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Does Public School Competition Affect Teacher Quality?

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Choice has been promoted as a potential way to improve schooling, but the justification for that position is largely based on theoretical ideas. The empirical foundation for that position has been thin. Because there has not been extensive modern experience in the United States with choice of individual schools, little information has accumulated about its impact on public schools. This analysis focuses on how public competition affects public school outcomes.

Under most conceivable scenarios of expanded choice, even with private school vouchers, the public school system will still remain the majority supplier of schooling. Therefore, it is important to know what might happen to quality and outcomes in the remaining public schools. This research is designed to provide insights about that from an analysis of how public schools respond to competition from other public schools.

The empirical analysis has two major components. First, estimates of average school quality differences in metropolitan areas across Texas are compared to the amount of public school competition in each. At least for the largest metropolitan areas, the degree of competition is related to performance of the public schools. Second, the narrower impact of metropolitan area competition on teacher quality is investigated. Because teacher quality has been identified as one of the most important determinants of student outcomes, it is logical to believe that the effects of competition on hiring, retention, monitoring, and other personnel practices would be one of the most important aspects of any force toward improving public school quality. The results, while far from conclusive, suggest that competition raises teacher quality and improves the overall quality of education.

The margins of competition

Much of the attention to competition for the public schools has concentrated on how private alternatives compare to the public schools. with some related attention to how they affect performance in the public schools. Most of the analysis has been concerned with Catholic schools. Currently, almost ninety percent of all students attend public elementary and secondary schools. This percentage has been stable for some time, although the exact character of the alternative private schooling has changed. The percentage of private school students in Catholic schools has declined, while other religious based schooling has increased. Nonetheless, adequate data on non-Catholic schools have not been readily available.

The literature on Catholic school performance is summarized in Neal (1998) and Grogger and Neal (2000). The evidence has generally indicated that Catholic schools on average outperform public. This superiority seems clearest in urban settings, where disadvantaged students face fewer options than others. This evidence is, nonetheless, subject to some caveats. First, as recognized since some of the earliest work on the topic (Coleman, Hoffer, and Kilgore 1982), it is difficult to separate performance of the private schools from pure selection phenomena. Specifically, since private school students could have attended public schools but instead pay extra for private schooling, they are clearly different than the public school students with identical measured characteristics. A variety of alternative approaches have been taken to deal with the selection problem, and a rough summary of the results after those efforts is that there remains a small advantage from attending Catholic schools.[1] Second, this literature says little about the distribution of school quality within the Catholic sector. Within the public sector, it is widely believed that school quality varies considerably across schools,

[1] Grogger and Neal (2001) suggest, however, that there is no advantage to attending private elite schools – a surprising result given the extra cost generally involved in that. These results are possibly the result of selection problems, but it is not a simple relationship because most people would expect positive selection into these elite schools.

and one might suspect that the same holds true for private schools. The relevance of this is that the value of alternative private schooling may vary across local areas, implying that the amount of effective competition for the public schools also varies. Unfortunately, little is known about this.

Our interest, however, centers on the reactions of public schools to the private sector. In an important article about the impact of private schools on schools in the public sector, Hoxby (1994) demonstrates that public schools in areas that have larger concentrations of Catholic schools perform better than those facing less private competition. This analysis provides the first consistent evidence suggesting that public schools react to outside competition.

Other forms of competition are, nonetheless, potentially more powerful. Perhaps the most important element of competition comes from other public school jurisdictions. Specifically, households can choose the specific jurisdiction and school district, à la Tiebout (1956), by their choice of residential location. While adjustment is costly, these choices permit individuals to seek high quality schools if they wish. Residential location decisions are of course complicated, involving job locations, availability of various kinds of housing, school costs and quality, and availability of other governmental services. Given choice opportunities plus voting responses, this model suggests pressure on schools to use resources effectively. Otherwise one might expect housing values to be affected.

The simple choice model would suggest naturally that larger numbers of schools or school districts per student would offer more opportunities for residents and thus more competition across schools. This simple model motivates the empirical analyses of Borland and Howsen (1992) and its extension and refinement in Hoxby (2000). Borrowing from empirical industrial organization, it is possible to calculate a Herfindahl index of concentration of schooling options.[2] The simple inclusion of measures of concentration indicates that areas with less choice have poorer schools on average (Borland and Howsen 1992). Noting, however, that the existing distribution of families across districts reflects

[2] The calculations and interpretation of this index are discussed below.

endogenous reactions to school quality, Hoxby (2000) pursues alternative strategies to look at the causal impact of concentrations. She finds that consideration of endogeneity increases the estimated impact of competition on the performance of schools.

Jurisdictional choice is not, however, the only way in which competition among public schools could be or is expressed. A variety of different institutional structures for schools have developed that affect the possibilities for competition. The classic argument for competition comes from Friedman (1962) with his arguments for vouchers. The well-known arguments suggest that separating the finance of schooling from the production of schooling by allowing students to choose the school they attend would improve individual satisfaction with the outcomes. Within the United States, this approach has been vigorously debated, but few examples of implementation have occurred. The most celebrated application has been Milwaukee, Wisconsin, where vouchers have been available to a (constrained) number of poor children since 1990 (Witte 1999). A number of privately financed alternatives have also been offered (Howell et al., 2000). Most of the attention to these voucher programs has centered on the student outcomes of students in them as compared to public schools.[3] Because these programs have been very marginal to the education system, there has been little suggestion that the public schools have made any adjustments in response.[4] Thus, these choice experiences have not provided information about how public schools might react to a larger, more institutionalized program.

In part because of concerns about and opposition to voucher proposals that would involve private schools, a wider implementation of expanded choice within the public schools has occurred. Perhaps the longest running class of choice programs has been magnet schools. Magnet schools typically involve establishing a distinctive educational program – for example, college preparation,

[3] A variety of controversies have developed in these analyses. Perhaps the primary analytical issue is dealing with selection of students and an appropriate comparison group. See, for example, the discussions in Witte (1999), Rouse (1998), and Greene, Peterson, and Du (1998).

[4] Rouse (1998) compares some attributes of voucher and public schools but does not suggest that there is any behavioral reaction of the public schools.

vocational and technical, or the arts – and drawing students from throughout an entire district. Because these schools attract students across neighborhood attendance zones, magnets have been a popular device to further racial desegregation of schools (Armor 1995). But, because they are creatures of individual districts in their overall provision of services and have the special desegregation purposes, they have not been viewed as offering competition to the other schools in the districts.[5]

Extensions of public school choice has, however, been designed with explicit competitive purposes. The State of Minnesota developed a series of innovative programs to encourage parents to choose among public alternatives (see Nathan 1989, 1994; Hanushek with others 1994). These included first within district choice in Minneapolis and St. Paul and subsequently choice across districts. These types of programs have been duplicated in other states and have been suggested as alternatives to vouchers. The incentives under these systems depend crucially on the rules for choice, financing, and the like.[6] But, they also make evaluation very difficult, because the programs are generally open to all qualified students (e.g., all students within a district) and there is no ready comparison district or set of students. Thus, little is known about their empirical impact.

In what can be thought of as an extension of public school choice, recent attention has turned to charter schools. Charter schools, while varying across states in their form, are essentially independent public schools that are freed from much if not all control of local districts (cf. Finn, Manno, and

[5] Moreover, there has been little analysis of the performance of these schools vis-à-vis more traditional public schools, perhaps because of the difficulty of controlling for the nonrandom selection of students inot magnet schools.

[6] Some of the key aspects of these programs are: what happens if there is excess demand for a given school; what finances go with the student; and what happens to public schools and their personnel if the school loses significant numbers of students. For example, both within and across district plans typically allow voluntary transfer in *if* there are openings, and this constraint often severely limits student flows. Also, if schools lose students but all teachers and administrators retain employment rights in a district, any competitive pressures are lessened or eliminated.

Vanourek 2000). As such, they are financially independent, and their continued existence depends on their ability to attract students.[7]

Much of the analysis and discussion of charter schools to date has concentrated on describing the size and character of the sector. This information is instructive, because it suggests that the charter school sector is complex and heterogeneous. It is not aimed at a specific segment of the market but instead covers varying specializations and foci, admits very different kinds of students defined by socio-economic and racial background, and offers programs for special education and LEP students. Thus, the picture is one of a variety of small start-ups that compete with traditional public schools on many dimensions.

While performance information is not readily available, analyses of the organization and structure have begun. For example, Hoxby (2001) suggests that competitive suppliers in the form of charter schools tend to employ noticeably different teachers. Charter schools tend to have fewer certified teachers and fewer teachers with master's degrees – items that have not proved important in student achievement (Hanushek 1997) – but they look more for teachers with academic majors as opposed to education majors. Ballou and Podgursky (1995, 1997) suggest similar outcomes for private schools. These differences may provide a partial roadmap for how public schools eventually respond.

Nonetheless, because the development of the charter school alternatives is relatively recent, little is known at this time about the reactions of existing public schools to these alternatives. As they grow, however, they offer some chances for direct analyses.

Finally, in terms of potential competitive pressures on public schools, "exit vouchers" such as those enacted in Florida offer a distinct alternative. Under these, students who attend schools judged as failing are provided vouchers to use at any public or private school that they believe will better serve their educational needs. Because choice is exercised only when the public school is failing, these plans

[7] State charter legislation also tends to have general rules about renewal of charters. At this time, it is unknown whether or not these external evaluations will have any impact on charter continuations.

are not traditional competition for the public schools, even though they might provide pressures to improve schools that are close to failing.[8]

The consideration of the various margins for competition of public schools underscores the limited information that is available about how public schools respond. Perhaps even more important, virtually no evidence exists concerning the form of any responses. Without any understanding of the mechanisms through which competition affects public school quality or for that matter of why private schools produce superior outcomes, the difficulties of fully controlling for student heterogeneity will inevitably raise questions about the extent to which unobserved student and family factors confound the empirical estimates.

Some questions about public school response

The starting point for most consideration of competitive response is an analogy to private, for-profit markets. When consumers exercise decision making about purchases in a private market, firms respond to ensure profitability and, ultimately, survival. If this reaction were to hold in public education, schools and districts would be expected to alter their behavior if competitive alternatives led families to choose other schools.

The traditional Tiebout mechanism suggests that parents will in fact exert direct influence on schools to provide both bundles that they desire more and to provide them more efficiently. While there are different models of the process – including voting and mobility, the basic model suggests that schools should respond to Tiebout pressures and that having more competing jurisdictions should strengthen the Tiebout pressures.[9]

[8] The actual operation of the Florida program, which continues under legal challenge, requires that a school be found failing for three years in a row. The actual criteria for rating are currently in flux.
[9] See also the discussion of observable outcomes in Hoxby (2000).

But there are also forces that push actions to be more muted. Institutionally, district survival is virtually guaranteed under plausible changes in the competitive environment. Moreover, unless the teachers and administrators can personally capitalize on increased demand, they might be somewhat immune to losses of students.

There are various behavioral models that might suggest some responses. If the decision makers are budget maximizers (e.g., Niskanen 1970), they might be concerned with loss of students. But even there, within some ranges the budget maximizer might find alternative actions such as budget manipulation more productive than attempts to raise quality (see, for example, Filimon, Romer and Rosenthal 1982).

Anecdotal evidence suggests that, with few exceptions, public schools have not paid much explicit attention to changes in the current level of competition. For example, Arizona is one of the top states in terms of charter school competition, but the rate of growth in the overall numbers of students in the state implies that demand for traditional public schools has not declined. Moreover, if the voucher alternatives or the charter schools tend to draw away difficult to educate students, the public schools may even find this desirable instead of being a threat.

The kinds of pressure to which districts respond are also unclear. As mentioned previously, competitive schools – whether private, charters, or whatever – almost certainly come in various quality dimensions. One might not expect, for example, that a high quality public school would react to a low quality private alternative. Or, a public school might actually encourage a private charter schools emphasizing programs for special education students. Such possibilities raise the idea that any competitive responses of public schools are variable, depending on very specific local circumstances.

A wide variety of situations could, nonetheless, lead administrators and teachers to respond to competitive pressures and student losses. For example, a superintendent's ability to move to another district may be related to evidence about such responses. Or local contracts may permit teacher

separations when their school is closed for insufficient demand. For example, in the classic case of within district competition and reactions in District 2 of New York City, it appears that underperforming teachers tended to leave the profession, but the generalizability of this open to question. The point here is simply that little is known about the circumstances that do and don't lead to public school responses to competitive pressures.

Nor is it obvious how to define the "competitive market." While the district is the fundamental operating and decision-making unit, districts themselves can be very large and heterogeneous. This heterogeneity could lead to competition, and responses, being more local in nature – say at the school rather than the district level. For example, Weimer and Wolkoff (forthcoming) suggest that school quality differences are capitalized into housing prices at the individual school rather than the district level. If schools are reacting to expressions of demand, analysis may have to consider very local markets.

If schools respond, how do they do so? If is ambiguous how schools compete when they decide to do so. The underlying Tiebout choice model and the basic Friedman voucher model do not indicate that schools will compete on any simple quality dimension. First, it is plausible to think of schools as adding value in multiple dimensions, including, for example, simple achievement, the arts, sports, various societal norms, and religious content. Some families may be willing to trade good sports programs for some academic achievement. If competition offers a wider array of alternatives defined not just in "quality" but in the mix of outcomes offered, the public schools may either not compete or respond in very specific dimensions.

The essential point is that many very basic issues have not been addressed in prior work. While the underlying competitive paradigm may be attractive and may provide general motivation for empirical analysis of school performance, there is not very detailed guidance on many issues of analytical approach and strategy.

It also seems clear, given the extent of alternative organizational forms at this time, that the best opportunities to observe public school reactions come from reactions to competition of other public schools. Because it is potentially is the best current source of empirical information, we pursue this in the empirical analysis.

The Importance of Teacher Quality

The large amount of work into the determinants of student achievement has failed to yield any simple descriptions of the key school factors. Specifically econometric studies of educational production functions have not yielded consistent findings for major resource measures. Financial measures (spending per pupil and teacher salaries) and real resources (teacher experience and degrees, class size, facilities, and administration) do not appear to capture much of the variation in school or teacher quality (Hanushek 1986, 1997).[10]

On the other hand, schools and teachers have been shown to be dramatically different. A variety of researchers have looked at variations among teachers in a fixed effect framework and have found large systematic differences in individual teacher performance.[11] The general approach has been to estimate value-added models of individual student performance and to assess whether or not performance gains differ across individual teachers.[12] In every instance, large differences have been found (and these differences have generally been unrelated to the common measures of teachers and classrooms found in the more traditional econometric estimation).

[10] While parts of this discussion have generated controversy – largely over the policy conclusions that might be drawn – none of the discussion has suggested that any of these resource measures are good indicators of overall school quality. The focus in the discussion has been whether or policy changes in any of these could be expected to yield positive effects on student performance. See, for example, the papers in Burtless (1996).

[11] See, for example, Hanushek (1971, 1992), Murnane (1975), Armor et al. (1995), and Murnane and Phillips (1981).

[12] Importantly, by estimating value-added models that take into account the entering achievement of students, these models remove potentially biasing other influences – past performance and school factors, individual ability, and so forth – that are important for the levels of achievement.

These analyses do not, however, conclusively identify the impacts of different teachers. Because parents frequently set out to choose not just specific schools but also specific teachers within schools, the make-up of individual classrooms may not be random. This possibility is compounded by two other influences. Teachers and principals also enter into a selection process that matches individual teachers with groupings of children. Additionally, if the composition of the other children in the classroom is important, i.e., there are important peer group effects on achievement, the gains in an individual classroom will partially reflect the characteristics of the children and not just the teacher assigned to the classroom. These considerations suggest a possibility that classroom outcome differences reflect more than just variations in teacher quality.

The multiple, concurrent influences on student achievement clearly make it extremely difficult to isolate the effects of each of these components, let alone specific characteristics such as class size or peer group quality. Rivkin, Hanushek, and Kain (2000) show how the availability of matched panel data for individual students and schools can be employed to separate out the various influences. The focus of that paper, which is extended in the work here, is the importance of teacher quality.

Equation 1 presents a stylized representation of annual learning for student i in grade g in school s in year t as a linear function of individual, family, community, school, and teacher factors, where school refers to all school influences other than the quality of teaching and including facilities, administration, and so forth.

(1) $learning_{igs} = individual_{it} + family_{it} + community_{st} + teacher_{gst} + school_{st}$

Focusing on learning in a single year with a value added framework (which conditions on prior achievements as opposed to considering just the level of achievement) immediately controls for all factors that have a constant influence on performance. The next step is to account for the many non-

school factors that affect learning and that are correlated with school and teacher characteristics through the endogenous selections of neighborhood and school. While standard value added approaches simply included observable measures of family socio-economic status and community environment, there is little reason to believe that the available variables adequately eliminate confounding influences.

Consider, however, what happens when multiple cohorts of students are observed over time. Such matched panel data permit a comparison of student learning in two successive years, effectively eliminating the influences of all factors that have a constant effect on the *rate of learning*. This approach, developed in Rivkin, Hanushek, and Kain (2000), uses grade-to-grade variation in achievement gain and school and teacher variables to identify specific school and teacher effects.

The availability of multiple tests and cohorts provides a source of variation in academic performance that cannot be driven by unchanging student attributes such as ability or motivation, or by unchanging school-by-grade characteristics. Models that control for fixed student and school-by-grade effects relate differences in achievement gains between grades and cohorts to differences in school characteristics or teachers. Such differences identify the impacts of schools and teachers uncontaminated by the many systematic contemporary and historical family and ability factors that have potentially plagued past research.

The estimation of "pure" teacher quality differences produces some strong results. This model was estimated using the microdata from the UTD Texas Schools Project (described below). For Texas elementary students, the variation in teacher quality *within* schools (i.e., ignoring all variation across schools) is large. One standard deviation of teacher quality – for example, moving from the median to the 84th percentile of the teacher quality distribution – increases the annual growth of student achievement by at least 0.11 standard deviations, and probably by substantially more. This magnitude implies, for example, that having such an 84th percentile teacher for five years in a row rather than a

50th percentile teacher would be sufficient to eliminate the average performance gap between poor kids (eligible for free or reduced lunch) and nonpoor kids.

Evidence on the importance of teacher quality forms the basis for a major segment of the empirical analysis here. Specifically, if local competition is important, it should be possible to detect its impact on teacher quality using variation in the degree of competition across the state of Texas. It would be surprising for competition to exert a substantial effect on students without influencing the quality of teaching.

Empirical Analysis

A wide variety of past studies have demonstrated that the cognitive skills of students are very important both for individual success and for aggregate outcomes. Building on that evidence, we investigate how varying amounts of public school competition in the classic Tiebout sense affects student performance and the hiring of teachers. Importantly, our efforts are not general. They leave aside many of the issues discussed previously about possible dimensions of competition and concentrate entirely on issues of academic performance. Nonetheless, the importance of this topic for individual labor market outcomes and for the politics of schools justifies the choice.

The empirical work exploits the rich data set on student performance of the UTD Texas Schools Project. Because Texas is a large and varied state, a wide range of local circumstances is presented. Indeed, there are 27 separate Metropolitan Statistical Areas (MSAs) in Texas. We employ these data first to estimate overall quality differences between MSAs and to compare these results with the degree of public school competition. Following that, we investigate whether or not competition raises the quality of teaching.

As suggested by the previous discussions, however, this analysis is best thought of as a reduced form investigation. We do not observe the underlying decision making by school officials. Nor do we

have detailed and precise measures of the competition facing individual schools and districts. Instead we use aggregate indicators of potential competition from public schools and concentrate on whether or not there are systematic patterns to student outcomes.

A. The Texas Database

The data that are used in this paper come from the data development activity of the UTD Texas Schools Project.[13] Its extensive data on student performance are compiled for all public school students in Texas, allowing us to use the universe of students in the analyses. We use 4th, 5th, and 6th grade data for three cohorts of students: 4th graders in 1993, 1994, and 1995. Each cohort contributes two years of test score gains. Students who switch public schools within the state of Texas can be followed just as those who remain in the same school or district, a characteristic we use in our analysis. Although explicit background measures are relatively limited, the panel feature can be exploited to account implicitly for time invariant individual and school effects on achievement.

The Texas Assessment of Academic Skills (TAAS), which is administered each spring, is a criterion-referenced test used to evaluate student mastery of grade-specific subject matter. We focus on test results for mathematics, the subject most closely linked with future labor market outcomes. We transform all test results into standardized scores with a mean of zero and variance equal to one. The bottom one percent of test scores and the top and bottom one percent of test score gains are trimmed from the sample in order to reduce measurement error. Participants in bilingual or special education

[13] The UTD Texas Schools Project has been developed and directed by John Kain. Working with the Texas Education Agency (TEA), this project has combined a number of different data sources to compile an extensive data set on schools, teachers, and students. Demographic information on students and teachers is taken from the PEIMS (Public Education Information Management System), which is TEA=s statewide educational database. Test score results are stored in a separate database maintained by TEA and must be merged with the student data on the basis of unique student IDs. Further descriptions of the database can be found in Rivkin, Hanushek, and Kain (2000).

programs are also excluded from the sample because of the difficulty in measuring school and teacher characteristics for these students.

Student data are merged with information on teachers using unique school-grade identifiers. We aggregate across the teachers within each grade of each school. Aggregation overcomes what is possibly the largest form of selection within schools – that which occurs when parents maneuver their children toward specific, previously identified teachers or when principals pursue purposeful classroom placement policies. Looking at overall grade differences, which is equivalent to an instrumental variable estimator based on grade rather than classroom assignment, circumvents this within-grade teacher selection.

The empirical analysis considers only students attending public school in one of the 27 MSAs in Texas. A substantial majority of all Texas public school students attend schools in one of these MSAs. Each is defined as a separate education market, and measures of competition are constructed for each. Below we discuss potential problems associated with defining education markets in this way.

B. Competition and School Quality

How will public school competition affect the provision of education? While Tiebout type forces would be expected to raise the efficiency of schooling, it is not clear that more competition will necessarily result in higher school quality. If wealth differences or other factors related to school financing lead to more resources in areas with less competition, the efficiency effects of competition could be offset by resource differences. Therefore we consider differences in both school quality and school efficiency across metropolitan areas.

A second important issue is precisely how to define the relevant competition. The importance of district administrators in allocating funds, determining curriculum, hiring teachers, and making a variety of other decisions suggests that much if not most of the effects of competition should operate at

the district level. However, anecdotal evidence on school choice provides strong support for the notion that parents actively choose among schools within urban and large suburban school districts, consistent with the view that principals and teachers exert substantial influence on the quality of education. This anecdotal information is reinforced by the aforementioned research on housing capitalization (e.g., Weimer and Wolkoff, forthcoming). Therefore we treat this as an empirical question and measure competition on the basis of the concentration of students in both schools and districts.

While Hoxby (2000) provides the empirical context within which to place this study of school efficiency, the methodology employed here is much closer to the work by Abowd, Kramarz, and Margolis (1999) on inter-industry wage differences. Just as inter-industry wage differences reflect both worker heterogeneity and industry factors, inter-school or district differences in student performance reflect both student heterogeneity and school factors. However, a comparison of wage differences for a worker who switches industries or achievement differences for a student who switches schools effectively eliminates problems introduced by the heterogeneity of workers or students. In this way the availability of matched panel data facilitates the identification of sector effects.

We use the sample of students who switch metropolitan areas to identify 27 metropolitan area fixed effects on the basis of the average differences in achievement gain between the initial and new school district for all students who move. These fixed effects provide an index of average school quality in a metropolitan area. To the extent that fixed differences across individuals and families are the primary determinants of school and district choice, this approach effectively eliminates much of the confounding influences of student heterogeneity present in cross-sectional data analyses.

However, neither workers nor students switch sectors at random, and changes in circumstances may dictate the characteristics of the destination school as well as affect student performance. For example, families who experience job loss or divorce may relocate to inferior districts, while families

who experience economic improvements may tend to relocate to better districts.[14] If the underling family changes are not accounted for and correlated with changes in public school quality, the observed differences in school quality will confound family and influences. While we have a crude control for family economic circumstances, it likely does not capture all factors contributing to both the move and academic achievement.

Our problem is identification of average quality of schools in an MSA, and the most common concerns about motivation for moving are probably less here. Mobility across regions is more importantly linked to job relocations and less to seeking specific schools or other amenities. Thus, while mobility motivations are especially important when considering the specific district chosen, we average across all receiving districts and are interested in just the average performance. The focus on competition effects means that unobserved family factors uncorrelated with public school competition do not cause a problem.

Nonetheless, we may not entirely circumvent the problems introduced by unobservable factors related to both our measures of competition and academic performance. Unobserved community or school factors such as resource differences that are correlated with the measure of competition make it difficult to identify competition effects on school quality or even more specifically on school efficiency. We do include average class size as a proxy for school resources in some specifications in an effort to estimate the effect on school efficiency. While average class size captures at least a portion of any difference in resources, there is a good chance that influences of confounding factors remain.[15]

[14] Note that the direction of any bias is ambiguous. Negative or positive shocks that precipitate a move may affect performance prior to the move as much as or even more than performance following a move.

[15]Inter-metropolitan area differences in the price of education quality raise serious doubts about the validity of expenditure variables as measures of real differences in resources. Such differences result from cost of living differences, variability in working conditions, differences in alternative employment opportunities for teachers as well as other factors.

Perhaps the most important problems, however, relate to the measure of competition and of specific academic markets. As Hoxby (2000) points out, the Herfindahl index is itself endogenously determined by the location decisions of families. Any movement of families into better districts within a metropolitan area will change the value of the Herfindahl index, raising it if families concentrate in larger districts and lowering it if families move to smaller districts such as would be the case with urban flight. In essence, the Herfindahl index reflects both the initial administrative structure of schools and districts as well as within metropolitan area variation in school or district quality. Only the former provides a good source of variation, and that is the source of variation Hoxby attempts to isolate with her IV approach. We do not have available instruments, so the second source of variation may introduce bias of an indeterminate direction.

The second of these issues is the difficulty of identifying the relevant education market, i.e., defining the appropriate set of schools from which parents choose. It is certain that a number of families who work in an MSA choose to live outside the MSA, and thus measuring school competition using the Census definitions of MSAs almost certainly introduces some measurement error which would tend to bias downward the effects of competition.

Finally, if there is extensive teacher sorting among schools and districts on the basis of teacher quality, it may be difficult to disentangle any behavioral effects of additional competition from the reduction in the average metropolitan area within school variance in teacher quality that would follow structurally from reducing teacher concentration in schools or districts. Compare the cases of three equally sized districts and four equally sized districts where teachers are sorted into a perfect quality hierarchy across districts. If teachers are drawn from the same initial distribution in both areas, the additional district will mechanically lead to smaller within school variance. However, evidence from Rivkin, Hanushek, and Kain (2000) suggests that sorting of teachers on the basis of quality may in fact be quite limited in many areas. Work by Ballou (1996) and Ballou and Podgursky (1995) documents

teacher hiring practices in which applicant skill does not play a primary role. Moreover, we have very little information about the nature of the teacher quality pool, but one would expect competitive pressures to change the hiring practices of where in the distribution teachers are drawn.

Nevertheless, the possibility remains that a lower Herfindahl index may be associated with more extensive sorting without inducing a behavioral change. In an effort to address this issue, we divide metropolitan areas up into separate school markets on the basis of student income, under the assumption that an expansion in the number of wealthy districts, while permitting increased teacher sorting, does not effectively increase the number of choices for poor children and visa versa. A finding that income specific competition measures are more strongly related to the within school variance in teacher quality than the overall competition measure would support the belief that competition induces a behavioral response.

Prior to presenting the results, one important methodological issue should be addressed. In order to identify systematic differences among schools or districts, both student and school (or district) fixed effects must be estimated simultaneously because of the correlation between student and school characteristics. If student fixed effects are removed first, any school influences that are correlated with fixed differences such as wealth are removed.[16] However, the large number of students makes concurrent estimation of student and school or district fixed effects computationally intractable. Abowd et al. (1999) use an instrumental variables solution, but the inability to evaluate instrument validity raises doubts about the consistency of the results. We use an alternative approach based on subsample estimation techniques: independent subsamples small enough to include the entire vector of student and metropolitan area fixed effects are used to produce a series of estimates of metropolitan area fixed effects; averages of the subsample estimates for each metropolitan area fixed effect represent the

[16]The removal of school fixed effects first also removes all differences in school quality systematically related to student heterogeneity. See Abowd et al (1999) for a discussion of this issue.

differences across metropolitan areas in school quality.[17] Notice that we use metropolitan area rather than school or district fixed effects because competition, however measured, varies only among metropolitan areas.

Results

Figures 1 thru 4 plot metropolitan area fixed effects against the Herfindahl index, the measure of competition.[18] Names for the five largest metropolitan areas are reported, while circles represent the remaining MSAs. The fixed effects are produced by regressions of the gain in achievement on subsidized lunch eligibility, a dummy variable for moving (some students may also move prior to 5th grade), eight indicators for community type, and student and metropolitan area dummy variables for a sample of students who switch metropolitan areas between grades 5 and 6. Each student contributes two observations to the regression. Figures 1 and 3 measure competition by the concentration of students into school districts, while Figures 2 and 4 measure competition by the concentration of students into schools, permitting competition to occur within districts. In an effort to isolate competition effects on efficiency, the regressions underlying Figures 3 and 4 include average class size as a control for resource differences. Not surprisingly given the strong evidence that class size and other resource differences explain little of the total variation in school quality, the inclusion of class size has little impact on the pattern of estimated effects. Therefore we focus attention on Figures 1 and 2.

The overall patterns presented in Figures 1 and 2 do not reveal a strong positive relationship between competition at either the district or school level and school value added. Rather the scatter of

[17]Each student contributes once to the metropolitan area fixed effects. Preliminary work using 500 randomly drawn samples produced quite similar estimates.

[18]Average enrollments in 5th and 6th grade for the three years of data are used to construct the Herfindahl index. The Herfindahl index is the sum of squared proportions of enrollment. Therefore, with a single district, it would equal one, and the index would imply maximum concentration. Similarly the index approaches zero as the number of equal sized schools or districts increases.

points moves roughly along a horizontal line regardless of whether competition is measured at the school or district level. Either competition does not have a substantial effect or the actual effects are offset by other influences not captured by the regression specifications. Note that competition varies far less when measured at the school level, because any dominance of large districts is ignored.

Despite the lack of an overall positive relationship between competition and school quality, the estimates for the five largest metropolitan areas do provide some evidence that competition matters. The ordering of Dallas, Houston, San Antonio, Fort Worth, and Austin according to school quality exactly matches the ordering by competition regardless of how competition is measured. It may be that unobserved differences between these and the other, much smaller metropolitan areas are quite large while the differences among these five districts that are correlated with the degree of competition are much smaller. While this hypothesis cannot be tested with the available data, it does provide one plausible explanation for the pattern of results. Nevertheless, these four figures provide mixed support at best for the belief that public school competition improves school quality, in large part because of the almost certain presence of other factors that vary systematically by the degree of competition in metropolitan areas and affect achievement gains.

C. Competition and Teacher Quality

The mixed results on the effects of competition on overall school quality reflect the difficulty of identifying overall school quality, notwithstanding the availability of matched panel data. This portion of the empirical analysis investigates a much narrower question with a methodology that likely does a far better job of controlling for confounding influences on student outcomes. While the quality of teaching is only one of many determinants of school quality, evidence in Rivkin, Hanushek, and Kain (2000) strongly suggests that it is the most important factor. Consequently, it would be highly unlikely that competition would exert a strong effect on school quality without affecting the quality of teachers.

At first glance the problem might appear to be quite simple: more competitive areas should lead schools to hire better teachers as measured by teacher education, experience, test scores, and other observable characteristics. However, a number of issues complicate matters, two of which appear most important: 1) evidence overwhelmingly shows that observable characteristics explain little of the variation in teacher quality in terms of student performance (see Hanushek 1986, 1997); and 2) competition could lead schools to raise teacher quality per dollar spent but not the level of quality, and it is quite difficult to account for cross-sectional differences in the price of teacher quality.

Based on the severe difficulty inherent in isolating the contributions of teachers to between school or district differences in student performance in combination with difficult task of accurately capturing cross-sectional differences in the price of teacher quality, we do not believe that an analysis of the effect of competition on teacher quality per dollar in salary is likely to produce compelling evidence. We pursue a very different empirical approach focusing on the within school and district variation in the quality of teaching, using the methodology developed in Rivkin, Hanushek, and Kain (1998). In essence, this approach examines the link between competition and the variance in teacher quality, testing the hypothesis that more competition should lead to less variance in the quality of teaching within schools and districts. Lower variance would result from the fact that competition would push schools to hire the most qualified applicants and to be more aggressive in pushing teachers to perform better and in dismissing teachers who do not teach well. Schools not facing much competition would be free to pursue other considerations in hiring and to avoid potentially unpleasant retention decisions and serious monitoring.

The within school variance in teacher quality, measured in terms of the student achievement distribution, is estimated from year to year changes in average student test score gains in grades five

and six.[19] We hypothesize that, if there is substantial variation in teacher quality, schools and districts with more teacher turnover should experience greater variation in student performance across cohorts. Of course other factors that contribute to differences across cohorts might be systematically related to teacher turnover, and we take a number of steps to control for such confounding influences.

The methodology and identifying assumptions are described in detail in Rivkin, Hanushek, and Kain (2000) and only summarized here. Throughout, we look just at within school variance in teacher quality and ignore any between school variance. In order to sort out teacher quality effects from other things that might be changing within a school, we concentrate on the persistence of achievement gains across cohorts for each school. The idea behind the estimation is that the pattern of achievement gains across grades and cohorts of students within a school should remain constant (except for random noise) if differences among individual students are taken into account and if none of the characteristics of the school (teachers, principal, curriculum, etc.) change. We then relate systematic changes in teachers and in other aspects of schools to any changes in the pattern of achievement gains that are observed.

The basic framework regresses the between cohort variance in school average test score gains on the proportion of teaching positions occupied by new people in successive years. Intuitively, if teacher quality differences are important, high turnover of teachers should lead to more variation in quality over time; this should show up in lack of persistence of student gains across cohorts. To control for other influences on the variation in cohort performance, the regressions also standardize for the inverse of the number of teachers in the grade,[20] the inverse of student enrollment, and other factors, and restrict the sample to students who remain in the same school for both grades effectively removing

[19] We concentrate on grade average achievement largely because the data do not permit us to link students with individual teachers, but it also avoids problems of within grade sorting of students and teachers.

[20]The proportion of teachers who are different must be divided by the number of teachers in a school because of the aggregation to grade averages. The total within school variance in teacher quality includes not only variation across grades but also variation within grades. The variance of grade averages equals the total variance divided by the number of teachers per grade as long as the hiring process is identical for adjacent cohorts and grades.

fixed student effects.[21] Some regressions also remove school or even school by grade fixed effects, identifying effects on competition by differences in the rate of teacher turnover between the 1993 and 1994 cohorts and the 1994 and 1995 cohorts.

The dependent variable generally analyzed is:

$$[(\Delta\bar{A}^{c}_{6s} - \Delta\bar{A}^{c}_{5s}) - (\Delta\bar{A}^{c'}_{6s} - \Delta\bar{A}^{c'}_{5s})]^2$$

Each term in this expression involves the average growth in achievement (ΔA) for a given grade (5 or 6) and a given cohort (c or c') in a specific school (s). This measure focuses on the pattern of achievement changes and how it differs across cohorts. The term can be interpreted as the degree that achievement patterns lack persistence: if nothing changes in the grade pattern of achievement across cohorts, this term will be zero. If teacher turnover raises the year-to-year variation in teacher quality and thus increases the variation in student outcomes across cohorts, the coefficient from regressing this term on the proportion of teachers that are different should be positive.[22]

The new contribution of this work is the introduction of competition into the analysis in the form of an interaction between the proportion of teachers who are different and the Herfindahl index for the MSA. If competition works to reduce the within school or district variance in teacher quality, the coefficient on the interaction term should be positive. (Because variation over time in the Herfindahl index is not used, the main effect of the index cannot be identified in the fixed effect specifications so it is not included).

The fact that districts exert substantial control over teacher hiring suggests that it is the competition between districts that should have the strongest influence on teacher quality. However,

[21] Some specifications (not reported here) include controls for new principals and new superintendents. Each may directly affect the variation in achievement and be correlated with teacher turnover. However, the results are quite insensitive to the inclusion of these variables.

[22] Rivkin, Hanushek, and Kain (2000) also show that the magnitude of the coefficient has a simple interpretation. It equals four times the within school variance in teacher quality.

there are a number of reasons to believe that the competition should be measured at the school level. First, principals exert a great deal of control over hiring, retention, and monitoring; second, within district variation in working conditions in the absence of flexible salaries could lead to substantial variation in quality; and third, on the practical side, the methodology depends on variation in the proportion of new teachers divided by the number of teachers. In districts with many teachers, high values of the denominator overwhelm any variation in teacher turnover, and it may preclude detecting the effects of variations in quality. Nevertheless, for completeness, the empirical analysis measures competition at both the school and district level.

Results

Tables 1 and 2 report the main results on the effects of school and district competition, respectively. The focus of attention is the interaction of % different teachers and the Herfindahl index. The main effect for the within school variance in teacher quality is % different teachers/# teachers, and the interaction term identifies how the variance in teacher quality is affected by different degrees of competition within metropolitan areas. Consistent with expectations, the estimates in Table 1 using school level competition are much more precise. No interaction coefficients using district competition are significant even at the 10 percent level. The school competition results support the hypothesis that competition raises school quality through its effect on teacher personnel practices. All interaction terms are positive and significant at the five percent level, even in the specification that includes school by grade fixed effects. In other words, less competition leads to a larger within school variance in teacher quality. The magnitude of the interaction coefficients in the fixed effects model suggests that a one standard deviation increase in the degree of competition (a 0.02 point decline in the Herfindahl index) would reduce the within school variance of teacher quality by roughly 0.09 standard deviations in the teacher quality distribution.

While this effect size might appear small, it is in fact large relative that of measured inputs such as class size. Rivkin, Hanushek, and Kain (2000) find that a one standard deviation reduction in class size (roughly three students per class) would lead to a 0.02 point increase in achievement. In other words, effect sizes for class size reduction are between one fourth and one fifth as large as the effect size for competition and teacher quality.

Importantly, a metropolitan area wide variable may provide a noisy measure of competition for most students and be susceptible to the structural problems described earlier. While the estimation cannot be easily divided in terms of individual high and low income students, it is nevertheless informative to focus on schools serving a large proportion of low-income students and those serving a small proportion. Therefore we divide the sample into schools in which at least 75 percent of students are eligible for a subsidized lunch and those in which fewer than 25 percent are so eligible (the middle category is excluded) and compute two Herfindahl indexes for each metropolitan area.

Table 3 reports the results for these two samples of schools. The results suggest that public school competition is much more important for lower income students, for whom the interaction coefficients are positive and strongly significant. In contrast, the estimates for schools with very few lower income students are small and statistically insignificant. To the extent that private school alternatives are much more relevant and place much more pressure on schools serving middle and upper middle class students, this result is not altogether surprising, and it is consistent with the belief that the observed effects capture a behavioral response. At the very least, more should be learned about competition effects for lower income and minority students, because most of the large urban districts in the country serve increasingly lower income populations.

In summary, these results provide support for the notion that competition affects teacher quality. Importantly, the inferences drawn about quality from estimates of effects on within school variance rest upon the assumption that administrators do not systematically act to ensure the highest

quality of teaching possible. Evidence from Ballou and Podgursky (1995) and Ballou (1996) of school hiring decisions not driven primarily by applicant quality supports the view that there is a great deal of slack in the hiring process. Moreover, the small number of teachers released on the basis of poor performance and anecdotal evidence of weak efforts by many teachers is consistent with lax monitoring procedures. Of course the positive coefficient on the interaction term could reflect the fact that schools in more competitive metropolitan areas hire more systematically but not any better than others, i.e., that they hire more similar teachers but not ones of higher quality. However, there is little a priori reason to support this interpretation.

Conclusion

These results provide the first piece of evidence on the mechanisms through which competition may affect school quality; they suggest that more competition tends to increase teacher quality, particularly for schools serving predominantly lower income students. Given the evidence that teacher quality is an important if not the primary determinant of school quality, a finding that competition was not related to the quality of teaching would have raised doubts about the strength of the link between competition and overall school quality.

Future work in this area should explore both specific aspects of the teacher/management relationship such as hiring, tenure, and monitoring, as well as the effects of competition on the use of inputs and other aspects of school operations. Information on the mechanisms through which competition affects school quality will provide a much better understanding of the processes that generate the observed link between competition and school quality. In addition, such information is also relevant for efforts to improve the existing public schools.

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Table 1. Estimated Effect of Math Teacher Turnover on the Squared Difference in School Average Test Score Gains Between Cohorts (abs value of t statistics in parentheses)

% math teachers	0.013	0.036	0.039
different / # teachers	(0.85)	(2.58)	(1.46)
% different / # teachers *	1.35	1.18	2.05
school Herfindahl Index	(2.60)	(2.38)	(2.01)
observations	1,140	1,140	1,140
school fixed effects	no	yes	no
school by grade fixed effects	no	no	yes
controls for inverse of enrollment	yes	yes	yes
sample restricted to non-movers	yes	yes	yes

Table 2. Estimated Effect of Math Teacher Turnover on the Squared Difference in District Average Test Score Gains Between Cohorts (abs value of Huber t statistics in parentheses)

% math teachers	-0.040	-0.030	0.100
different / # teachers	(1.55)	(1.38)	(1.91)
% different / # teachers *	0.11	0.06	-0.28
school Herfindahl Index	(1.25)	(0.93)	(1.56)
observations	832	832	832
school fixed effects	no	yes	no
school by grade fixed effects	no	no	yes
controls for inverse of enrollment	yes	yes	yes
sample restricted to non-movers	yes	yes	yes

Table 3. Estimated Effect of Math Teacher Turnover on the Squared Difference in School Average Test Score Gains Between Cohorts, by School Demographics (absolute value of t statistics in parentheses)

Sample	Schools with >75% Eligible for Subsidized Lunch			Schools with <=25% Eligible for Subsidized Lunch		
% math teachers	0.006	0.044	0.060	0.110	0.053	0.056
different / # teachers	(0.23)	(1.61)	(1.15)	(2.90)	(1.55)	(0.94)
% different/ # teachers *	1.15	0.97	1.19	-0.18	-0.08	0.06
school Herfindahl Index	(2.50)	(3.71)	(2.11)	(1.07)	(0.55)	(0.21)
observations	306	306	306	272	272	272
school fixed effects	no	yes	no	no	yes	no
school by grade fixed effects	no	no	yes	no	no	yes
controls for inverse of enrollment	yes	yes	yes	yes	yes	yes
sample restricted to non-movers	yes	yes	yes	yes	yes	yes

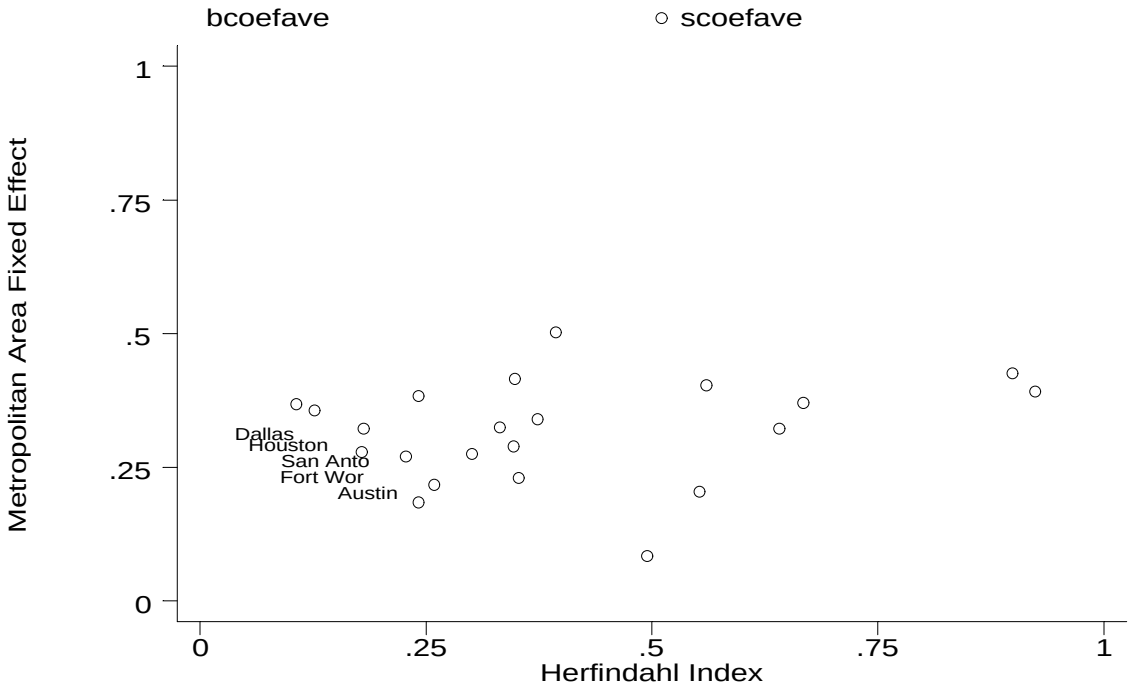

Figure 1. School Quality and District Concentration

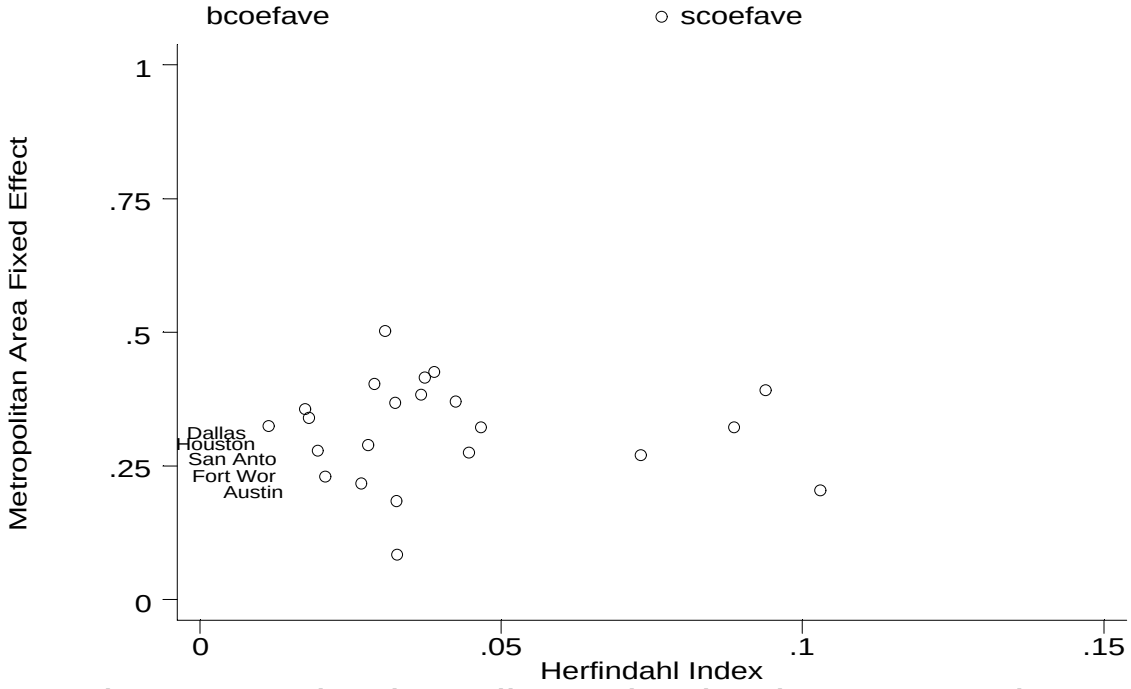

Figure 2. School Quality and School Concentration

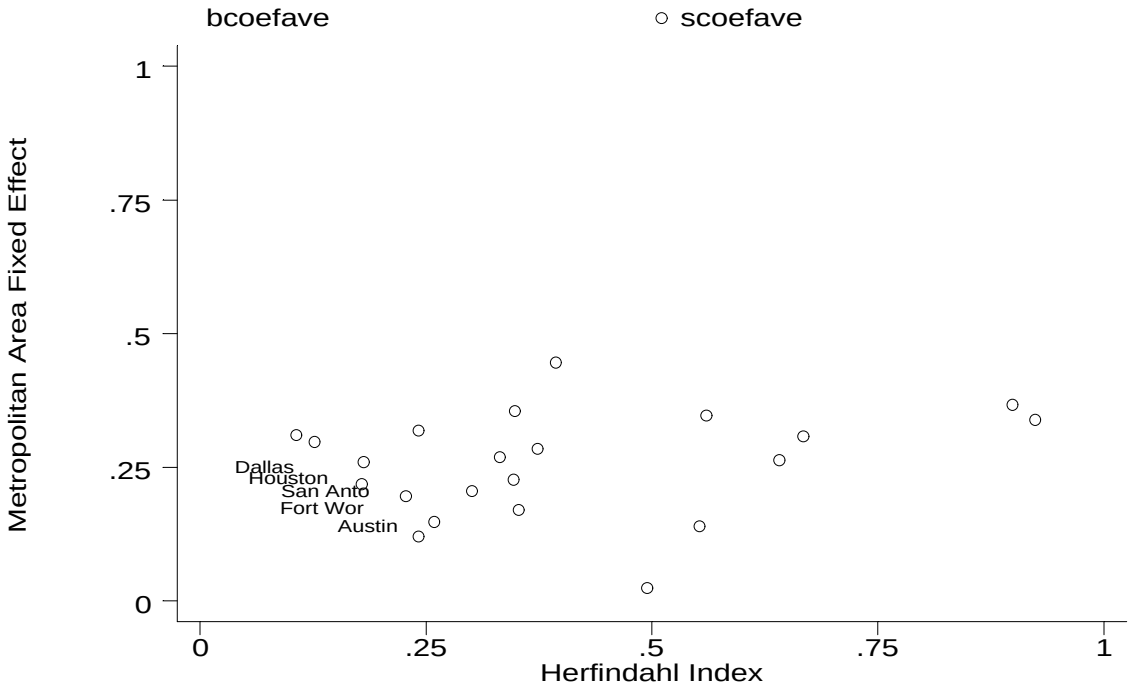

Figure 3. School Efficiency and District Concentration

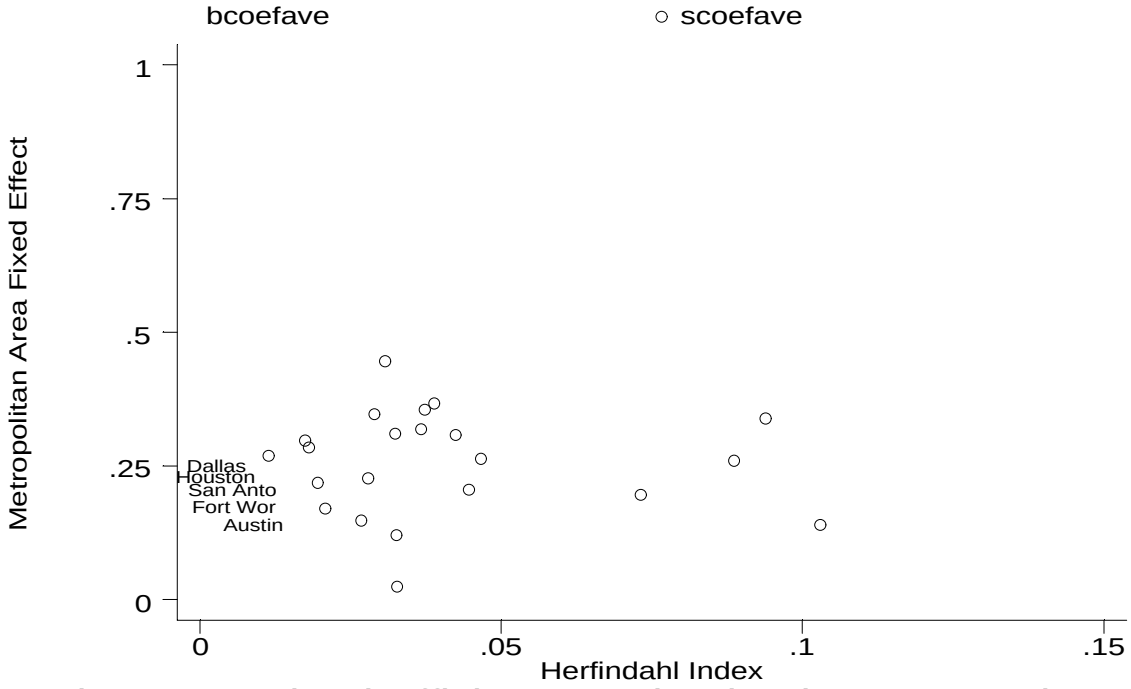

Figure 4. School Efficiency and School Concentration