issues related to economies of scale in the provision of education. Hirsch notes that "the conditions that help private industry to benefit from scale economies, lower factor costs, larger and more efficient plants, and circular and vertical integration" do not apply to schools (1968, p. 503). As district size grows, Hirsch suggests "administrative top-heaviness" and "unionization of public servants…can produce diseconomies"(p. 503).[3] Rather than permit orderly planning and co-ordination for growth, Hirsch argues that large organizations suffer from an inability to move forward.

Attempts by researchers to assess the impact of scale in education on costs or student achievement are hampered by problems associated with measuring outputs and controlling for environmental conditions. Bradford, Malt and Oats (1969) observe that it is hard to define a unit of educational output. Researchers use measures such as test scores or graduation rates, but the success of individuals beyond school would be a better indicator of value added. Fox (1981) and Duncombe and Yinger (1993) discuss the problems researchers face in empirically investigating economies of scale. In particular, Duncombe and Yinger stress the importance of controlling for what they call environmental cost factors—conditions that might affect the costs of providing public services in different circumstances.

There are two types of studies examining economies of scale in education. The first are empirical estimations of cost functions. Studies that have tried to estimate economies of scale in education by means of estimating cost functions generally have not controlled for differences in district size. An exception is Chakraborty, Biswas and Lewis (2000) who examine cost functions for school districts in Utah. Chakraborty, Biswas and Lewis find economies of scale comparing districts from 1000 students to over 25,000 students. All else constant, the proportion of students graduating increased with district size.

In assessing economies of scale empirically, the alternative to estimating cost functions is to examine production functions. Researchers regress measures of outcomes (test scores, for example) on measures of school and student inputs, including class, school, and, rarely, district size.

Two studies that included measures of district size are by Kiesling (1967) and Fowler and Walberg (1991). Kiesling (1967) examines achievement scores from a 1957 sample of about 100 school districts in New York State. Depending on how the data are grouped and what grades are examined, Kiesling finds either no effect or a negative effect of district size on student achievement. However, Kiesling does not include any measures of environ-

[3] Trejo (1991) discusses size economies in union formation.

mental conditions (other than what might show up in per pupil expenditures) and he does not control for school or class size. Kiesling looks at fairly small districts; to test for size effects he divides districts into two sets, those with more than 2000 students and those with less than 2000 students. The largest district in Kiesling's sample has 36,590 students.

Fowler and Walberg (1991) use data from 293 secondary schools in New Jersey, in school districts ranging from 462 to 54,768 students.[4] They examine 18 outcome measures (most of which are test scores), using a backward stepwise procedure to isolate statistically significant factors. Their results are generally consistent with what other researchers have found: District socioeconomic status (a weighted measure of characteristics including education, occupation, density, urbanization, income, unemployment and poverty) is the most important statistical determinant of outcomes. Second is the percent of students from low-income families in a school. Adding a measure of district size, Fowler and Walberg find it to have a negative effect on 10 of their outcome measures (all test scores). In this study, larger school districts are associated with inferior academic performance.[5]

4. Tests using 1999 California data

To further examine the relationship between district size and academic achievement, we use the production function approach, with school level standardized test scores as the dependent variable in our regressions. The 1999 California database allows an examination of economies of scale to a much larger size than has been evaluated in previous studies. One in six schools in California are in districts with more than 40,000 students. One in twelve schools are in the Los Angeles Unified School District, which tested nearly 600,000 students in 1999. The database includes 6730 schools in 833 districts in California. Because relevant variables are missing for some observations, we use 5525 schools representing 755 districts. Each school is an observation. The smallest district in our sample tested 101 students.

As the dependent variable, we use the 1999 California Academic Performance Index (API), a weighted average of Stanford 9 test scores. This measure is calculated by the California Department of Education to measure individual school performance. Controls are added for the nature of the inputs and environmental conditions that may affect the production of education. Economies of size are tested by including class size, school size, and district size as explanatory variables.[6] Separate regressions are run for elementary, middle, and high schools in the State.

The California Department of Education database includes measures that allow us to control for the characteristics of the inputs—both students and teachers—at the school level. Two measures that have consistently been shown to influence test scores across all studies of educational achievement (see Fowler & Walberg, 1991)—parental income and education—are included in the regressions. Parental income is measured by the percent of students in the school who receive free or reduced price meals at the school. The percentage of students receiving free or reduced price meals provides information on the lower part of income distribution. We also include the median household income (tied to the zip code of the school) to capture information regarding the middle of the income distribution. Our education measure is the percent of a school's parents who have graduated from college.

Previous studies have controlled for teacher quality using measures of experience (in years) and education with little success. These measures have not shown themselves to be good proxies for teaching ability. We argue that socioeconomic variables control not only for characteristics of the student population, but for teacher competence as well. It is likely that teachers sort themselves, so that average teacher quality is not independent of the student population of the school. Schools with wealthier students and relatively-well educated parents will have an excess supply of teachers, allowing these schools to pick teachers who, on average, are superior. We believe the predominance of family variables in explaining educational outcomes in previous research is, in part, a reflection of sorting among teachers.

It would be appropriate to include controls for other inputs, such as capital equipment, facilities and textbooks. We do not have these measures. For several reasons, this is not likely to be a serious hindrance. Most important, prior work shows little evidence of a relationship between school spending and student performance (Hanushek, 1986). Also, in California, funding for schools is provided at the state level, for the express purpose of promoting equity in service provision. Third, district records of capital equipment and facilities are not likely to contain current market values. Finally, supplies purchased may be poor proxies for inputs to the actual educational process.[7]

[4] An earlier study by Walberg and Fowler (1987) did not control for school size.

[5] Fowler and Walberg (1991) did not control for class size.

[6] For recent evidence on class size, see Krueger (1999) and Angrist and Lavy (1999). Both studies find some evidence of a positive impact of reducing class size on academic performance.

[7] The Los Angeles Unified School District, for example, has purchased textbooks, but anecdotal stories suggest that not all students have access to textbooks appropriate to their course-

To control for environmental conditions that affect the production of education, we include population density and the share of children enrolled in private schools. Population density allows us to control for characteristics of dense urban areas that may affect the production of education. The population density measure is per acre, by city, town, or place name. This measure, missing in previous studies, is important for assessing district size effects. Without such a control, district size may act as a proxy for densely populated areas. By including population density, we control for the nature of the physical environment in which education is produced.

Duncombe and Yinger (1993) emphasize the importance of including controls for the physical environment in assessing economies of size. Talking about fire protection, they note the difficulty of protecting dense, tall structures; the same quantity of fire trucks and personnel will not translate into the same level of fire protection in two areas if environmental conditions differ.

Fox (1981) makes this point with respect to the production of education. He notes the importance of population density in determining physical capital costs and transportation costs that may lead to significant differences in production techniques across communities.

It is possible that high transiency rates or high costs of addressing truancy may be related to population density. High transiency rates make it difficult to offer an integrated curriculum to students. High costs of addressing truancy will result in absences that belie a teacher's best efforts to educate a child. To capture and control for these conditions, we include a measure of population density for the city or town in which each school is located.[8,9]

We also add a measure of the private school population from the 1990 US Census, following recent interest in the hypothesis that private school competition encourages public school performance.[10] The percent of students in the school's local area (zip code) who are attending private school measures competitive pressures that might motivate nearby public schools to improve educational outcomes.

Information on class, school, and district size is available at the school level, allowing us to measure their separate impact. We estimate production functions for elementary, middle, and high schools separately. Fox (1981) argues that elementary and secondary schools are likely to have different equipment needs and course offerings, leading to smaller economies in the production of elementary education. We are able to test this premise.

5. Empirical findings on district size

The dependent variable used here is the school level academic performance index. Using ordinary least squares, district size has a negative coefficient that is statistically significant at a 1% error level for the elementary and middle school regressions. It is not significant in the high school regression. Most of the other variables have significant coefficients with the expected signs. The adjusted R^2 has a range from 0.62 to 0.72 in the three regressions. The ordinary least squares results are very similar to the instrumental variable results shown below in Table 1.[11]

It is possible that district size and API scores are simultaneously determined. School districts that that report high API scores may attract new residents. A series of Hausman tests confirms that some degree of simultaneity does exist between district size and API scores.[12] To control for this endogeneity, one approach would be to use the change in API scores over time as the dependent variable in the regressions. Changes in API scores are less likely to be simultaneously determined with district size. Parents are more likely to be attracted to a district that has a high API score than a district that is showing an improvement in API scores. However, when the change or the percent change in API score (1999 to 2000) serves as the dependent variable, the regressions fit poorly, with the adjusted-R^2s taking values less than 0.05. There is not enough change in the API scores from 1999 to 2000 for this approach to provide any insights. Perhaps this approach will be more useful in the future, when researchers can examine changes in test scores over longer periods of time.

Another option is to use an instrumental variable estimation technique in place of ordinary least squares. Here, we use the number of schools in each district as an instrument for district size. The number of schools in the district is correlated with district size, but is less

work and, when they do have textbooks, many students are not allowed to take the books home.

[8] Measures of population density are available for cities for 1990. For other areas, we examined each location individually and chose a measure from a similar area nearby. In very rural, remote areas for which population density figures were not available, we applied the density measure from the least densely populated area in our database. These cases constitute 1.4% of the sample.

[9] Population density may also control for locational attributes that are attractive to teachers and other administrators. Bidwell and Kasarda (1975) suggest that large cities are more likely to offer employment opportunities for spouses and to "afford more of the amenities of life that attract and hold competent teachers." (p. 61).

[10] See Testa and Sen (1999) and Hoxby (1998, 2000).

[11] A table presenting the ordinary least squares results can be seen at www.csun.edu/~vcact004/schools/OLS.doc

[12] See Hausman (1978). Detailed results of the Hausman tests are available from the authors.

Table 1
Instrumental variable results by type of school Dependent variable: 1999 APIInstrument for district size: Number of schools in district

Variable	Regression 1 Elementary schools		Regression 2 Middle schools		Regression 3 High schools	
	Unstandardized coefficients	Standardized coefficients	Unstandardized coefficients	Standardized coefficients	Unstandardized coefficients	Standardized coefficients
Constant	615.37		502.85		462.46	
	(34.78)**		(16.86)**		(23.95)**	
DISTRICT SIZE	-5.42×10^{-5}	−0.063	-1.04×10^{-4}	−0.13	-2.91×10^{-5}	−0.037
	(−5.27)**	(−5.27)**	−(4.00)**	−(4.00)**	(−1.42)	(−1.42)
SCHOOL SIZE	−0.059	−0.073	−0.0021	−0.0073	0.0027	0.015
	(−6.83)**	(−6.83)**	−(0.24)	−(0.24)	(0.56)	(0.56)
K-3 AVE	−2.27	−0.033				
CLASS SIZE	(−3.24)*	(−3.24)*				
4-6 AVE	0.034	0.00074	0.25	0.0079		
CLASS SIZE	(0.072)	(0.072)	(0.35)	(0.35)		
7–12 AVE			−1.92	−0.045	−2.32	−0.065
CLASS SIZE			(−1.95)†	(−1.95)†	(−2.55)*	(−2.55)*
MEAL	−1.43	−0.34	−0.86	−0.20	−0.30	−0.068
	(−26.37)**	(−26.37)**	(−6.99)**	(−6.99)**	(−2.59)**	(--2.59)**
COLLEGE	3.52	0.38	5.57	0.48	7.24	0.71
GRAD	(30.57)**	(30.57)**	(16.87)**	(16.87)**	(26.96)**	(26.96)**
PRIVATE	1.53	0.074	1.04	0.057	0.12	0.0069
SCHOOL	(6.61)**	(6.61)**	(2.40)*	(2.40)*	(0.31)	(0.31)
POP DENSITY	−1.42	−0.048	−2.64	−0.094	−0.89	−0.037
	(−4.35)**	(--4.35)**	(−3.84)**	(−3.84)**	(−1.56)	(−1.56)
MEDIAN HH	0.0018	0.15	0.0023	0.21	0.0011	0.14
INCOME	(13.09)**	(13.09)**	(8.43)**	(8.43)**	(5.73)**	(5.73)**
Adjusted-R^2	0.62	0.62	0.68	0.68	0.71	0.71
N	4025	4025	753	753	747	747

Numbers in parentheses are *t*-statistics. † significant at a 10% error level. * significant at a 5% error level. ** significant at a 1% error level.

affected by endogenous movements across districts. Of course, if higher API scores attract additional residents, schools will become overcrowded and, eventually, the number of schools in the district will increase. But, because it takes time to build new schools, using the number of schools rather than the number of pupils gives us some distance from any endogenous changes in the student population.

Table 1 shows the instrumental variable results. There are three regressions, one for elementary schools, one for middle schools, and one for high schools.[13] Both standardized and the more typical non-standardized coefficients are presented. Standardized coefficients are estimated from a regression where each observation is the difference between the measure and its variable mean, divided by its standard deviation.

All variables used are listed in Table 2 with means and standard deviations for each.[14] When the Park test for heteroskedasticity is applied to the regressions, no heteroskedasticity is detected.[15]

Focusing on the district size variable in Table 1, we find that the coefficient for district size is negative and statistically significant at a 1% error level for both the elementary and middle schools regressions. It is statistically insignificant in the high school regression. These results for the district size variable are the same as the ordinary least squares regressions.

The number of students participating in school lunch programs is included in the regressions to control for student inputs to the production of education. However, several other variables are included in the state database that would serve the same purpose—the percent of the

[13] Five schools are not included in the sample because they are not classified as either an elementary, middle, or high school.

[14] Correlation coefficients for all of the variables can be seen at www.csun.edu/~vcact004/schools/correlations.doc

[15] See Studenmund (1997) for a description of the Park test.

Table 2
Means and standard deviations

Variable	Mean	Standard deviation
API	629	131
DISTRICT SIZE	61,033	149,097
SCHOOL SIZE	526	394
K-3 AVE CLASS SIZE	19.73	2.02
4-6 AVE CLASS SIZE	28.88	3.22
7-12 AVE CLASS SIZE	27.92	3.53
MEAL	38.44	32.10
COLLEGE GRAD	22.56	14.03
PRIVATE SCHOOL	9.40	6.72
POP DENSITY	7.16	4.69
MEDIAN HH INCOME	36,037	12,136

school population that is classified as minority and the percent with limited English. The high correlation among these three variables, however, precludes including them together in the same regression.[16] When the percent of students participating in school lunch programs is replaced in the equations reported in Table 1 with alternative measures of socioeconomic status, the results are similar. The district size coefficient is negative and shows statistical significance at a 1% error level in the elementary and middle school regressions, just as in Table 1, when the percentage of minority students is included in place of the percent participating in school lunch programs. If, instead, the measure of the school population with limited English replaces the lunch program variable, once again, the district size coefficient is negative and significant at a 1% error level for elementary and middle schools, and it is insignificant in the high school regression.

District size is measured by the number of students enrolled in a district. Thus, in Table 1, the estimated coefficient on the district size variable for elementary schools, -5.42×10^{-5} indicates the average decrease in API score when the district size increases by just one student, keeping everything else constant. For elementary schools, an increase in district size of 100,000 students lowers the average API score by 5.4 points, keeping an array of other factors constant. The standardized coefficient of -0.063 can be given a meaningful interpretation. Consider two school districts that are exactly the same except for size. The size of one district exceeds the other by a standard deviation, 154,465 students.[17] This district will have an average API score that is 8.63 points less than the smaller school (6.3% of 137, the standard deviation of the API for districts in the sample that have elementary schools).

The model was also estimated using a nonlinear approach, adding DISTRICT SIZE squared as an additional explanatory variable. This nonlinear variable is not statistically significant and does not appreciably alter the results for the other variables.

Turning to other measures of size, school size has a significant, negative effect on elementary school achievement levels (at a 1% error level). There is no evidence of a negative school size effect at the secondary level. When it comes to class size, again, only the youngest students—those in grades K-3—appear to be affected. In the elementary school regression, the K-3 average class size variable has a negative and significant coefficient at a 5% error level. On average, every student added to a K-3 level class is correlated with over a 2-point drop in the API. These results suggest that class and school size are most important at the elementary level. The class size result supports aiming scarce resources toward class size reduction efforts at the elementary level.

The percentage of students who receive free or reduced price meals at school was expected to be associated with lower levels of academic achievement, all else constant. As expected, the coefficient of the MEAL variable is negative and significant at a 1% error level in all three regressions. For elementary schools, the coefficient is -1.43, indicating that, on average, for every percent increase in those receiving free or reduced price meals, a school's API score falls by 1.43.

The percent of a school's parents who are college graduates has a positive and significant coefficient (at a 1% error level) in all three regressions. For elementary schools, if the percentage of parents who are college graduates goes up by 1%, on average a school enjoys a 3.5 increase in its API score. For high schools, the effect is even larger: The coefficient is 7.24. In all three regressions, the coefficient on the measure of parent's education has the largest standardized coefficients.

The percent of children in private school enters positively and significantly as a determinant of API test scores for elementary and middle schools, but not high schools. It is significant at a 1% error level for elementary schools, and at a 5% error level for middle schools. A 1% increase in the percent of children enrolled in private schools in a community is associated with a 1.5-point increase in the API, for public elementary schools. This

[16] The correlation coefficients range from 0.59 to 0.77.

[17] This is the standard deviation for district size among districts that have elementary schools in the sample. The standard deviation for district size for the entire sample used in this study is 149,097.

is consistent with the premise that competition from private schools improves public school outcomes.

The population density measure has a negative coefficient and is significant at a 1% error level for elementary and middle schools. The negative coefficient on the population density variable suggests that urban schools have a harder time producing education. (Note that the school lunch variable, MEAL, and population density share a correlation coefficient of 0.28.)

If population density is removed from the regressions, the coefficient for district size in Table 1 becomes 22% greater for elementary schools, 6% greater for middle schools, and 19% greater for high schools.[18] The change for the high schools should not be given much consideration, since the coefficient is statistically insignificant. Even so, as suggested earlier, failure to control for population density leads to an overstatement of the importance of district size.

When the share of the population with limited English replaces the school lunch variable in the regressions in Table 1, population density is no longer significant in the middle and high school regressions. It remains significant at the 1 percent level in the elementary school regression. If the school lunch variable is replaced by the percent of the students identified as minority in the regressions in Table 1, the population density results are unchanged.

Median household income has a positive coefficient and is statistically significant at a 1% error level for all three types of schools. The standardized coefficients for median household income are relatively large, indicating that median household income has a relatively prominent impact on API scores. For example, an increase in the median household income of $10,000 would be associated with an 18-point increase in the API score for elementary schools.

Because standardized coefficients are calculated in terms of standard deviations, the standardized coefficients can be compared directly across variables. For example, in Table 1, for elementary schools, the standardized coefficient of the district size variable is larger (in absolute value) than the standardized coefficients for population density and both class size variables. In addition, the standardized coefficient is close to the standardized coefficient value for private school enrollment. For middle schools, the standardized coefficient for district size is even larger. It indicates that district size has a greater impact than school size, both relevant measures of class size, the share of children enrolled in private schools, and population density. In the high school regression, the standardized coefficient for district size is larger than that for the share of children enrolled in private schools and is equal to that of population density. As expected, school district size is a relevant, significant negative correlate of API scores.

To examine the robustness of the results, the instrumental variable regressions are estimated again excluding schools within the Los Angeles Unified School District from the sample.[19] With nearly 600,000 students tested in 561 schools, the Los Angeles Unified School District is far larger than the next largest district, San Diego Unified, with nearly 105,000 students tested.[20] The policy implications of the results are altered if the affect of district size is driven only by the presence of the LAUSD in the sample. However, when LAUSD is excluded, the district size coefficient remains statistically significant at a 1% error level for middle schools. For high schools and elementary schools, the district size coefficient is statistically insignificant. The results for the rest of the independent variables are similar to those shown in Table 1 when LAUSD is included.

The next largest school district is San Diego City Unified. LAUSD and San Diego City Unified are the only California districts that have more than 70,000 students. As a further test of robustness, the instrumental variable regressions are run using removing both LAUSD and San Diego City Unified from the sample.[21] The coefficient for district size is negative and statistically significant for all three types of schools. (Significance is at a 1% error level for elementary and middle schools, and a 5% error level for high schools.) With the two largest districts removed from the sample, the evidence that larger districts are associated with lower API scores remains. (The results for the rest of the independent variables are similar to those shown in Table 1 when LAUSD and San Diego City Unified are included.)

6. Conclusion

The empirical results of this paper confirm the hypothesis that school district size is an important determinant of program quality. Looking at California, where one can find districts of all sizes, and where 1/6th of all students are in schools in districts with more than 40,000 students, we find that district size has a negative effect on student performance, as measured by standardized test scores. In 1999, in California, students attending school in larger districts did not perform as well on standardized tests as

[18] These results are not shown, but are available from the authors.

[19] The results with LAUSD omitted can be seen at www.csun.edu/~vcact004/schools/NoLAUSD.doc

[20] Although there are 561 schools in the Los Angeles Unified School District, only 523 appear in the Regressions in Table 1. The other observations have missing variables.

[21] These results can be seen at www.csun.edu/~vcact004/schools/NoLAorSanDiego.doc

those attending schools in smaller districts. We show that failing to control for population density leads to an overestimate of the negative effect of district size on school-level standardized test scores.

Estimating regressions for elementary and secondary schools separately, we find evidence of a negative impact of district size for elementary and middle schools. District size appears to have the largest negative impact on middle school student performance. The results from California point toward reducing school district size, along with school and class size at the elementary level, as potentially important to educational reform.

Acknowledgements

The authors thank Robert Krol for his comments.

References

Angrist, J. D., & Lavy, V. (1999). Using Maimonides' Rule to estimate the effect of class size on scholastic achievement. *Quarterly Journal of Economics*, *114*(2), 533–575.

Bidwell, C. E., & Kasarda, J. D. (1975). School district organization and student achievement. *American Sociological Review*, *40*(1), 55–70.

Bradford, D. F., Malt, R. A., & Oates, W. E. (1969). The rising cost of local public services: Some evidence and reflections. *National Tax Journal*, *22*(2), 185–202.

California Department of Education (2000). www.cde.ca.gov

Chakraborty, K., Biswas, B., & Lewis, W. C. (2000). Economies of scale in public education: An econometric analysis. *Contemporary Economic Policy*, *18*(2), 238–247.

Duncombe, W., & Yinger, J. (1993). An analysis of returns to scale in public production, with an application to fire protection. *Journal of Public Economics*, *52*, 49–72.

Fowler, W. J. Jr., & Walberg, H. J. (1991). School size, characteristics, and outcomes. *Educational Evaluation and Policy Analysis*, *13*(2), 189–202.

Fox, W. F. (1981). Reviewing economies of size in education. *Journal of Education Finance*, *6*(3), 273–296.

Hanushek, E. A. (1986). The economies of schooling: production and efficiency in public schools. *Journal of Economic Literature*, *24*(3), 1141–1177.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica*, *46*, 1251–1271.

Hirsch, W. Z. (1968). The supply of urban public services. In H. S. Perloff, & L. Wingo Jr. (Eds.), *Issues in Urban Economics* (pp. 477–525). Baltimore: The Johns Hopkins Press.

Hoxby, C. M. (2000). Does competition among public schools benefit students and taxpayers? *American Economic Review*, *90*(5), 1209–1238.

Hoxby, C. (1998). What do America's traditional forms of school choice teach us about school choice reforms? *Federal Reserve Bank of New York, Economic Policy Review*, 47–59.

Kiesling, H. J. (1967). Measuring a local government service: a study of school districts in New York state. *The Review of Economics and Statistics*, *49*(3), 356–367.

Krueger, A. B. (1999). Experimental estimates of education production functions. *Quarterly Journal of Economics*, *114*(2), 497–532.

Lederman, N. M., Frankl, J. S., & Baum, J. (1987). *Governing the New York City Schools.* A Report of the Board of Trustees of the Public Education Association, Public Education Association, New York

Moe, T. M. (1984). The new economics of organization. *American Journal of Political Science*, *28*(4), 739–777.

Sauerwein, K. (1999). Signatures submitted on bid to split L.A. Unified. *Los Angeles Times*, Part B, Page 1, December 12.

Strang, D. (1987). The administrative transformation of American education: School district consolidation, 1938–1980. *Administrative Science Quarterly*, *23*(3), 352–366.

Streifel, J. S., Foldesy, G., & Holman, D. M. (1991). The financial effects of consolidation. *Journal of Research in Rural Education*, *7*(2), 13–20.

Streifel, J. S., Holman, D., & Foldesy, G. (1989). An overview of the research on school district consolidation. *Journal of Rural and Small Schools*, *5*(3), 34–39.

Studenmund, A. H. (1997). *Using Econometrics* (3rd ed.). New York: Addison-Wesley.

Testa, W. A., & Sen, S. (1999). School choice and competition. *Chicago Fed Letter*, Number 143a, Special Issue, The Federal Reserve Bank of Chicago.

Trejo, S. J. (1991). Public sector unions and municipal employment. *Industrial and Labor Relations Review*, *45*(1), 166–180.

Walberg, H. J., & Fowler, W. J. Jr. (1987). Expenditures and size efficiencies of public school districts. *Educational Researcher*, *16*(7), 5–11.