PRIVATE SCHOOLS AND PUBLIC QUALITY: AN ANALYSIS OF THE EFFECTS OF PRIVATE SCHOOLS ON PUBLIC SCHOOL PERFORMANCE

By

CHRISTOPHER ROMAN GELLER

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2000

UMI Number: 9989307

UMI

UMI Microform 9989307

Bell & Howell Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

Roy Bahl
____
Dean
Andrew Young School of Policy Studies

Dissertation Committee:

____
Chair

____

____

____

____

ACKNOWLEDGEMENTS

Many people have helped me in a myriad of ways. I would like to thank them all, at least as members of groups. If I have neglected any, I apologize and hope they know that I value their contributions.

It is difficult to express the great appreciation, thanksgiving, and affection that I feel for my supervisor and committee. Prose cannot express the depth of my gratitude to David Sjoquist and Mary Beth Walker, the two faculty members who have been associated with this project the longest.

As a graduate assistantship boss and dissertation supervisor Dave Sjoquist gave much better than he got. I cannot imagine being able to repay my debt. I appreciate his insight, skills, wry humor, and tolerance from the depth of my heart. Many thanks for the repeated econometrics lessons and technical advise that Mary Beth Walker gave me. Thanks for bringing me this topic and sticking with us though all the unexpected twists. But, most especially, I give thanks for that short note she sent me after my first major setback and the unflagging support since then. Bruce Seaman showed me beauty in economics just as I began the Ph.D. program. It was good to work with him again at the end. I appreciate Carol McGrevin for taking time from her own school and program to give me insights from her practical experience with schools and public school administration.

Indeed, each member of the faculty and staff in the Department of Economics has been pleasant, supportive and helpful far beyond my expectations when I entered the program. Dorie Taylor provided critical-long distance help in completing this document and Sue Fagan facilitated many steps along the way. My fellow students helped me often. I would especially like to thank Jamie Boex, Dagney Faulk, Joey Smith, and Wen Tsui at Georgia State, who provided ideas, technical advise, and editorial assistance. Jai Hyung Yoon of Deakin provided clever mathematical techniques and clear exposition.

Thank you to the many workers at the Georgia Department of Education who assisted me with acquiring data and understanding the school system as a whole. Among them, I would like to single out Kay Bell, Cathy Smiley, and especially Beverly Moraco. Morris Johnson of Georgia Independent Schools and Malcolm Cummings of the Georgia Association of Christian Schools provided me with data, insights, and valuable information on policies.

Two Universities have employed me while I have pursued this work. I would especially like to thank Bharat Hazari of Deakin University and Mary Bumgarner of Kennesaw State University for their understanding and support.

A doctorate and dissertation do not arise from the university and research environment alone. Over the years, my parents. siblings. and teachers have built my abilities. I would especially like to thank two teachers for contributions long ago that specifically helped me with this dissertation. Abe Thurman and David Walker laid the foundations for the analytical thought and writing capacity upon which this dissertation stands.

My wife and children have endured disruption and inconvenience due to my work on this dissertation. My wife Lee Adams has also given me encouragement, editorial contributions and held my expectation of success for me.

I hope that all of these people may take some pride in this work.

CONTENTS

TABLES

FIGURES

ABSTRACT

PRIVATE SCHOOLS AND PUBLIC QUALITY: AN ANALYSIS OF THE EFFECTS OF PRIVATE SCHOOLS ON PUBLIC SCHOOL PERFORMANCE

CHRISTOPHER R. GELLER

August 4, 2000

Committee Chair: Dr. David L. Sjoquist

Major Department: Economics

Two empirical approaches fail to find improvement in public school performance from private school competition in Georgia. Both approaches use lagged measures of competition in order to avoid problems of endogeneity between private school presence and public school performance, and use control variables to restrict the impact of extraneous factors. One approach uses levels of competition. performance and controls. The other approach uses changes in competition. performance and controls. Both approaches were refined using data on high schools. Using separate data on third grades. neither approach supports the hypothesis that a competitive effect exists.

Establishing theoretical conditions under which competition improves performance shows that Georgia is an unlikely environment to find a competitive effect on public school performance. For example, many public schools in Georgia have enrollments at or above designed capacity and so may not seek more students. Also, many private schools attract students on grounds which public schools may not emulate for legal reasons. The theoretical results show that a competitive effect could reasonably exist elsewhere under real world conditions.

Previous studies outside Georgia have found evidence that public schools improve their performance in response to private school competition. The theoretical results provide insights about why the empirical results differ between areas.

CHAPTER I: INTRODUCTION

As we enter the Twenty-first Century, it is becoming increasingly important for the American workforce to be proficient in learning new skills and adopting new technology. The information age and its concomitant explosion of technology require that not only those who direct the world's economies, but also those who drive those economies, master dynamic technology. The majority of American citizens are educated in public schools. Thus, America depends upon the public education system to deliver workers and consumers with knowledge and ability. However, the public schools are widely perceived as failing in their vital task of producing workers who are well prepared to be productive in today's economy.[1] According to the news media, Americans have real doubts about the ability of public schools to be effective institutions of learning. In a recent survey of 300 Atlanta area businesses, over half the respondents stated that the quality of Georgia's public schools hampered their company's ability to find qualified workers (*Atlanta Business Chronicle* 1999). Few analysts would question the importance of education in today's information and technology driven society.

Given the chronic concerns with public school performance, and the pleas for increased privatization of government services, proposals intended to broaden school choice and foster competition are popular policy suggestions. However, choice and competition in various forms, have been part of American public schooling for over a century. In the 1870s, parents chose schools within some districts on the basis of religion

---

[1]A search of the *New York Times* web site (http://archives.nytimes.com/archives/search) on January 14 1999 yielded over 80 articles in the last year addressing actual or perceived crises in public education in the USA.

and ethnicity. In other areas, parents changed residence to take advantage of differences in school policy. School systems responded to parental and public demands by revising religious curriculum to attract students from Roman Catholic schools. Also public schools competed with each other for status and prestige (Adams 1875). Open enrollment is the oldest and most common form of school choice within districts. In open enrollment, students are initially assigned to neighborhood schools, and they may transfer to any other school in the district if space is available (Young and Clinchy 1992). Government run schools were under local control with diverse policies until the 1930s, permitting parents to choose between a variety of alternatives at least within urban areas (Friedman and Friedman 1979).

Desgregation-driven choice plans began in Baltimore, Maryland in 1954, when parents gained the (nominal) opportunity to enroll their children in any Baltimore public school with vacancies.[2] However, the Baltimore plan included significant effective constraints. After initial partial integration, schools drifted to increasing levels of segregation – although not returning to full segregation (David 1994). Similar plans elsewhere also met with limited success. To more fully promote integration, these programs developed into "controlled choice" in which students' parents list their preferences for schools and then the district places the students in schools according to the stated preferences and racial limits for each school (Friedman and Friedman 1979). In the majority of cases the students are placed in their first choice school and the majority of the remainder are placed in their second choice (Young and Clinchy 1992).

---

[2]This chapter was greatly aided by Rouse and McLaughlin's (1998) excellent review for the National Academy of Sciences.

However, this system is currently under attack as an unconstitutional use of race by the government (U.S., et al. v. Georgia (Troup County School District), Civil Action No. 1,69-cv-12972-RLV, N.D. GA. June 20, 1997).

Magnet school programs provide a less structured choice method for desegregation than does controlled choice. The magnet school plan places special high quality programs in primarily minority schools to encourage majority students to enroll in them. Since magnet schools accept students from throughout a district, they have the potential of increasing competition as well as decreasing segregation (Young and Clinchy 1992).

Choice as a driver for quality did not enter the educational debate until 1955 when Milton Friedman proposed educational voucher plans. However, before voucher plans were actually implemented, school districts developed alternative schools in response to grass-roots demand. In the 1960s, parents dissatisfied with current public schools advocated for alternative schools designed for specific functions or using particular methods. By the early 1980s there were millions of students enrolled in such schools. Most of the alternative schools specialized in at-risk students by the early 1990s (Young and Clinchy 1992).

During the 1970s and 1980s, a variety of other choice plans developed across the USA. In the late 1980s states began implementing interdistrict choice plans. Characteristically, Minnesota was the first introducing a voluntary plan which permitted students to attend schools in other districts and have their home district pay their tuition. In 1990 the plan became mandatory in that all districts had to accept transfers, space permitting. Arkansas, Iowa, and Nebraska implemented comparable plans that same year. Since then several other states have begun interdistrict choice plans, sometimes on fairly limited bases (Young and Clinchy 1992). However, it may be worth noting that at least in Minnesota at that time, interdistrict competition was prohibited explicitly by state law (Lieberman 1990).

The first use of vouchers in the USA was in Alum Rock, California in the early 1970s (Friedman and Friedman 1979). Some 125 communities in Vermont and Maine have no public high school and permit students to attend private schools at public expense. In some of the communities students are able to choose particular schools (Young and Clinchy 1992). The East Harlem community school district in New York City instituted a large-scale choice program among its junior high schools in 1975. In this program schools specialized in areas such as health, environmental science, sports, or performing arts. By 1982 the program included all the junior high schools and the district had experienced considerable improvements relative to other New York City community school districts (Young and Clinchy 1992).

During the 1990s school choice as a means to improve performance moved beyond small experiments or special cases and started to be implemented as formal policy. In 1990, Wisconsin initiated a voucher program to subsidize low-income students in Milwaukee to attend non-religious private schools. Two hundred and fifty-nine students completed the first year using vouchers and over twice that many commenced the 1991-92 year using them (Young and Clinchy 1992). Cleveland, Ohio implemented a voucher system in 1996 which allows funds set aside for public education to be used by parents to pay for private school for their children. By 1999, Cleveland's program enrolled about 3600 low income students in over 50 private schools. In that year, Ohio's Supreme Court held that public vouchers did not violate separation of church and state. The ruling encourages other large public school systems that are proposing or adopting choice programs in an effort to improve school quality. However, the program faced an uncertain future due to other legal and legislative concerns (Kronholz 1999).

The element of choice appears to offer an avenue for competitive pressure. Many advocates of school choice have in part justified such expenditures of public funds by suggesting that the presence of private schools places competitive pressure on public schools, thereby improving their performance (for example, Friedman and Friedman 1979). Certainly most economists, following Friedman, would expect an increase in performance with an increase in competitive pressure. However, research on public schools has not consistently found these effects of the presumed competitive pressure (Newmark 1994). In studies of public schools in various competitive environments, empirical studies have yielded mixed results and the theoretical modelling of the impact of competition on school productive performance is informal and incomplete (Hoxby 1998).

This dissertation establishes explicit theoretical grounds for the possibility of, and conditions for, private schools to exert competitive pressure that results in higher public school performance. The theory suggests that certain elements must exist for a competitive relationship to exist between public and private schools. These elements include among others, that public schools desire more students, and that public and private schools are substitutes in the production of education.

The dissertation then establishes empirically that there is no evidence for such effect in data from Georgia school systems between 1980 and 1990. The dissertation concludes with broader considerations and policy implications of the results.

This dissertation proceeds as follows. Chapter two is a review of the current literature addressing competitive effects of private schools on public schools, especially the central work by Hoxby (1994). Chapter three develops a theory of how private competition affects public schools and investigates the conditions for a beneficial competitive effect. Chapter four details the data used in this analysis. Chapter five explains the empirical models. We refine an instrumental variables approach with multiple trials on data from tenth grades. The refined model is then tested on third grade data. Additionally, we develop a differences model using tenth grade data and test it on third grade data. Chapter six, concludes by relating the empirical observations to the theoretical results and drawing policy conclusions.

CHAPTER II: LITERATURE REVIEW

Theorists and practitioners have suggested a number of avenues to increase competition among public schools. Competition could be increased within the government system. Union hegemony could be broken, permitting more influence from other parties, such as parents, school boards, administrators, and individual educators. Competition would be greater between schools if families could choose to send their children to any school within their district (open enrollment). Competition could be increased between districts by making inter-district transfers easier and removing the financial penalties usual for such transfers (Young and Clinchy 1992). Yet, before such "reforms" are implemented it is wise to examine, both theoretically and empirically, whether and under what conditions competitive pressures would benefit public schools.

Public School Response to Private Schools

The empirical results concerning competitive effects between private and public schools are mixed. Some find support for positive competitive effects (Couch, Shughart, and Williams 1993; Hoxby 1994). Other studies do not reveal significant improvement from competition (Newmark 1994).

Couch, Shughart, and Williams (1993) (hereafter "CSW") use a reduced form equation estimated with ordinary least square (OLS) regressions to document that public schools in North Carolina counties with higher levels of private school enrollment also had higher grades on the End of Term Test for Algebra I. Their study took county school systems as the unit of analysis and used a cross-sectional data set consisting of algebra test scores, private school enrollment and a number of socioeconomic controls. The authors obtained the test scores, the educational levels of test-takers' parents, and private school enrollment from North Carolina's Department of Public Instruction and socioeconomic controls from the 1990 US Census of Population.

Specifically, they regressed normalized algebra I test scores (ZSCORE) on the percentage of the county's students who were enrolled in private schools (PRIV) and several control variables:

(1) ZSCORE = g(PRIV, BLACK, PARENTED, POVERTY, TOTFPS, DENSITY, u).

BLACK is the percent of the county's population that was African-American. PARENTED is the percentage of the parents of Algebra I test takers who have less than a high-school education. POVERTY is the percentage of the county households below the poverty level. TOTFPS is public school system total expenditures per student, and DENSITY is the population density of the county.

CSW's empirical results indicated that a one percentage point increase in private school enrollments leads to a 0.08 standard deviation increase in Algebra I test scores. It is noteworthy that the average school system in North Carolina has about three percent of its students in private school. Thus, the average North Carolina system would perform at about a fourth of a standard deviation lower in the absence of private schools.

CSW do not specify an explicit theoretical model. However, they clearly consider public schools to face minimal competition and therefore to function as monopolies. They envision that increasing competitive pressure from private schools will reduce the monopolistic inefficiencies of public schools and improve their quality. CSW state "individual schools and school districts will be forced by the threat of lower enrollments to offer curricula and instruction that more closely match the demands of the consumers of public education" (p. 302). They cite Eberts, Schwartz and Stone (1990) to support the claim that there is little competition within the public school system. Further, they note that "the critical point is that competition strongly reinforces parental influence on test score performance" (p. 309) and so presumably prompt public schools to teach more effectively.

However, there are potential difficulties with CSW's work. Although CSW use OLS in their estimations, they acknowledge that there is reason to expect endogeneity between private school enrollment and public school performance. They performed a test of the null hypothesis of exogeneity, but based on the information provided in their paper, the test statistic is inappropriate to the null being tested, and in fact is inconsistent. Further, Newmark (1994) notes that CSW's results are not robust across closely related data sets.

Newmark (1994) replicates CSW's model using nearly identical data, expands it to additional standardized exams, and then uses different measures of private school competition. Based upon Newmark's results, CSW's results do not appear to be robust. Using private enrollment data that is one year more recent than that used by CSW, Newmark establishes nearly identical results for North Carolina's exam for Algebra I. However, the state gives a total of eight comparable End of Course exams, including two others in mathematics. Levels of private schooling do not show significant positive correlation with any of these tests other than Algebra I. As an additional evaluation for robustness Newmark uses an alternative measure of private school competitive pressure as a regressor for Algebra I score. This additional measure is the percentage of students enrolled in private schools as reported by the 1990 U.S. Census. Census data provide a somewhat different measure of competition than CSW's data from the North Carolina governor's office. The Census data include home schooling students and those that attend private schools in other counties. The effect on Algebra I scores is not significant using the census measure of private school enrollment. Newmark concludes that "the authors' (CSW) result is a coincidence" (p. 371). He believes that variation in private school enrollment may be "simply too small" to affect outcomes. "Would we expect a monopolist to behave differently than a firm with about 90 percent of the market?" (p. 372). He answers "no", considering that North Carolina's private school enrollment in absolute terms grew by less than one percent from 1972 to 1989, and so does not provide a growing competitive fringe.

Perhaps the most important empirical support for competition having positive effects on public schools comes from Hoxby (1994). Hoxby uses an instrumental variables (IV) approach in a nation-wide study to show that public schools perform better in areas where they face more competition from private schools. Specifically, public high schools have a higher retention rate in areas with high population densities of Roman Catholics, a result also shown by Martinez-Vazquez and Seaman (1985). This is true even though Catholics themselves tend to leave school sooner than the general population (Hoxby 1994).

Hoxby (1994) does not provide an explicit theoretical ground for why competition should improve educational performance. Rather, she posits two possible anecdotal "routes by which private schools may affect public school administrators and teachers" (p. 5). She suggests that competition from private schools could be relevant through mechanisms addressed in principal-agent problems or through possible financial incentives for school staffs.

In Hoxby's model, the percentage of a population that is Catholic is a proxy for lower tuition in private schools. This is reasonable because over 80% of private schools in the US are Catholic, and Catholic school tuition is often subsidized by Catholic congregational donations.[3] Her model is built upon two equations. The first equation is:

(2) $y_{ij} = gC_j + \mathbf{X}_j b_1 + \mathbf{X}_{ij} b_2 + w_j + v_j + e_{ij}$

where: i denotes individual variables, j denotes county level variables, y represents various measures of student outcomes such as educational attainment, wages and test scores. C is the share of students in private school, **X** denotes exogenous descriptors, *w* is unexplained school quality, *v* is a county level error term, and *e* is an individual error term.

The second equation is:

(3) $C_j = \mathbf{R}_j a_1 + \mathbf{X}_j a_2 + a_3 w_j + i_j$

where: **R** represents denominational variables including adherents and churches/synagogues, and *i* is a county level error term.

Equation 3 serves as a first stage IV estimate in equation 2, then the system is estimated by feasible generalized least squares (FGLS). In effect, the IV is the vector [**RX**]. It is the latter form that shows competitive influence over school outcomes.

[3]Private school tuition is difficult to measure or define. Schools often set high tuition and offer scholarships to most students.

Hoxby's (1994) data are compiled from six sources: 1) the National Longitudinal Survey of Youth, 2) the Survey of Church and Church Membership in the United States, 3) the National Center for Education Statistics: Private Schools in America Survey 1980, 4) the Census of Government 1982, 5) the 1980 Census and 6) the 1983 City and County Data Book. In all, the study uses 10,589 observations.

Hoxby concludes that:

> a change in Catholic population that translates into a 10 percentage point increase in the share of enrollment in Catholic schools produces a wage increase of about 2%, a 2 percentile increase in the AFQT score, a 2 percentage point increase in the probability of high school graduation by age 19, a 3 percentage point increase in the probability of two years of college by age 24, and a 3 percentage point increase in the probability of college graduation by age 24 (p. 28).

Hoxby's (1994) approach is by far the most sophisticated to be applied to competition between private and public schools. Her results appear to be sound and uncontested in the literature.[4]

Disagreements over empirical results have been heated in the debate over private school impacts on public schools. Couch and Shughart (1995), in response to Newmark's (1994) criticism of their paper, speculate that Newmark had accused them of "extensive specification search" in establishing their model. Chubb and Moe (1993) and Lee and Byrk (1993) seem to believe that the phrase "engineered our analysis" implies fraudulent

---

[4]This work is currently under revise and resubmit with the *Journal of Political Economy*. Reported on www.economics.harvard.edu/faculty/hoxby/hoxby_cv.PDF, 21 March 2000.

intent rather than a potentially accidental consequence of investigating alternative models. Accusations of hidden agendas and academic deception appear surprisingly often in this literature. This acrimony exists despite the fact that the danger and prevalence of unintentional bias in social analysis was well documented more than a decade earlier (Gould 1981). Given the emotionally laden content of this research (and resulting debate) and the dangers of incidental post-hoc specification of models, it is critical to develop our models clearly, refine them on one data set, and then test the results with other data.

Competitive Pressure May be Illusory

There are several additional methodological reasons to question the robustness of these studies. All existing studies use cross-sectional data and examine whether the presence of private schools in a school district has a significant impact on the summary measure of public school test scores. Most authors note a strong potential for endogeniety between these variables; public school test scores could easily have a causal relationship with private school enrollment. This could occur in two ways: private schools could draw away the higher scoring public school students, or an already low-performing public school could push academically oriented students toward private schools.

A further difficulty is the paucity of data. Most studies rely on one or two test scores to measure student performance, usually for a single grade level. Also, some researchers use exams that are administered to only a subset of students, thereby weakening the usefulness of the test as a measure of overall school performance.

Presumed Model

Implicit in the idea that school choice can exert competitive pressure on public schools is the assumption that public school administrators and teachers can measurably influence performance outcomes. CSW and Hoxby (1994) share an apparent presumed model of school administration behavior in which administrators maximize a utility function of the approximate form of $U=u(N,F,\mathbf{X_1})$ where N is the number of students, F is administrator effort, and $\mathbf{X_1}$ is a vector of exogenous variables. Utility increases in the number of students and decreases in effort. Further, N is assumed to be an increasing function of school performance, $N=n(P,\mathbf{X_2})$, which is in turn an increasing function of administrator effort, $P=p(F,\mathbf{X_3})$. Thus, when faced with competition for students, administrators would increase performance (especially test scores) to stabilize or increase the number of students. However, in the absence of competition, administrators use their assumed monopoly power to engage in "shirking" or pursue objectives other than those that lead to high levels of educational performance. This view is consistent with some models of governmental behavior, whereas other models predict different relationships.

Models of Competition and Government Efficiency

Economic literature includes several models of government behavior. Breton (1996) represents seven general forms. Two forms focus on government efficiently achieving society's common good: *organicist* and *benevolent despot*. The former ascribes identical preferences to the government and all individuals. In the latter, leaders know and pursue society's preferences. According to these models, government agencies operate efficiently in achieving social goals. Other models of government behavior focus on the self-interest of government decision-makers. Most of the latter treat the government as a monolithic structure pursuing an objective. In *bureaucratic capture* models, bureaucrats turn government power to their own agendas. In *interest group* models nongovernmental power blocks can tailor government behavior to their own goals. *Leviathan* models represent government as a monopoly that maximizing its surplus. The *monolithic* view of government focuses on the apparently unique power of coercion that governments hold over people. Breton's final model represents governments as composite forms that experience *competition* both between government agencies and from nongovernmental institutions.

Of these, only the Leviathan and competition models seem suited to address private school versus public school competition. The others assume efficient outcomes, which would shift only slightly in public schools in response to minor changes (such as constraints or populations served) resulting from the presence of private schools. The Leviathan and competition models permit monopoly based inefficiencies, allowing for major performance gains due to the introduction of (or increased) competition.

The Tiebout (1956) hypothesis is one example of a model that permits, but does not require governments to act efficiently. According to Tiebout, local governments may compete in attracting residents, and so may be inclined to improve their performance to the degree that other local governments are within close commuting distance. Martinez-Vazquez and Seaman (1985) find evidence that public schools respond to variations in Tiebout-style competition.

With the broad disagreements and varying perspectives in this literature, it may be helpful to construct an explicit model based upon individual rationality. Such model development may resolve apparent contradictions in the literature and provide an explicit basis for further debate.

It appears from the review of the literature that the pertinent question has been misidentified from the beginning. It certainly was at the beginning of the present project.

Not only have the econometrics been flawed and the data poor, the problem has not been identified. Previous research focused on whether the presence of private schools improves the quality of public schools. A more fruitful question is "Under what conditions does the presence of private schools improve the quality of public schools?"

CHAPTER III: A THEORY OF PUBLIC SCHOOL AND PRIVATE SCHOOL COMPETITION

This chapter presents a model of the interaction between households and public school administrators. The former choose between public schools and private schools while the latter decide on the level of effort to exert on producing educational performance. The household decision is assumed to be based upon income, preferences, school performance, and access to private schools. The model developed in the first section shows that an increase in access to private schools leads to an increase in the performance of public schools. The following section shows that reasonable relaxation of assumptions negates this key result, permitting public school performance to be independent of private school competition.

Formal Exposition

General Assumptions

Assume there are two sets of decision-makers: a single public school administrator and an arbitrarily large set of heterogeneous student's households. Each member of both sets maximizes its own utility. We use the term "care" to mean that the subject's utility changes with differing levels of the object. None of the decision-makers cares directly about the utility of any other, although they may care about common issues. Assume there is a perfectly elastic supply of private schools with identical performance and a perfectly elastic supply of public schools with performance identical within the set of public schools.

Assumptions Concerning Households

Assume that each household: (1) has one child whom the household chooses to send either to public or to private school; (2) has a fixed endowment *I*, and; (3) has a taste (denoted Θ) for either public school education or private school education. There is a non-education related composite consumer good **X** with a price of one, $p_x=1$. Households care directly about the performance of the school their child attends, as well as the quantity of the composite consumer good. Let the performance of public schools be denoted f_b and the performance of private schools be denoted f_v.[5] Households' utility increases at decreasing rate with higher school performance and more of the consumer good.

School taste (Θ) varies continuously, with low values associated with a strong preference for public schools and high values associated with a strong preference for private schools. In effect, Θ is a measure of an individual household's willingness to forgo goods in **X** to send their child to private school. This is a measure of preference for private schools per se, not for any performance they may have. Intuitively, these households may for example, believe that private schools provide a more proper environment for children. Thus, at high levels of Θ households have less concern for relative differences in performance between public and private schools. There is no *a priori* reason that Θ need be positive and higher magnitude negative numbers would indicate stronger preferences for public schools, with decreasing regard for relative

[5]As "p" is already used as an abbreviation, we use the dominant internal consonants "b" and "v" as abbreviations for "public" and "private", and "f" for "performance."

performance. Essentially, Θ reflects differences across individuals in the parameters of the utility function.

Let p_v denote the cost of attending private schools. We let p_v be the amount of **X** that must be foregone to send the student to private school rather than a public school. We assume that p_v is the same for all households. The price of attending private school, p_v, includes (but is not restricted to) tuition, transportation costs, commute time, books, and uniforms. We interpret an increase in p_v to mean that access to private schools has decreased. Thus, p_v serves as measure of private school competition to public schools[6]. Lower access costs indicate greater competition as households may select private schools over public schools more easily. We assume that p_v is exogenous. For convenience, we assume that public education is costless to the households, as it serves as the base line relative to private schools.

Households, by assumption, compare the potential utility of sending their students to each type of school. They then send the students to whichever school yields the higher total utility. The utility maximization problem for households is:

$$(4) \qquad \text{Max} \begin{cases} U_{max}: u_b = u_h(f_b, X, \Theta) \\ U_{max}: u_v = u_h(f_v, X - p_v, \Theta). \end{cases}$$

We assume that: the endowment **I** and Θ are fixed for each household, are distributed continuously and independently and are uncorrelated with any variation that

---

[6]There are other measures of access and competition that might serve equally well such as the number of private schools or distance to private schools. We use the more inclusive measure of broadly conceived price as the substitutability of public and private schools is central to our investigation and relative price is essential in investigation of substitute goods.

may exist in student's capacity to learn.[7] We further assume that the utility functions are continuous and that in equilibrium there is at least one student in each of the public and private schools.

Implications For Households

From the assumptions of continuity and independence, it follows that there will be at least one household for whom the difference in utility between the two school systems is arbitrarily small. Any change in performance or access costs will therefore cause one or more of these households to switch school systems. See Ben-Akiva and Lerman (1985) for further exposition of such discrete choice models.

As private school performance increases or its access costs decrease, the utility any household could derive from private school enrollment increases. Conversely, as public school performance decreases, the utility any household could derive from public school enrollment decreases. As potential utility from private school enrollment increases or potential utility from public school enrollment decreases, public school enrollment decreases. Thus, the number of public school students (s_b) is a function of private school performance (f_v), public school performance (f_b) costs (p_v), the preferences parameter (Θ) and initial endowments (I):

(5) $s_b=s(f_v,f_b,p_v,\Theta,I)$.

[7]This model permits, but does not require, that students vary in their capacity to learn, i.e. their responsiveness to administrator effort.

Assumptions Concerning the Administrator

By assumption, there is one public school administrator who exerts effort to improve public school performance. The administrator's utility (u_a) is a function of the amount of effort exerted on the job (e_a) and the number of students in public school s_b:

(6) $u_a=u_a(e_a,s_b)$.

Public school enrollment may represent other variables of possible concern to administrators such as the allocation of resources or the social standing of the administrator. We assume, however, that performance does not directly enter the administrator's utility function. Since administrator utility is a function of enrollment, and enrollment is a function of public school performance, the model is simplified by not having performance enter the administrator's utility directly. Thus simplified, the model is more tractable and easier to interpret with a minimal loss of explanatory power.

Public school performance is assumed to be a function of administrator effort and the exogenously determined school resources per student (r);

(7) $f_b=f(e_a,r)$.

The exogenous resources could be from local property tax allocations or state grants to education.

Assume that the administrator's utility decreases with effort at increasing rates: $\partial u_a/\partial e<0$, $\partial^2 u_a/\partial e^2>0$. Further, assume utility increases with the number of students at diminishing rates: $\partial u_a/\partial s>0$, $\partial^2 u_a/\partial s^2<0$. In order to assure an interior solution, we assume that at low levels of effort, the marginal indirect utility from effort through the number of students is greater than the marginal direct disutility of effort.

Implications For the Administrator

Substituting (7) into (5) and (5) into (6) allows the administrator's utility to be expressed as:

(8) $u_a = u_a(e_a, s(f_v, f_b(e_a, r), p_v, \Theta, \mathbf{X}))$.

In (8) the variables and vectors f_v, r, p_v, Θ, **X** are exogenous and e_a is the control variable. We are concerned with the effects of variations in p_v. Thus, the relevant total derivative of this utility function is:

(9) $du_a = \partial u_a/\partial e_a \, de_a + (\partial u_a/\partial s_b \, \partial s_b/\partial f_b \, \partial f_b/\partial e_a) \, de_a + (\partial u_a/\partial s_b \, \partial s_b/\partial p_v) \, dp_v$.

Solving for dU_a/de_a and setting it equal to 0 yields the utility maximization condition for the administrator as:

(10) $\partial u_a/\partial e_a = - \partial u_a/\partial s_b \, \partial s_b/\partial f_b \, \partial f_b/\partial e_a - (\partial u_a/\partial s_b \, \partial s_b/\partial p_v) \, dp_v/de_a$.

As dp_v/de_a equals zero, the utility maximization condition may be simplified as:

(10′) $\partial u_a/\partial e_a = - \partial u_a/\partial s_b \, \partial s_b/\partial f_b \, \partial f_b/\partial e_a$.

The second derivative of (8) is:

(11) $d^2u_a =$

$(\partial^2 u_a/\partial e_a^2)de_a^2 + (\partial u_a/\partial s_b \, \partial s_b/\partial f_b \, \partial^2 f_b/\partial e_a^2)de_a^2 + [\partial u_a/\partial s_b \, \partial^2 s_b/\partial f_b^2 \, (\partial f_b/\partial e_a)^2] \, de_a^2 +$

$2[(\partial u_a/\partial s_b \, \partial^2 s_b/\partial f_b \partial p_v \, \partial f_b/\partial e_a) \, dp_v de_a] + [\partial^2 u_a/\partial s_b^2 \, (\partial s_b/\partial f_b)^2 \, (\partial f_b/\partial e_a)^2] \, de_a^2 +$

$2[(\partial^2 u_a/\partial s_b^2 \, \partial s_b/\partial p_v \, \partial s_b/\partial f_b \, \partial f_b/\partial e_a) \, dp_v de_a] + (\partial u_a/\partial s_b \, \partial^2 s_b/\partial p_v^2) \, dp_v^2 +$

$[\partial^2 u_a/\partial s_b^2 \, (\partial s_b/\partial p_v)^2] \, dp_v^2$.

In order to investigate the stability of the utility maximization we solve for the second derivative of administrator utility with respect to administrator effort. Noting that private school access costs are independent of public school administrator effort:

(12) $d^2u_a/de_a^2 = \partial^2u_a/\partial e_a^2 + \partial u_a/\partial s_b\ \partial s_b/\partial f_b\ \partial^2 f_b/\partial e_a^2 + \partial u_a/\partial s_b\ \partial^2 s_b/\partial f_b^2\ (\partial f_b/\partial e_a)^2$
$+ \partial^2 u_a/\partial s_b^2\ (\partial s_b/\partial f_b)^2\ (\partial f_b/\partial e_a)^2$.

Let us consider the signs of each of the right hand side terms in (12). We have assumed that utility decreases with effort with increasing marginal costs, thus

(12a) $\partial^2u_a/\partial e_a^2 < 0$.

All the functions relating utility to effort through public school student enrollments and public school performance have been assumed to be increasing with diminishing marginal returns. Thus, in the following three inequalities, all first partial derivatives are positive and all second partial derivatives are negative, yielding:

(12b) $\partial u_a/\partial s_b\ \partial s_b/\partial f_b\ \partial f_b^2/\partial e_a^2 < 0$,

(12c) $\partial u_a/\partial s_b\ \partial^2 s_b/\partial f_b^2\ (\partial f_b/\partial e_a)^2 < 0$, and

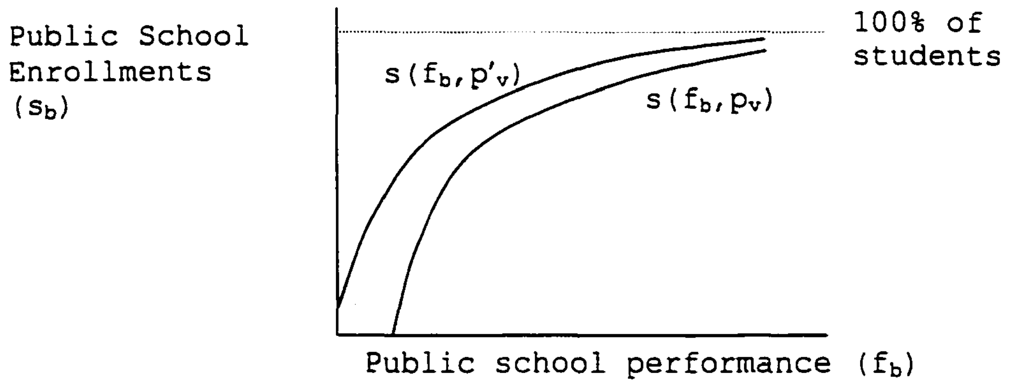
(12d) $\partial s_b/\partial f_b\ \partial^2 u_a/\partial s_b^2\ \partial s_b/\partial f_b\ (\partial f_b/\partial e_a)^2 < 0$.

Thus, the second derivative (12) of the utility function (8) is negative and the utility maximization is stable and well defined, given that the utility maximizing level of effort is positive.

Let us consider the impact of an increase in private school competition, modeled as a decrease in access cost. Private school access costs affect only one partial in the utility maximization condition (8), the middle right hand side term. As shown immediately below, this cross partial ($\partial^2 s_b/\partial f_b \partial p_v$) is negative.

Consider the impact of an increase in private school access costs upon the relationship between public school enrollments (s_b) and public school performance (f), as shown in Figure 1. When private school costs increase from p_v to p'_v, more students enroll in public schools at any level of public school performance while still bounded above at 100 percent of the students. Thus, the slope of the function decreases at every level of performance. This result depends upon the assumptions of increasing utility from the consumption good and school performance and concern for performance decreasing as Θ increases. We see that the cross partial of public school enrollments with respect to own performance and other price is negative.

Figure 1. Performance, Competition and Public School Enrollments

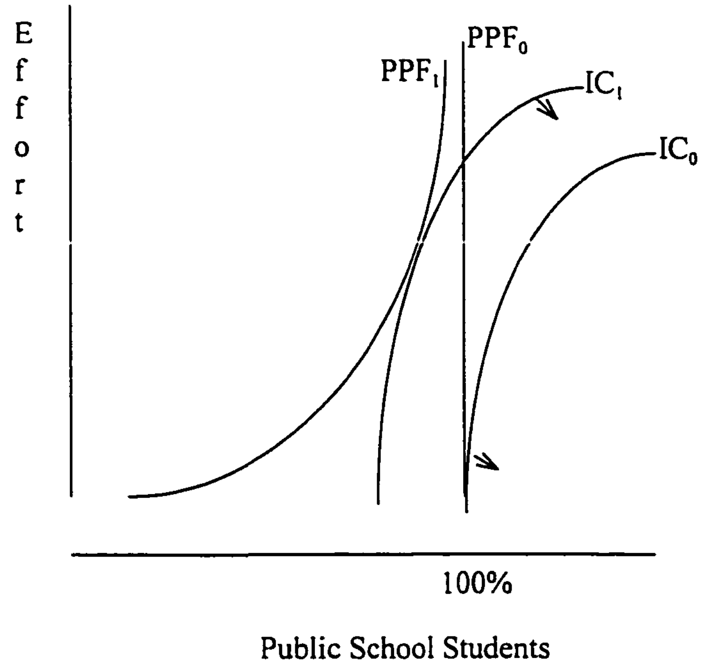


An increase in private school competition, as represented by a decrease in access costs, changes the utility maximizing level of administrator effort. A decrease in private school access costs increases the middle right hand side term in 10′. Since the right hand side carries a negative, the left hand side must decrease. A decrease in the marginal utility of effort implies an increase in effort itself. Thus, increased private school competition can lead to increased administrator effort, and so increased public school performance.

The conditions faced by the public school administrator can be illustrated using a production possibilities frontier and indifference curves. Enrollment is bounded at 100 percent of the students. Figure 2 shows the contrast between no access to private schools (ie, p_v equals infinity) in PPF_0 and the presence of such competition in PPF_1. PPF_0 indicates that in the absence of private schools, public schools enroll all the students regardless of administrator effort. The PPF_1 shows the effect of the presence of private schools. The PPF_1 slopes upward reflecting the assumptions that administrator effort improves performance and that households care about school performance. The PPF_1 bows outward due to the assumptions of diminishing marginal returns on administrator effort and that as Θ increases household s are less concerned with school performance.

No effort yields the highest indifference curve, IC_0 is preferred to IC_1, in the absence of private schools (PPF_0). However, effort must be exerted to gain the highest indifference curve in the presence of private schools (PPF_1). Thus, an increase in access to private schools may lead to an increase in public school performance.

Figure 2. Administrator Effort



General Results

The results above show that under the given assumptions in this model, utility maximizing effort by the public school administrator increases in response to increases in access to private schools. As public school performance is an increasing function of administrator effort, better access to private schools leads to higher performance in public schools.

Relaxation of Assumptions

The result of private school competition leading to increasing performance is sensitive to the assumptions of this model. Minor, reasonable relaxation of the assumptions can negate or reverse the central result that better access to private schools leads to higher performance in public schools. This is important as complexities of the problem in real world terms suggest the formal assumptions do not fully reflect the multifaceted reality of private school competition for public schools.

Consider first that more academically inclined students may have a tendency to attend private schools. It is reasonable to assume that students vary systematically in their ability to learn[8] (ie, how much their performance varies with administrator effort). Alter the original model by supposing that this responsiveness correlates positively with Θ. As minor as it may seem to allow for better students to have a stronger preference for private schools, it leads to a change in the administrator's utility function and so in the comparative statics with respect to changes in the cost of attending private schools. As shown above, a decrease in access costs leads to more students attending private schools. Given that households of more academically responsive students have higher Θ values, less responsive students remain in public school when private school access increases. Under these conditions, the third RHS term in the utility maximization (10′) has a positive cross partial derivative with respect to the cost of accessing private schools, $\partial^2 f_b/\partial e_a \partial p_v > 0$. The cross partial of the middle right hand side term in 10′ was shown above to be negative ($\partial^2 s_b/\partial f_b \partial p_v < 0$). Thus, an increase in access to private schools increases one term and decreases another in the utility maximization conditions (10′), leading to ambiguous effects on administrator effort and public school performance.

[8]This is permitted, but not required, in the original model.

After revising one assumption of independence of student ability and preference for private schools, it is not possible to determine the effect that a change in access to private schools has on utility maximizing administrator effort. Depending on the relative magnitudes of the right-hand side terms, effort could increase, decrease, or remain constant. Suppose that the system is disrupted by a decrease in access costs (an increase in private school competitive pressure). If the first RHS term in equation (10′) is relatively large and relatively many performance-oriented students remain in public school, the magnitude of the RHS would increase. To maximize utility, the marginal disutility of effort must increase as well. Thus, administrator effort would increase and public school performance would improve. If on the other hand, the loss of performance sensitive students dominates, the magnitude of the RHS decreases. Maximum utility would be restored through a decrease in the control variable e_a, which would decrease the magnitude of $\partial u/\partial e_a$ due to increasing marginal costs. Thus, administrator effort and public school performance would decrease.

Consider a second point. Administrators often cannot influence educational outcomes directly. Rather, their influence must run through intermediaries. These intermediaries (possibly teachers, students, parents, or trainers for the teachers) may not respond to increased administrator effort. Union rules, constraining state regulations, apathetic or already fully engaged teachers, and parents who lack the time or willingness to exert influence, for example, could prevent administrator effort from being transmitted to the students. In terms of the formal model, $\partial f_b/\partial e_a$ may equal zero. Thus the administrator's utility maximizing effort would be unresponsive to private school access.

Third, public school enrollment may not be sensitive to proximity, expense, or quality of private schools, as public and private schools may not be substitutes. A clear example of this would be Amish schools which enroll all the local Amish children and no others (Hostetler 1980). This would be incorporated into the formal theory by dropping the assumption that Θ is distributed continuously, and in its place assume just two extreme values of Θ. In effect, public schools and private schools would not be substitutes. Thus, the second RHS term of the utility maximizing administrator effort (10′), $\partial s_b/\partial f_b$, may equal zero and be unresponsive to changes in private school access.

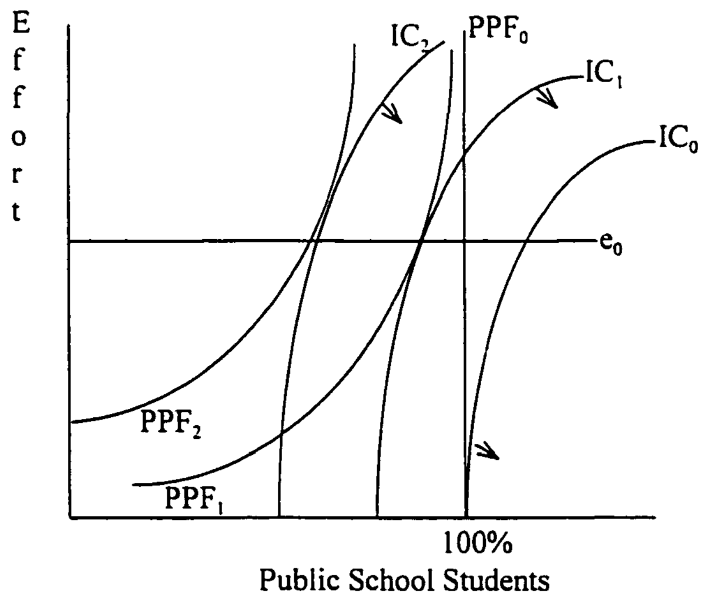
Fourth, private schools may attract students who are less responsive to school than the average student would be. Hoxby (1994), citing the US Department of Education, *Private Schools in the USA: A Statistical Profile* (Benson and McMillen 1991) pp 117-124, states that fundamentalist parents consciously sacrifice academic quality for religious or moral values. If increased access to private schools were to remove less responsive students from the public schools, public school administrators could achieve higher public school performance with less effort[9].

Fifth, administrators may not prefer more students. In a school system that is already overcrowded to the extent that large numbers of students have their classes in trailers or the schools resort to double shifts in scheduling, administrators may prefer to have some of the students leave. If funding is not perfectly correlated with enrollment, increases in enrollment could decrease funding per student (r). Decreasing per student resources could make teaching more difficult. Again, administrators may prefer fewer students. Therefore, the first term in (10′), $\partial u_a/\partial s_b$, may be zero or negative.

[9]An income effect with respect to student performance and utility.

Administrator effort may not increase with private school competition under possible institutional constraints. See Figure 3 in which PPF_0 and PPF_1 have the same meaning as in Figure 2, and PPF_2 indicates a higher level of private school competitive pressure. The PPF_2 is everywhere interior to PPF_1 due to the conclusion that decreases in access costs lead to increases in private school enrollments. If there were institutional mechanisms that enforce some minimum amount of effort from the administrator (e_0), then low levels of competitive pressure, PPF_1, would not have an effect. However, higher levels of competitive pressure, PPF_2, would increase administrator utility maximizing effort.

Figure 3. Constrained Administrator Effort



Summary

Competitive private school pressure may have a beneficial outcome for public school performance, but would not under all conditions. Of course, this theoretical result that competition increases performance arises from a particular environment. Reality may diverge from the assumptions in that environment. Several assumptions are important in modelling an improvement in public school performance from private school competition. In the absence of any of these assumptions, the current theory would not predict that the presence of private schools would improve the performance of public schools. Further, this model may overlook some important subtleties of the real world. A number of processes in the real world could lead to a failure of competitive pressure to have beneficial effects on public school performance.

1) Private schools may not be substitutes for public schools. Religious, ethnic or socioeconomic considerations may dominate all other considerations ($\partial s_b/\partial f_b=0$).
2) Private schools may enroll below average students from public schools. This would permit higher measured performance in the public schools with less effort by the public school administrator.
3) As noted in the literature review, public schools may operate efficiently without shirking by administrators. This efficiency could be driven by any of many socioeconomic forces including voting or Tiebout style selection of school districts. Likewise, the model development establishing that administrators prefer more students ($\partial u_a/\partial s_b= 0$) could fail in at least three ways.

4) Public administrators may not care about the loss of resources that comes with lower enrollments. For example, their personal income and working conditions may be independent of the resources allocated to their district.
5) Public administrators may prefer lower enrollments because it causes an increase in per-student funding where there is funding from set property taxes.
6) Public administrators may prefer lower enrollments due to school overcrowding.

Additional complexity does not resolve these problems. Consider two examples. A more sophisticated treatment of school funding may necessitate addressing the "money does not matter" empirical result, that is, changes in funding may not influence public school performance. A more complex treatment of motivation would necessitate considering that if private schools enroll the better students from public schools, it could excuse poorer performance in the public schools.

The empirical model in this work arises primarily from previous literature. The primary role of theory here is to assist in interpreting results and identifying policy relevant implications.

CHAPTER IV: EMPIRICAL APPROACH AND DATA

The model presented in chapter three describes conditions under which competition may affect public school performance, and also suggests reasons why private school competition may not affect public school performance. Thus, there is an open empirical issue as to whether private school competition impacts public school performance in particular instances. This chapter and Chapter 5 recount our investigation of such impacts in Georgia. Chapter 4 explains our general approach and data. Chapter 5 gives the specific empirical tests and results. Chapter 4 progresses through three sections. The first is a description of the general empirical model. The second describes the data and their sources. The third section explains variations in the general model which exploit the richness of the data.

Model Development

The richness of the data permits great flexibility in developing the empirical model. Two basic structures were investigated. The first is an expansion of the model used in Couch, Shughart, and Williams (1993) (CSW), as continuity with the literature, but with several modifications detailed below. The second empirical model uses lagged differences and perhaps more precisely matches the intuition that increases in competition should improve public schools. These two models are developed below.

Further, the existence of data by grade level permitted the development of empirical models with one set of data and testing it with another. This procedure avoids pretest bias and precludes the possibility that extensive specification search drives the empirical results, as noted by Newmark (1994), Couch and Shughart (1995), Chubb and Moe (1993) and Lee and Byrk (1993). Since previous studies have focused on high school results, tenth grade data serves for developing the empirical model. The model is then tested on third grade data.

The empirical model should address several issues and questions. The theory in Chapter 3 suggests that the performance of public schools may be modeled as a function of private school competition, household tastes and household income. Empirically, we address tastes with socioeconomic variables. A broad set of social and economic variables affects educational outcomes. Some of these can be readily measured or proxied, however, unobservable variables might be important. How fast does competition take effect? Which private schools may provide competition for public schools? Do public schools compete among themselves? What is the appropriate geographic level of analysis for addressing school competition? Do private schools reduce public school test scores by cream skimming the best students? The concerns are explained directly below and the means of addressing them are explained with the mathematical model or in the data section as is appropriate.

A number of socioeconomic variables have been shown to influence test scores. Test scores tend to rise with income and educational levels in the population. They tend to fall with higher poverty rates and some minority presences. Some authors maintain that level of urbanisation and school expenditures affect school performance, for example Eberts, Schwartz and Stone (1990). Existing studies have generally used these variables together with a measure of private school enrollment as explanatory variables for a concurrent measure of school performance (see for example, CSW, Hoxby 1994). The empirical model in this work expands this usual form.

A long-standing problem in empirical studies that attempt to explain student performance is the difficulty of controlling for unobservable variables that influence performance. These include factors such as family attitude toward education, whether or not parents read to young children, etc. In order to mitigate the bias introduced by the omission of these variables, we include test grades from two years and two grade levels earlier. For example, 1990 (1989-1990 academic year) third grade reading scores are regressed on 1988 first grade reading scores. Thus, the earlier scores are tests from the same students to the extent that the student body has remained constant.

Allowing private school competition to have a lagged effect is an important generalisation of the model. Consider that public schools would need time to respond to competition. Administrators allocate resources with annual budgets submitted months in advance. Changing staff takes years. Revising teaching methods and developing teaching plans is time consuming. Even appraising the level of competitive "threat" from a new rival would not be instantaneous. Therefore, it is difficult to accept that performance in a given year is a function of private school enrollment in that same year. A preferable specification is to model the performance of public schools as an explicit function of private school enrollment in previous years. This model has the advantage of avoiding endogeneity because the current year's public school performance cannot cause previous year's private school enrollment.

A possible concern is that test scores are sufficiently constant that public school performance can be anticipated years in advance. Empirically, in Georgia, the correlation coefficient for test scores over the four years between 1987 and 1991 is 0.69 for reading and 0.62 for mathematics, so people would not be able to anticipate future scores accurately. Thus, previous private school enrollment should not be endogeneous with later public school test scores.

Not all private schools serve as substitutes for public schools. As noted in the theoretical section some private schools may not serve the same students as public schools or may have significantly different missions.

If private schools represent competition for public schools, it is reasonable that neighboring public schools may also. Just as parents may choose to send their children to a private school, they may choose their residence to gain access to specific public schools. More choices arguably could lead to higher competitive pressures. The measure for public school competition is the number of schools serving the grade in question in adjoining counties.[10] Since our concern is with school district level results, one must consider competition from beyond the district. Adjoining counties were used instead of adjoining districts, as counties are the more consistent geographic unit. Martinez-Vazquez and Seaman (1985) argue since schools vary in demographics and performance even within systems, the number of schools in a school district is an appropriate measure of competition.

The information on private schools did not identify the residences of the students' families. Many Georgia city school districts are small. It is unreasonable to assume that private students resided in the public school district that happens to geographically include that private school. Counties are more consistent in size than are city school districts. In addition, in Georgia populations tend to be centrally located in counties. Counties therefore make acceptable geographic units for private school competitive

---

[10]Counties with no direct road access were excluded.

pressure. Although county level data is not precise for this measure, it is the best we can do given the data available.[11]

The model includes concurrent, grade specific, private school enrollment as a percentage of the county's student body in order to take into consideration the effect of private schools "cream skimming" the best of the public school students. Current private school enrollment is considered a measure of skimming rather than of competition for two reasons. First, competition is related to choice, hence the use of the number of private schools to measure competition. Second, complex institutions such as schools and long production processes such as education would not show immediate changes in response to competition. Of course, the use of current private school enrollment raises the issue of endogeneity. The solution is to use an instrumental variable estimator for the performance equation.

Model Specification

Our model consists of a two stage least squares estimation. The first equation predicts private school enrollment:

(13) $PRIV_{2,t}$, =

$g(PRIV_{2,t-n4}, BLK_t, COLLPCT_t, PCY_t, EXP_t,$

$DENSITY_t, TEST_{g,t-n5}, PUBCOM_{t-n6}, e_t)$.

The instrument is the lagged value of the percentage of students in private school. Other exogenous variables are included to improve the efficiency of the IV estimator.

---

[11]In model development, school district level private enrollment data covering all grades was tried. It did not result in superior fit of the data.

The equation of interest is:

$$(14)\ TEST_{g,t} = f(PRIV_{i,t-n1}, PRIV_{j,t-n2}, BLK_t, COLLPCT_t, PCY_t, CHPOV_t, EXP_t, DENSITY_t, TEST_{g-2,t-2}, PUBCOM_{t-n3}, e_t).$$

TEST is the average test score for grade level g in a school district. The score may be either reading or mathematics. Time subscripts indicate the test year (t) and lags of possibly different duration (n1, n2, ... nk).

PRIV represents private school competitive pressure. This is measured in four ways for the empirical work. $PRIV_1$ is the percentage of all students in private school based on the Census of Population and Housing, and regardless of grade.[12] $PRIV_2$ is grade specific private school enrollment as a percentage of total county enrollments in that grade. $PRIV_3$, is the number of private schools serving the grade. $PRIV_4$ is the number of private schools serving the grade as a percentage of all schools serving the grade. The use of private competition variables at the county level is explained below.

The demographic control variables are from 1990 unless otherwise noted. PCY is per capita income in 1989.[13] BLK is the percentage of residents who are black. COLLPCT is the percentage of residents older than 24 who are college graduates. EXP represents the average instructional expenditures per student. CHPOV is the percentage households with children between 5 and 18 years old that are below the poverty level. DENSITY is population density. This model adds two control variables beyond those

[12]The private school variables are given more transparent mnemonics below for use with regressions.

[13]Among the control variables, 1989 and 1990 may proxy for one another.

used by CSW: previous test scores, and public school competition documented below (PUBCOM). The random error term is e.

Data Sources

Data for this analysis come from five sources. Variable names, descriptions and descriptive statistics are in Table 1. Correlation coefficients are in Appendix A.

There are two primary sets of sources of data for measuring competition in Georgia schools districts, one for private schools and another for public schools. The first is the *Directory of Nonpublic Schools in Georgia* (GA DOE 1971-1994), a listing of every private school in Georgia organized by county or school district (varying by year) printed yearly from 1971 to the present. The Georgia Department of Education, Office of Administrative Services compiles this data from reports from each private school, which are required to verify school attendance for children of the ages at which school attendance is legally required (GA DOE 1985 in series 1971-1994). This directory includes the name, location, enrollment and grades covered for each school. Enrollment figures are restricted to in-state students. The information is detailed enough to identify boarding schools, Dependent Military Schools, and many religiously specific schools.

In order to measure potential public school competition, the number of public schools by grade was collected for all Georgia school districts and all school districts in counties adjoining Georgia. Data on the number of public schools in Georgia came from the Georgia Public Education Directory: State and Local Schools and Staff (GADOE 1985-1990) from various years. The education departments of South Carolina and Florida provided the data by facsimile. Each of the school districts that adjoin Georgia in North

Table 1.

Descriptive Statistics: Two-State Least Squares Estimation Regressions on 10th Grade

Variable	Description	Mean	Std Dev
BCOM1083	Public 10th Grades, 1983	15.47	14.64
BCOM1086	Public 10th Grades, 1986	15.50	14.83
BCOM1088	Public 10th Grades, 1988	14.88	13.57
BLACKPCT	Percent of Population that is Black	26.28	17.27
CHPOV90	Percent of households with children below poverty	17.31	7.61
COLLPCT	Percent of adults college educated	11.60	6.49
DENSITY	Population density	284.93	548.86
M1088	10th Grade math scores, 1988	322.76	4.57
M1089	10th Grade math scores, 1989	323.78	3.65
M1090	10th Grade math scores, 1990	325.58	4.34
M887	8th Grade math scores, 1987	211.70	3.95
M888	8th Grade math scores, 1988	212.90	4.28
PCINCOME	Per capita income	10679	2389
PERPRI1082	% of 10th Graders in Private School, 1982 ($PRIV_2$)	6.04	7.53
PERPRI1083	% of 10th Graders in Private School, 1983 ($PRIV_2$)	5.43	6.43
PERPRI1084	% of 10th Graders in Private School, 1984 ($PRIV_2$)	5.38	6.31
PERPRI1085	% of 10th Graders in Private School, 1985 ($PRIV_2$)	5.07	5.85
PERPRI1086	% of 10th Graders in Private School, 1986 ($PRIV_2$)	4.92	5.56
PERPRI1087	% of 10th Graders in Private School, 1987 ($PRIV_2$)	4.88	5.49
PERPRI1088	% of 10th Graders in Private School, 1988 ($PRIV_2$)	4.79	5.32
PERPRI1089	% of 10th Graders in Private School, 1989 ($PRIV_2$)	4.36	5.10
PERPRI1090	% of 10th Graders in Private School, 1990 ($PRIV_2$)	4.10	5.00

Table 1. continued

Descriptive Statistics: Two-State Least Squares Estimation Regressions on 10th Grade

Variable	Description	Mean	Std Dev
PRSCH1082	Number of Private 10th Grades, 1982	2.07	3.47
PRSCH1083	Number of Private 10th Grades, 1983	2.03	3.22
PRSCH1084	Number of Private 10th Grades, 1984	2.09	2.97
PRSCH1085	Number of Private 10th Grades, 1985	2.15	3.09
PRSCH1086	Number of Private 10th Grades, 1986	2.23	3.32
PRSCH1087	Number of Private 10th Grades, 1987	2.31	3.47
PRSCH1088	Number of Private 10th Grades, 1988	2.30	3.57
PRSCH1089	Number of Private 10th Grades, 1989	2.19	3.54
PSCHPR1083	% of 10th Grade Schools are Private, 1983	34.59	25.52
PSCHPR1086	% of 10th Grade Schools are Private, 1986	35.83	26.04
PSCHPR1088	% of 10th Grade Schools are Private, 1988	36.44	26.05
R1088	10th Grade Reading Scores, 1988	329.65	4.38
R1089	10th Grade Reading Scores, 1989	327.88	4.06
R1090	10th Grade Reading Scores, 1990	330.74	4.15
R887	8th Grade Reading Scores, 1987	207.76	4.28
R888	8th Grade Reading Scores, 1988	208.99	4.05
RIXPS88	Real Instruct. Expend. / Student, 1988	2487	283
RIXPS89	Real Instruct. Expend. / Student, 1989	2587	313
RIXPS90	Real Instruct. Expend. / Student, 1990	2669	319

Carolina and Alabama provided the numbers by telephone[14]. In most districts, the number of schools did not change during the 1980s, and about as many experienced decreases as increases.

In 1990 Georgia had 186 school districts. Twenty-seven of these were city school districts while the remainder were county districts. Five pairs of counties and one set of three counties shared their high schools. The largest school district (Dekalb County) had over 73,000 students in over 100 institutions. The smallest district (Taliaferro County) had fewer than 200 students.

The series *Georgia Student Assessment Program Official State Summary* from the Georgia Department of Education (1986-1993) provides norm referenced test scores (NRT) and criterion referenced test scores (CRT) from 1985 to the present.[15] CRT tests are scored relative to an absolute standard whereas NRT tests are scored relative to a mean. Since the standard of comparison may vary annually with NRTs (GA DOE 1986-1993), CRTs are more appropriate when comparing over time. Reading and mathematics test scores are available for each of these years. The empirical model was developed using the Basic Skills Test (BST), a CRT required for high school graduation, for the 1987-88 and following two school years. The selected model was estimated using third grade CRT scores from the same years. These tests are required of every Georgia public student in the relevant grades. Universal testing makes these tests more appropriate measures of school performance than are specialized tests given to subsets of students.

[14]These data are available from the author.

[15]Earlier years back to 1970 are available in various forms including microfiche, original reports, and an old computer database from the Georgia Department of Education and the Archives of the State of Georgia. They are also available from the author.

Additional demographic data and an independent measure of private school enrollment were obtained from the 1980 and 1990 *US Censuses of Population and Housing* (US Department of Commerce 1981 and 1991). Unpublished data from the Fiscal Policy Center, Georgia State University provided classroom instructional expenditures and full time equivalent enrollment figures.

Variations of the Model

This study uses both reading and mathematics test scores. The two are not simply different measures of educational performance, but rather potentially measure different aspects of education. Madaus *et. al.* (1979) shows that teaching effectiveness impacts mathematics more than it does other subjects. Students may read at home for entertainment and have parental role models for reading, but few people practice mathematics for fun. Therefore, mathematics arguably reflects schools' performance more directly then does reading.

The various measures of private school competitive pressure have different interpretations. The empirical measures vary on two dimensions -- grade and year -- as well as falling into the four broad classifications presented in the theoretical section, $PRIV_1$ to $PRIV_4$. Mnemonic identifiers may permit easier interpretation of results given the large number of specific measures and the subtle differences between them.

PRIVPCT ($PRIV_1$) is the percentage of the county's school enrollment attending private school, based on Census of Population and Housing data. The Census includes home schooled students in its count of private school students and counts students based upon residence. This measure combines competition at all levels, from primary to high school, and includes as potential competitors any institution that educates local children no matter how distant. CSW and Newmark (1994) use measures of private school enrollment which include all grades together. Newmark used census counts to check for robustness of CSW results that were based on enrollment data from North Carolina Department of Public Instruction records.

The variables PERPRIX82 to PERPRIX90[16] ($PRIV_2$) are based on Department of Education data and gives the grade specific percentage of Georgia resident students who attend private schools locally each year. The "X" indicates the grade level and can be 3 or 10. Thus, this measure counts as local competition only local private schools and include all Georgia resident students attending them, even students from other counties. This measure misses schools in other counties that draw away local students, but does include schools in separate school districts within a county. The primary advantage of this measure is that it can be tailored for specific grades. Since enrollment and grades served are both available for each private school. estimated enrollment for any specific grade equals the number of students in that school divided by the number of grades served by that school. Ungraded programs were considered to serve 12 grades, unless they served fewer than 48 students. Low enrollment, ungraded schools often closed within a few years and had poor reputations or were unknown to local educators[17] and were excluded from the count.

Dependent military schools and some religious schools did not draw students from the same population as public schools. Mennonite, Seventh Day Adventist, and some Orthodox Yeshivas reported that their student bodies consisted essentially of all

[16]The final digits indicate the school year.
[17]Based on informal telephone calls to schools and school district offices.

school-aged members of their denominations.[18] In order to focus more precisely on potential competitors with public schools, students attending these private schools were not included in the count of private students.

The two measures above treat competitive pressure as proportional to the number of students lost to private schools. This makes sense from the perspective of losing students and funding. One could also consider competitive pressure to arise from the number of local alternative schools. Choice is a critical element in competition. Five private schools with one 3rd grade classroom each may provide more competition to public schools then one large private school serving the same number of students. Expanding an existing school probably faces fewer barriers than opening a new one. If so, the presence of several small schools would show potential for future competition.

PRSCHX82 to PRSCHX90 ($PRIV_3$) are annual counts of the number of private schools in each county serving grade X, where "X" can be 3 or 10. PSCHPRX83, PSCHPRX86, and PSCHPRX88 ($PRIV_4$) are measures of the percentages of the county's schools serving grade X that are private, for 1983, 1986 and 1988. It is unclear whether the absolute number of schools or the relative number would be more relevant to competition. Intuitively, it seems that three private schools would provide more competitive pressure in a county with one public school as compared to a county with ten public schools. These measures also exclude dependent military schools, exclusive religious schools, and small ungraded private schools.

[18] This was established through telephone calls to the schools. Exclusive enrolment is not enforceable formal policy, but is pronounced in these cases.

Because none of these methods is unambiguously superior to the others, all were tried in the development of the empirical model, even the product of PRIV3 and PRIV4. PRIV4 arguably performed best empirically[19] with data on tenth graders.

The empirical literature and theory provide no clear guidance on the length of the lag between private schools opening, and there being an observable effect on public school test scores. Test scores were regressed on private competitive pressure lagged from one to eight years. In some variations of the model, short lags tended to yield higher t-statistic values (albeit with negative coefficients on private school competition). One interpretation of this observation is that the negative results show that households are anticipating poor public school performance a few years in advance and good students leave, compounding poor performance. To control for this possibility of cream skimming, an IV for the current, grade specific percentage of students in private school (PERPRI1090 and PERPRI390, $PRIV_2$) was added to the regression. This measure should be proportional to any effect from cream skimming provided that competitive effects are lagged at least a year. Lagged measures based upon the number of private schools (PRSCH10Y, $PRIV_3$ and PSCHPRI10Y, $PRIV_4$) represent competition and are not strongly collinear with the current percentage of students in private school (Table 2).

[19]Best in the sense that it yielded more significant results.

Table 2.

Correlation Coefficients: Current Percentage of Students in Private School with Lagged Measures of Private Schools

	PRSCH1086	PRSCH1088	PERPRI1090	PSCHPR1088	PSCHPR1086
PRSCH1086	1	0.95261	0.39796	0.38442	0.41949
	0	0.0001	0.0001	0.0001	0.0001
PRSCH1088	0.95261	1	0.39804	0.4457	0.36004
	0.0001	0	0.0001	0.0001	0.0001
PERPRI1090	0.39796	0.39804	1	0.51974	0.52542
	0.0001	0.0001	0	0.0001	0.0001
PSCHPR1088	0.38442	0.4457	0.51974	1	0.79005
	0.0001	0.0001	0.0001	0	0.0001
PSCHPR1086	0.41949	0.36004	0.52542	0.79005	1
	0.0001	0.0001	0.0001	0.0001	0

Pearson Correlation Coefficients
Prob > |R| under Ho: Rho=0
N =179

CHAPTER V: EMPIRICAL RESULTS

Chapter five progresses through three sections. The first section gives tenth grade empirical results used to refine the model. The second section applies the refined model to the third grade data and draws conclusions. Section three presents a differences version of the model including refinements using the tenth grade data set and conclusions using the third grade data. It is necessary to contrast between the initial regression and the differences regression that follows it. For convenience we refer to the initial model as the "levels" version, as it uses the numerical level of the variables rather than a difference.

Empirical Refinement

Tables 3 and 4 show the instrumental variables (IV) estimates using the model contained in equations 7 and 8 with the 10^{th} grade reading and mathematics scores and the percentage of schools that are private lagged two, four, and seven years. These are the lags for which the number of public schools serving the 10^{th} (or 3^{rd}) grade is known. Of the six regressions, two of the measures of private school presence have marginally significant coefficients. The percentage of schools that are private lagged two years was marginally significant in the reading scores equation (Table 3), and the same measure lagged four years was also marginally significant in the mathematics equation (Table 4). In five of the six regressions, the sign on the coefficient of private school presence was positive, consistent with the hypothesis of competition having beneficial effects. The two significant coefficients showed comparable magnitudes, about a one and a half point increase in public school test scores with a doubling of private school pressure. This is

Table 3.

Two-Stage Least Squares Estimation: 10th Grade Reading Scores in 1990

Dependent Variable PERPRI1090

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	32.801	23.303	1.408	
PERPRI1085	0.681	0.041	16.537	***
R1088	-0.115	0.069	-1.658	*
BLACKPCT	0.018	0.021	0.828	
COLLPCT	0.103	0.067	1.544	
PCINCOME	0.298	0.199	1.495	
CHPOV90	-0.031	0.052	-0.599	
RIXPS90	0.106	0.079	1.333	
DENSITY	-1.992	0.569	-3.504	***
BCOM1086	-0.057	0.021	-2.715	***

Dependent Variable **R1090**

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	238.533	13.668	17.452	***
PSCHPR1088	0.015	0.009	1.763	*
PERPRI1090	-0.141	0.060	-2.334	**
R888	0.439	0.064	6.865	***
BLACKPCT	-0.081	0.018	-4.5	***
COLLPCT	0.131	0.057	2.28	**
PCINCOME	0.172	0.178	0.968	
CHPOV90	0.012	0.045	0.267	
RIXPS90	-0.031	0.070	-0.442	
DENSITY	0.772	0.488	1.583	
BCOM1086	-0.025	0.019	-1.318	

Table 3. continued

Two-Stage Least Squares Estimation: 10th Grade Reading Scores in 1990

Dependent	Variable	**R1090**		
	Parameter	Standard	T for H0:	
Variable	Estimate	Error	Parameter=0	
INTERCEP	240.221	13.622	17.635	
PSCHPR1086	0.012	0.009	1.402	
PERPRI1090	-0.136	0.062	-2.189	**
R888	0.431	0.064	6.764	***
BLACKPCT	-0.081	0.018	-4.474	***
COLLPCT	0.136	0.058	2.344	**
PCINCOME	0.178	0.179	0.999	
CHPOV90	0.012	0.046	0.273	
RIXPS90	-0.035	0.070	-0.501	
DENSITY	0.765	0.491	1.559	
BCOM1086	-0.025	0.019	-1.36	

Dependent	Variable	**R1090**		
	Parameter	Standard	T for H0:	
Variable	Estimate	Error	Parameter=0	
INTERCEP	242.692	13.584	17.866	
PSCHPR1083	-0.003	0.009	-0.370	
PERPRI1090	-0.083	0.061	-1.373	
R888	0.423	0.064	6.624	***
BLACKPCT	-0.080	0.018	-4.402	***
COLLPCT	0.127	0.058	2.182	**
PCINCOME	0.213	0.000	1.193	
CHPOV90	0.002	0.179	0.050	
RIXPS90	-0.050	0.070	-0.716	
DENSITY	0.844	0.491	1.718	*
BCOM1086	-0.026	0.019	-1.397	

Note: 0.66 < adj. R^2 < 0.71, n=178.
*, **, *** significant at Prob. > |T|, 0.10, 0.05, 0.01.

Table 4.

Two-Stage Least Squares Estimation: 10^{th} Grade Mathematics Scores in 1990

Dependent Variable PERPRI1090

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	18.871	19.339	0.976	
PERPRI1085	0.677	0.042	16.257	***
M1088	-0.075	0.059	-1.277	
BLACKPCT	0.024	0.021	1.165	
COLLPCT	0.096	0.067	1.434	
PCINCOME	0.306	0.200	1.53	
CHPOV90	-0.024	0.052	-0.469	
RIXPS90	0.110	0.079	1.385	
DENSITY	-2.012	0.571	-3.525	***
BCOM1086	-0.057	0.021	-2.718	***

Dependent Variable **M1090**

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	192.420	12.421	15.492	
PSCHPR1088	0.010	0.009	1.095	
PERPRI1090	-0.102	0.064	-1.583	
M888	0.613	0.058	10.645	***
BLACKPCT	-0.057	0.020	-2.897	***
COLLPCT	0.097	0.062	1.583	
PCINCOME	0.139	0.192	0.728	
CHPOV90	0.040	0.049	0.815	
RIXPS90	0.039	0.075	0.517	
DENSITY	0.836	0.528	1.582	
BCOM1086	-0.023	0.020	-1.17	

Table 4. continued

Two-Stage Least Squares Estimation: 10th Grade Mathematics Scores in 1990

Dependent Variable **M1090**

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	191.715	12.234	15.67	
PSCHPR1086	0.018	0.009	1.923	*
PERPRI1090	-0.132	0.065	-2.029	**
M888	0.615	0.057	10.83	***
BLACKPCT	-0.056	0.019	-2.9	***
COLLPCT	0.107	0.061	1.743	*
PCINCOME	0.120	0.190	0.631	
CHPOV90	0.046	0.048	0.955	
RIXPS90	0.046	0.074	0.614	
DENSITY	0.775	0.525	1.475	
BCOM1086	-0.024	0.020	-1.187	

Dependent Variable **M1090**

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	194.644	12.294	15.833	
PSCHPR1083	0.003	0.009	0.323	
PERPRI1090	-0.078	0.064	-1.22	
M888	0.604	0.057	10.555	***
BLACKPCT	-0.058	0.020	-2.915	***
COLLPCT	0.096	0.062	1.546	
PCINCOME	0.158	0.192	0.825	
CHPOV90	0.037	0.049	0.755	
RIXPS90	0.031	0.075	0.415	
DENSITY	0.872	0.530	1.646	
BCOM1086	-0.024	0.020	-1.195	

Note: $0.64 < \text{adj. } R^2 < 0.70$, n=178
*, **, *** significant at Prob. > |T|, 0.10, 0.05, 0.01.

comparable to the normal trend increases in public school performance over two or three years. Public reading scores increased about a half a point a year on average in the late 1980s and mathematics scores increased about a point per year.

The occurrence of even marginally significant positive coefficients with two and four year lags, and not with longer lags suggests that competitive effects may be occurring after only a few years. It is reasonable that the effect would not remain for the longer lags as the number of private schools can change rapidly in Georgia counties and often the numbers are appreciably different after four years. The correlation coefficient between PRIV4 in 1988 and PRIV4 in 1984 is 0.74 for tenth grade and 0.72 for third.

The results for the control variables came out roughly as anticipated. Consider each in order.

The current percentage of 10^{th} graders in private school has a statistically significant negative coefficient, indicating cream skimming. There is potential for this coefficient to be affected by districts with low scores losing students to private schools. This simultaneity is the reason for the IV approach. With the average school district having about four percent of its tenth graders in private school, cream skimming lowers average public school reading and mathematics scores by about a half a point – a year or less of average progress.

The percentage of the population that is black has a significant negative coefficient and the coefficient on the percentage of adults who are college educated is positive and significant. Both are consistent with previous literature. Per capita income has a positive significant coefficient when college education, with which it is collinear, is excluded.

Real expenditures per student and density have weak effects, consistent with previous literature. Including density squared did not improve the performance of the model. The coefficient of the squared term was positive and insignificant, contradicting the expected effect from low central city scores.

It may be interesting informally that the control for public school competition yields negative but insignificant coefficients. A number of factors could complicate measuring the impact of public school competition. The measure we use is somewhat naive. For example, it does not consider the size of schools or their distribution across districts. Since school district boundaries limit choice between schools, districts could matter in public school competition. Also, this measure of public school competition is correlated with other variables, especially density, income and education. These may interact in a manner that masks competitive effects. Large numbers of schools may permit high levels of income segregation. If peer effects help disadvantaged students more than they harm the advantaged ones, high levels of public school choice could harm public schools as a whole. A study focusing on public school competition may be able to control for these and other complications.

Empirical Results

Most of the research to date addresses effects on performance in high school. Since education is likely to be a function of past learning, changes in teaching effort may have limited effects in high school. It may be that changing high school student's performance is profoundly difficult, whereas primary students may be more responsive to recent instructional efforts. Data matching that which was used to investigate the tenth grade above is also available for the third grade. Descriptions of the third grade data are in Table 5. Correlation coefficients are in Appendix A. A difference between the 10th and 3rd grade data sets is that there are eight more observations in the latter set. Several county school districts in Georgia share high schools; none share elementary schools.

Since the 10th grade results were encouraging only with two- and four-year lagged PSCHPR1088 and PSCHPR1086, that is the model used to test the third grade data (see Tables 6 and 7). Reading and mathematics scores were run separately as dependent variables. In each of the four cases (reading and mathematics, two and four year lags) the coefficient of interest was negative but insignificant. This does not support the hypothesis that competition from private schools improves the performance of public schools.

Most of the control variables behave the same in the third grade regressions as in the 10th grade ones. Note that for the third grade, the coefficient on expenditures is negative and significant. This suggests that school systems may be allocating resources to low performing primary schools more than with low performing high schools.

Table 5.

Descriptive Statistics: Two-Stage Least Squares Regressions for 3rd Grade Levels Model

Variable	Description	Mean	Standard Deviation
BCOM383	Public 3rd Grades Adjoing Counties 83	47.98	56.53
BCOM386	Public 3rd Grades Adjoing Counties 86	47.14	55.17
BCOM388	Public 3rd Grades Adjoing Counties 88	46.31	54.66
BSCH383	Number of Public 3rd Grades 1983	8.24	17.98
BSCH386	Number of Public 3rd Grades 1986	8.14	17.30
BSCH388	Number of Public 3rd Grades 1988	7.97	16.94
M187	1st Grade Mathematics Scores 1987	212.87	5.78
M188	1st Grade Mathematics Scores 1988	213.32	6.30
M189	1st Grade Mathematics Scores 1989	215.58	6.49
M387	3rd Grade Mathematics Scores 1987	209.09	6.38
M388	3rd Grade Mathematics Scores 1988	210.09	5.95
M389	3rd Grade Mathematics Scores 1989	211.36	6.07
M390	3rd Grade Mathematics Scores 1990	211.84	5.89
PERPRI382	% of 3rd Grade in Private School 82	4.81	6.00
PERPRI383	% of 3rd Grade in Private School 83	4.65	5.86
PERPRI384	% of 3rd Grade in Private School 84	4.53	5.58
PERPRI385	% of 3rd Grade in Private School 85	4.51	5.43
PERPRI386	% of 3rd Grade in Private School 86	4.58	5.62
PERPRI387	% of 3rd Grade in Private School 87	4.47	5.63
PERPRI388	% of 3rd Grade in Private School 88	4.43	5.44
PERPRI389	% of 3rd Grade in Private School 89	4.20	5.28
PERPRI390	% of 3rd Grade in Private School 90	4.05	5.32
PRSCH382	Number of Private 3rd Grades, 1982	2.78	6.26
PRSCH383	Number of Private 3rd Grades, 1983	2.77	5.94
PRSCH384	Number of Private 3rd Grades, 1984	3.02	6.24
PRSCH385	Number of Private 3rd Grades, 1985	2.97	6.27
PRSCH386	Number of Private 3rd Grades, 1986	3.10	6.68
PRSCH387	Number of Private 3rd Grades, 1987	3.29	7.18
PRSCH388	Number of Private 3rd Grades, 1988	3.24	6.85
PRSCH389	Number of Private 3rd Grades, 1989	3.16	6.71

Table 5. continued

Descriptive Statistics: Two-Stage Least Squares Regressions for 3rd Grade Levels Model

Variable	Description	Mean	Standard Deviation
PSCHPR382	% of 3rd Grade Schools are Private 82	23.37	19.05
PSCHPR383	% of 3rd Grade Schools are Private 83	23.25	19.58
PSCHPR384	% of 3rd Grade Schools are Private 84	24.52	19.35
PSCHPR385	% of 3rd Grade Schools are Private 85	24.08	19.11
PSCHPR386	% of 3rd Grade Schools are Private 86	24.44	19.55
PSCHPR387	% of 3rd Grade Schools are Private 87	25.04	20.96
PSCHPR388	% of 3rd Grade Schools are Private 88	25.77	19.80
PSCHPR389	% of 3rd Grade Schools are Private 89	25.35	20.09
R187	1st Grade Reading Scores 1987	212.03	6.83
R188	1st Grade Reading Scores 1988	213.15	6.98
R189	1st Grade Reading Scores 1989	214.60	7.39
R387	3rd Grade Reading Scores 1987	212.59	5.45
R388	3rd Grade Reading Scores 1988	213.62	5.37
R389	3rd Grade Reading Scores 1989	214.03	5.29
R390	3rd Grade Reading Scores 1990	215.56	5.73
RIXPS88	Real Inst. Expend./Student 88 $('90)100	24.77	2.88
RIXPS89	Real Inst. Expend./Student 89 $('90)100	25.76	2.82
RIXPS90	Real Inst. Expend./Student 90 $100	26.54	2.90

Note: n=186.

Table 6.

Two-Stage Least Squares Estimation: 3rd Grade Reading Scores in 1990

Dependent Variable PERPRI390

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	1.329	8.945	0.149	
PERPRI385	0.861	0.036	23.744	***
R388	-0.020	0.040	-0.499	
BLACKPCT	-0.006	0.017	-0.336	
COLLPCT	0.069	0.048	1.434	
PCINCOME	0.013	0.145	0.088	
CHPOV90	-0.012	0.037	-0.317	
RIXPS90	0.103	0.072	1.426	
DENSITY	0.135	0.441	0.307	
BCOM386	-0.004	0.004	-0.880	

Dependent Variable R390

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	163.663	11.237	14.565	
PSCHPR388	-0.018	0.017	-1.023	
PERPRI90	0.014	0.085	0.161	
R188	0.273	0.047	5.839	***
BLACKPCT	-0.072	0.028	-2.567	**
COLLPCT	-0.026	0.084	-0.306	
PCINCOME	0.646	0.244	2.652	***
CHPOV90	-0.129	0.065	-1.993	**
RIXPS90	-0.311	0.126	-2.463	**
DENSITY	0.065	0.777	1.369	
BCOM386	-0.004	0.008	-0.531	

Table 6. continued

Two-Stage Least Squares Estimation: 3rd Grade Reading Scores in 1990

Dependent	Variable	R390		
Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	163.041	11.241	14.504	
PSCHPR386	-0.011	0.019	-0.595	
PERPRI390	0.002	0.090	0.018	
R188	0.275	0.047	5.888	***
BLACKPCT	-0.070	0.028	-2.497	**
COLLPCT	-0.026	0.084	-0.305	
PCINCOME	0.628	0.243	2.579	**
CHPOV90	-0.136	0.066	-2.049	**
RIXPS90	-0.305	0.127	-2.391	**
DENSITY	1.081	0.781	1.384	
BCOM386	-0.004	0.008	-0.513	

Dependent	Variable	R390		
Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	163.839	11.187	14.646	
PSCHPR383	-0.027	0.018	-1.451	
PERPRI390	0.038	0.087	0.436	
R188	0.274	0.047	5.892	***
BLACKPCT	-0.067	0.028	-2.385	**
COLLPCT	-0.031	0.084	-0.374	
PCINCOME	0.642	0.242	2.647	***
CHPOV90	-0.139	0.065	-2.131	**
RIXPS90	-0.321	0.126	-2.550	**
DENSITY	1.054	0.078	1.360	
BCOM386	-0.004	0.008	-0.547	

Note: Adj. $R^2 = 0.831$ for PERPRI390 regression, and $0.560 \leq$ adj. $R^2 \leq 0.564$ for R390 regressions, n=186.
*, **, *** significant at Prob.>|T|, 0.10, 0.05, 0.01.

Table 7.

Two-Stage Least Squares Estimation: 3rd Grade Mathematics Scores in 1990

Dependent Variable PERPRI390

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	2.403	7.401	0.325	
PERPRI385	0.858	0.037	23.303	***
M388	-0.026	0.034	-0.764	
BLACKPCT	-0.006	0.016	-0.377	
COLLPCT	0.068	0.048	1.430	
PCINCOME	0.026	0.146	0.179	
CHPOV90	-0.010	0.037	-0.275	
RIXPS90	0.103	0.071	1.456	
DENSITY	0.129	0.438	0.294	
BCOM386	-0.004	0.004	-0.928	

Dependent Variable M390

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0	
INTERCEP	140.190	14.228	9.853	
PSCHPR388	-0.007	0.019	-0.383	
PERPRI390	-0.012	0.092	-0.130	
M188	0.362	0.062	5.854	***
BLACKPCT	-0.076	0.031	-2.450	**
COLLPCT	-0.029	0.091	-0.315	
PCINCOME	0.547	0.266	2.058	**
CHPOV90	-0.080	0.071	-1.139	
RIXPS90	-0.264	0.136	-1.941	*
DENSITY	0.550	0.841	0.655	
BCOM386	-0.009	0.008	-1.099	

Table 7. continued

Two-Stage Least Squares Estimation: 3rd Grade Mathematics Scores in 1990

Dependent	Variable	M390		
Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	139.966	14.184	9.868	
PSCHPR386	-0.008	0.021	-0.377	
PERPRI390	-0.008	0.098	-0.084	
M188	0.364	0.062	5.885	***
BLACKPCT	-0.075	0.031	-2.415	**
COLLPCT	-0.030	0.091	-0.325	
PCINCOME	0.540	0.265	2.038	**
CHPOV90	-0.085	0.072	-1.182	
RIXPS90	-0.266	0.137	-1.941	*
DENSITY	0.568	0.843	0.673	
BCOM386	-0.009	0.008	-1.105	

Dependent	Variable	M390		
Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	
INTERCEP	140.750	14.093	9.987	
PSCHPR383	-0.029	0.020	-1.447	
PERPRI390	0.043	0.094	0.460	
M188	0.364	0.061	5.933	***
BLACKPCT	-0.071	0.031	-2.296	**
COLLPCT	-0.038	0.091	-0.413	
PCINCOME	0.556	0.263	2.109	**
CHPOV90	-0.091	0.071	-1.290	
RIXPS90	-0.290	0.135	-2.141	**
DENSITY	0.549	0.835	0.657	
BCOM386	-0.010	0.008	-1.165	

Note: Adj. $R^2 = 0.832$ for PERPRI390 regression, and $0.511 \leq$ adj. $R^2 \leq 0.517$ for M390 regressions, n=186.
*, **, *** significant at Prob. > |T|, 0.10, 0.05, 0.01.

Differences Model

The idea being tested in this dissertation is that an increase in private school competitive pressure leads to an increase in public school performance. Ordinary least square (OLS) regressions on differences models permit direct translation of the idea into mathematical form where literal historic changes in private school competition are related to changes in public school performance. The differences approach provides the advantage of controlling for all stable unobservable variables. It likewise has the disadvantage of exaggerating the effects of any unstable unobservable variables. Descriptive statistics for the data used with this model are in Table 8.

Unlike usual first differences models, this model uses differences over varying lengths of time. Census data necessitates decade long differences. The use of decenteniel census data implicitly assumes that changes in census variables follow long trends. That is, that the change in census variables from 1980 to 1990 is correlated with the change in those variables between 1988 and 1990, the period over which the variables of interest change. First differences in test scores between consecutive pairs of years had negative correlations. For example, the difference in reading scores between 1988 and 1989 correlates with the difference between 1989 and 1990 at –0.35. The correlation between the same years for mathematics is –0.09. This negative correlation indicates that annual variations contain a relatively large stochastic element. We used two-year differences in test scores to reduce the impact of this annual variation. A longer difference would have decreased the impact of annual random variation even more.

Table 8.

Descriptive Statistics: 10th Grade Differences Model

Variable	Description	Mean	Std Dev
DR1090-88	Change in 10th Grade Reading scores '88 to 90	1.056	3.087
DM1090-88	Change in 10th Grade Math scores '88-90	2.808	3.803
DR1088-86	Change in 10th Grade Reading scores '86 to 88	0.045	3.389
DM1088-86	Change in 10th Grade Math scores '86 to 88	1.853	4.013
DR888-86	Change in 8th Grade Reading scores '86 to 88	2.140	3.406
DM888-86	Change in 8th Grade Math scores '86 to 88	3.945	3.600
DPCINCOM	Change, per capita income '80 to 90 in $1000	5.286	1.547
DCHPOV	Change, child poverty rate '80 to 90	-3.003	4.372
DCOLLPCT	Change, % college educated '80 to 90	2.060	2.448
DBLACKPCT	Change, % black '80 to 90	-0.509	3.897
DPVST1090-88	Change % 10th grade students in private school'88 to 90	-0.688	2.021
DPVST1088-86	Change % 10th grade students in private school'86 to 88	-0.104	1.877
DPVST1085-82	Change % 10th grade students in private school'82 to 85	-0.977	3.631
DPSHV1088-86	Change in % of schools with 10th grade that are private '86 to 88	0.663	16.909
DPSHV1085-82	Change in % of schools with 10th grade that are private '82 to 85	0.708	14.991
DBCOM1088-86	Change in public 10th grades in adjoining counties, '86 to 88	-0.627	1.584
DBCOM1086-83	Change in public 10th grades in adjoining counties, '83 to 86	0.028	0.764

Note: Number of observations is 177, all observations used in estimations. One system used in the levels approach did not have a high school for all the years used in the differences approach. Variables addressing change in schools are included for comparison to levels approach.

However, a relatively short time span was important in order to permit a short lag measure of private school competition. Differences in instructional expenditures and in the percentage of students in private school must match the two-year changes in test scores to control for their immediate impact. Competition variables have two multiyear lags, one recent and one older to permit flexibility of results.

Model Development

The differences model follows the levels model in using simultaneous private school enrollment to control for cream skimming. Therefore, the differences model must also be estimated in two stages. As with the levels model, we used the 10th grade data set to pursue an extensive search of potential specifications for the differences model.

We began the search using differences of all variables in the levels model. The first stage (equation 15) estimates the change between 1988 and 1990 in 10th grade private school students expressed as a percentage of all 10th grade students. The general form of the regression estimates this change in private students as a function of lagged changes in private school enrollments, recent changes in public school performance, changes in socioeconomic variables, and recent changes in public school competition. The estimated change in private school students correlates at 0.402 with the actual measure.

$$(15)\quad DPVST1088\_90 = f(DPRIV_{i,t-n1}, DTEST_{t-n2}, \mathbf{X}_t, DBCOM_{t-n3}, e_t),$$

where i=2,3 or 4; D represents the difference operator; and n1, n2, n3 are lags; and **X** is socioeconomic controls.

The second stage estimates (equation 16) changes between 1988 and 1990 in public school 10th grade reading and mathematics test scores. This change in test scores is estimated as a function of predicted simultaneous change in private students from the first stage, changes in private school competition, trends in socioeconomic variables and test scores, and lagged changes in public school competition and performance. Also, the controls include cohort effects by including lagged changes in test scores between the same sets of students two years earlier. For example, changes in tenth grade reading scores between 1988 and 1990 were regressed upon changes in eighth grade reading scores between 1986 and 1988. The second stage of the differences model was estimated using the three grade-specific measures of private school competition. This model may be written:

$$(16)\quad DTEST10_t = f(DPRIV_{i,t-n1},\ DPRIV_{2,t},\ \mathbf{X}_t,\ DBCOM_{t-n2},\ DTEST8_{t-2},\ DTEST10_{t-n3},\ e_t),$$

where D represents the difference operator; TEST10 refers to 10th grade scores; TEST8 refers to 8th grade scores; i=2,3 or 4; n1, n2 are lags; **X** is socioeconomic controls, and *e* is an error term.

The exploratory stage with tenth grade data involved literally hundreds of variations of the model. Approximately one twentieth of the coefficients on private school competition were significant at the five percent level, and about half of those were positive. No apparent pattern emerged in these results. For example, the difference between reading scores for two years regressed on the change of the number of private schools between two past years may have resulted in a significant positive coefficient. However, those results would not hold with the difference between math scores for the same two years, or with reading differenced between the preceding two years. Various lags and ranges of differences in private school competition did not reveal any pattern. One might expect that short lags (less than five years for example) might tend to be significant and longer lags less significant, or *vice versa*. No such pattern emerged.

One form of these regressions did however result in a positive and at least marginally significant[20] relationship between changes in both reading and mathematics scores regressed upon changes in private school competition. These results are presented in Table 9.

Several features of this model stand out. In the first stage, only previous changes in private school enrollment have strong explanatory value. The second stage has several interesting features, several of which are contrary to previous argument. Effects are apparently stronger on reading scores than on mathematics. It is measures of private school enrollments rather than of private schools themselves that show the apparent competitive effect. The coefficient for cream skimming is large, significant and positive. Also, competition from public schools shows a negative effect.

Some of the effects appear to be more reasonable. The cohort effects from earlier changes in test scores for the same students (DR8868 or DM8868) are positive and significant. These results are strong and robust across variations in the model. This result means that there are persistent differences between successive classes of students. These persistent differences between classes should incorporate any socioeconomic trends to the degree that those trends affect test scores. Therefore, the socioeconomic

[20]Significant only in that the t statistic is greater than two. The specification search precludes using "statistically significant" in a literal sense.

Table 9.

Two Stage Least Squares Estimation: 10th Grade Differences In Test Scores 1988-1990

Dependent Variable: DPVST1090-88
Adj R-squared 0.142

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEP	-0.383	0.682	-0.561
DPVST1088-86	-0.222	0.080	-2.781 ***
DPVST1085-82	0.223	0.041	5.434 ***
DR1088-86	-0.097	0.073	-1.325
DM1088-86	0.034	0.061	0.552
DPCINCOM	-0.014	0.150	-0.093
DCHPOV	0.011	0.033	0.327
DCOLLPCT	0.009	0.092	0.096
DBLKPCT	-0.007	0.038	-0.186
DBCOM1088-86	0.133	0.107	1.241

Dependent Variable: **DR1090-88**
Adj R-squared 0.254

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEP	2.969	0.517	5.737
DPVST1088-86	1.592	0.238	6.676 ***
DPVST1085-82	-1.421	0.224	-6.344 ***
DPVST1090-88	6.037	0.970	6.226 ***
DBCOM1088-86	-0.911	0.179	-5.097 ***
DBCOM1086-83	0.140	0.258	0.542
DR888-86	0.284	0.059	4.838 ***
DR1087-86	0.171	0.071	2.406 *

Dependent Variable: **DM1090-88**
Adj R-squared 0.247

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEP	1.700	0.607	2.801
DPVST1088-86	0.499	0.288	1.733 *
DPVST1085-82	-0.444	0.266	-1.671 *
DPVST1090-88	1.804	1.147	1.572
DBCOM1088-86	-0.384	0.221	-1.737 *
DBCOM1086-83	0.285	0.331	0.860
DM888-86	0.469	0.071	6.594 ***
DM1087-86	-0.138	0.080	-1.718 *

*, **, *** significant at Prob. > |T|, 0.10, 0.05, 0.01.

controls may be excluded from the model without meaningful reduction in explanatory value. Indeed, when the lagged results for the same students are included in the model, none of the socioeconomic controls yield consistent effects. Further, excluding the socioeconomic controls increased the adjusted R squared statistic with reading scores and decreased it with mathematics scores.

The most intriguing aspect of this version of the model is that short-term private school competitive pressure has an apparent significant and positive effect on public school reading test scores, and a marginally significant positive effect on mathematics scores. This version is therefore appropriate to use with third grade data to test the hypothesis that private school competition improves the performance of public schools.

One could be tempted to conclude that the results of the difference models severely undermine the hypothesis of private competition benefiting public schools. This is erroneous even beyond the obvious point that the statistical tests were not designed to reject primary hypothesis. Consider the results for the control variables. Only one of the control variables consistently yield significant coefficients of the anticipated sign. It would be reasonable to conclude that the results show variation in unobserved variables. Differences models may exaggerate such variation. Thus, these results do not clearly undermine the hypothesis that private school competition effects public schools.

Third Grade Results

It may be that the unobserved variables affect tenth grade scores more than third grade scores. Tenth grade students have a longer time to be affected by unobserved variables. Thus, regressions on third grade data are warranted.

We used the differences model on third grade data as a second formal test of the hypothesis that private school competition improves the performance of public schools. Variable definitions and descriptive statistics parallel those for the tenth grade data and are in Table 10. Correlation coefficients are in Appendix A. Both the descriptive statistics and the correlations are broadly consistent between the tenth and third grade data sets. Application of the model developed with the tenth grade data to the third grade data should not be problematic. The results of the estimation using differences in the third grade data are shown in Table 11. The results are entirely consistent with the null hypothesis that public school performance does not respond to competitive pressure from private schools.

Summary

Neither the levels approach nor the differences approach, support the hypothesis that private school competition improves public school performance as measured by student exam results. Models were constructed that yielded positive and significant coefficients for the competition variables on tenth grade exam results. However, these results are not robust when the models are applied to a different student exam, a different examination year, or to third grade student exams.

The only variable that has a significant effect on test scores is the cohort effect, and then only for reading. Differences in performance that exist in the first grade relate strongly to differences in reading, but are not strongly linked to differences in performance in mathematics. By the tenth grade, cohort effects are strong in both fields. Comparing results for reading and mathematics between third and tenth grade suggests that mathematics scores may be more sensitive to school performance than are reading

Table 10.

Descriptive Statistics: 3rd Grade Differences Model

Variable	Description	Mean	Std Dev
DR390-88	Change in 3rd Grade Reading scores '88 to 90	1.941	3.648
DM390-88	Change in 3rd Grade Math scores '88-90	1.750	4.447
DR388-86	Change in 3rd Grade Reading scores '86 to 88	1.888	4.503
DM388-86	Change in 3rd Grade Math scores '86 to 88	2.178	5.589
DR387-86	Change in 3rd Grade Reading scores '86 to 87	0.860	3.951
DM387-86	Change in 3rd Grade Math scores '86 to 87	1.185	4.895
DR188-86	Change in 8th Grade Reading scores '86 to 88	4.156	5.288
DM188-86	Change in 8th Grade Math scores '86 to 88	4.406	4.416
DPCINCOM	Change, per capita income '80 to 90 in thousands	5.222	1.571
DCHPOV	Change, child poverty rate '80 to 90	-3.177	4.541
DCOLLPCT	Change, % college educated '80 to 90	2.015	2.426
DBLACKPCT	Change, % black '80 to 90	-0.515	3.895
DPVST390-88	Change % 3rd grade students in private school'88 to 90	-0.381	1.642
DPVST388-86	Change % 3rd grade students in private school'86 to 88	-0.150	1.410
DPVST385-82	Change % 3rd grade students in private school'82 to 85	-0.308	2.293
DPSHV388-86	Change in % of schools with 3rd grade that are private '86 to 88	1.324	14.036
DPSHV385-82	Change in % of schools with 3rd grade that are private '82 to 85	0.705	11.079
DBCOM388-86	Change in public 3rd grades in adjoining counties, '86 to 88	-0.833	1.680
DBCOM386-83	Change in public 3rd grades in adjoining counties, '83 to 86	-0.839	2.460

Note: Number of observations is 186, all observations used in estimations. Statistics for variables shared with the 10th grade model differ because no school districts share primary schools and some share high schools. Variables addressing change in schools are included for comparison to levels approach.

Table 11.

Two Stage Least Squares Differences Estimation: 3rd Grade Scores Regressed on Change in Student Enrollments

Dependent Variable: DPVST390-88
Adj R-squared 0.042

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEPT	-0.122	0.520	-0.234
DPVST388-86	-0.316	0.086	-3.694 ***
DPVST385-82	-0.062	0.054	-1.145
DR388-86	0.010	0.041	0.237
DM388-86	-0.020	0.034	-0.584
DPCINCOM	-0.080	0.113	-0.706
DCHPOV	0.008	0.027	0.307
DCOLLPCT	0.081	0.074	1.094
DBLKPCT	-0.003	0.031	-0.095
DBCOM388-86	0.039	0.072	0.386

Dependent Variable: DR390-88
Adj R-squared 0.103

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEPT	1.916	0.827	2.316
DPVST388-86	0.424	0.569	0.745
DPVST385-82	-0.010	0.155	-0.064
DPVST390-88	1.929	1.734	1.112
DBCOM388-86	0.176	0.207	0.847
DBCOM386-83	-0.167	0.139	-1.203
DR188-86	0.211	0.048	4.367 ***
DR387-86	-0.062	0.067	-0.923

Dependent Variable: DM390-88
Adj R-squared 0.126

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEP	2.579	1.130	2.282
DPVST388-86	0.540	0.774	0.697
DPVST385-82	0.063	0.197	0.317
DPVST390-88	2.941	2.365	1.244
DBCOM388-86	0.143	0.264	0.543
DBCOM386-83	-0.087	0.178	-0.488
DM188-86	0.110	0.074	1.481
DM387-86	-0.038	0.076	-0.500

Note: n=186.
*, **, *** Significant at Prob. > |T|, 0.10, 0.05, 0.01.

scores since cohort differences in the latter are apparently well established by the first year of formal education.

In order to provide direct continuity with the levels approach, we also performed a two-stage least squares estimation using third grade data and using percentage changes in the number of private schools serving third grade as the measure of competitive pressure. These results are shown in Table 12, and are also consistent with the null hypothesis.

Table 12.

Two Stage Least Squares Estimation: 3rd Grade Differences in Test Scores 1988-1990 Regressed on Changes in Private Schools

First stage is shown in Table 11.

Dependent Variable: **DR390-88**
Adj R-squared 0.126

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEPT	1.352	0.407	3.325
DPSHV388-86	-0.027	0.020	-1.404
DPSHV385-82	0.036	0.023	1.548
DPSHV390-88	0.607	0.549	1.106
DBCOM388-86	0.171	0.202	0.844
DBCOM386-83	-0.154	0.137	-1.121
DR188-86	0.219	0.048	4.593 ***
DR387-86	-0.078	0.065	-1.209

Dependent Variable: **DM390-88**
Adj R-squared 0.026

Variable	Parameter Estimate	Standard Error	T for H_0: Parameter=0
INTERCEPT	1.906	0.554	3.443
DPSHV388-86	0.016	0.025	0.653
DPSHV385-82	0.050	0.030	1.683 *
DPSHV390-88	1.602	0.713	2.245 **
DBCOM388-86	0.147	0.260	0.564
DBCOM386-83	-0.074	0.177	-0.421
DM188-86	0.123	0.073	1.672 *
DM387-86	-0.071	0.068	-1.051

Note: n=186
*, **, *** Significant at Prob. > |T|, 0.10, 0.05, 0.01.

CHAPTER VI: CONCLUSIONS

Summary

Based on the results of this study, the presence of private schools did not improve the performance of public schools in Georgia in the late 1980s. Although statistical investigation cannot confirm a null hypothesis, the investigation here was sufficiently intensive and broad that the author is confidant that a meaningful benefit from private schools would have been detected had it been present.

This conclusion leads to the question of why an effect would be present on the national level as shown by Hoxby (1994), but absent in this state. A number of possibilities exist based upon the results of the theoretical work above. Overcrowding in Georgia schools could have lead to a negative marginal valuation of students by the public school systems. Too few private schools may have served as effective substitutes of public schools given the specialized missions of many of Georgia's private schools. Perhaps, private school competition is simply too low, and greater levels of competition would have stronger effects, even on the margin.

There is another, empirical, reason that our results differ from Hoxby's (1994) results. Hoxby's primary explanatory variable is the percentage of the local population that is Roman Catholic. The Southeast has a relatively low density of Catholics. However, even by regional standards, Georgia has few Catholics. Only nine of its 159 counties have a population that is over five percent Catholic, and none have over ten percent. The populations of seventy counties are less than one percent Catholic (Glenmary Research Center 1992). If the difference between the results is driven by this demographic difference, there are interesting implications. Hoxby's results may not generalize to private schools, but may apply only to Catholic schools (and the other well established religious systems she addresses).

Policy Implications

Evidence from Georgia suggests that private school competition will not improve public school performance. Hoxby's (1994) nation wide study shows there are benefits. The contract between these two works, in the light of the theory developed above, provides important insights. Catholic schools are close substitutes for public schools in that they function like neighborhood schools in many ways. They have ethnically and economically diverse student bodies, and tend to have strong academic programs. Also, Catholic school student bodies are not restricted to Catholics, but compared to many other religious schools, are diverse religiously (Hoxby 1994). Many of Georgia's private schools serve racially, religiously, or economically specific groups or have academic programs specifically designated to exclude instruction on evolution or human reproduction. One would not expect such schools to be effective substitutes for public schools. It is also hard to imagine how a public school might respond competitively to them given Constitutional constraints.

Currently there are no publicly available measures of student performance in Georgia's private schools.[21] It is unlikely that encouraging academically poor private schools would prompt an improvement in public schools. Any program that governments may institute to encourage private schools may result in aiding schools that perform worse than public schools and do not even have the level of information access and

[21]Verified by telephone conversation with the Georgia Accrediting Commission, Inc., Athens, Georgia.

oversight of public schools. This would neither necessarily provide a net social gain, nor provide a competitive force to improve the academic performance of public schools.

Alternatively, there may not be enough private schools in Georgia to prompt a competitive response. As Newmark (1994) notes, one would not necessarily expect a monopolist with 90 percent of a market to behave much differently than a monopolist with 100 percent. If this were the case, perhaps vouchers or charters could increase the competition and prove beneficial. There may be regions of the USA where Catholic schools are dense enough to trigger a competitive response in public schools. It would be interesting to apply Hoxby's model to various regions within the USA to investigate potential regional variation.

Charter schools are relatively autonomous public schools that operate under school-specific charters. Thus, they have the potential of combining public oversight and known performance measures with local control and flexibility. However, currently, charter schools serve a specialized function distinct from most public schools – discipline. Most charter schools are currently chartered to provide a strong disciplinary structure for at-risk students (RPP International and University of Minnesota 1997). Therefore, we would not expect charter schools to trigger a competitive response in other public schools, although they may remove enough difficult students that the performance of those who remain in traditional public schools may improve.

Although it is beyond the scope of this project, one may note that the coefficient of private school competition on public school performance was often negative and occasionally "significant". This suggests that private school presence harms public schools, perhaps by removing high performing students who serve as roll models for others.

Policies to promote private schools in order to prompt public schools to improve their performance must be tailored to fit that agenda. Merely increasing the level of competition from private schools, as envisioned for example by Friedman and Friedman (1979), would not improve public school performance in all environments.

Extensions and Future Work

This work could be extended in a number of ways. It would be interesting to apply this method to charter schools when there are sufficient numbers of them and enough time has passed to suggest a competitive effect may be present. Charter schools have not been a strong presence long enough to effect public schools at an aggregate level (see RPP International and University of Minnesota 1997). Arizona already has a large number of charter schools. In a few years. lagged effects may have occurred and the method in this thesis could be applied there.

Perhaps some countries or regions have higher levels of competition from private schools. Informal observation of Victoria, Australia shows a different relationship between public and private schools than was found in Georgia. Victoria has a higher number of private schools relative to its population, public school enrollment is decreasing in many areas, and public school administrators speak about changing policies and personnel in response to the presence of private schools.

Private schools do not always exert a competitive force on public schools. Our challenge is to find and harness the conditions under which competition benefits public schools.

Appendix A: Tables of Correlation Coefficients

Appendix A1

Correlation Coefficients for 10th Grade Levels

	BCOM1086	R888	M888	R1090	M1090	PCINCOME	BLACKPCT
BCOM1086	1	0.31913	0.28944	0.33842	0.30828	0.6707	-0.22258
	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0027
	179	178	178	178	178	179	179
R888	0.31913	1	0.86478	0.74952	0.69977	0.53223	-0.56463
	0.0001	0	0.0001	0.0001	0.0001	0.0001	0.0001
	178	178	178	178	178	178	178
M888	0.28944	0.86478	1	0.67499	0.77356	0.46999	-0.50085
	0.0001	0.0001	0	0.0001	0.0001	0.0001	0.0001
	178	178	178	178	178	178	178
R1090	0.33842	0.74952	0.67499	1	0.8603	0.57583	-0.62007
	0.0001	0.0001	0.0001	0	0.0001	0.0001	0.0001
	178	178	178	178	178	178	178
M1090	0.30828	0.69977	0.77356	0.8603	1	0.51267	-0.50148
	0.0001	0.0001	0.0001	0.0001	0	0.0001	0.0001
	178	178	178	178	178	178	178
PCINCOME	0.6707	0.53223	0.46999	0.57583	0.51267	1	-0.36754
	0.0001	0.0001	0.0001	0.0001	0.0001	0	0.0001
	179	178	178	178	178	179	179

Appendix A1 continued

	BCOM1086	R888	M888	R1090	M1090	PCINCOME	BLACKPCT
BLACKPCT	-0.22258	-0.56463	-0.50085	-0.62007	-0.50148	-0.36754	1
	0.0027	0.0001	0.0001	0.0001	0.0001	0.0001	0
	179	178	178	178	178	179	179
COLLPCT	0.50125	0.35608	0.31171	0.42367	0.40061	0.77215	-0.02053
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.785
	179	178	178	178	178	179	179
DENSITY	0.49289	0.16823	0.18212	0.23266	0.2724	0.44719	0.15313
	0.0001	0.0248	0.015	0.0018	0.0002	0.0001	0.0407
	179	178	178	178	178	179	179
CHPOV90	-0.4327	-0.58953	-0.47615	-0.59853	-0.45789	-0.61879	0.74247
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	179	178	178	178	178	179	179
PERPRI90	-0.02805	-0.21726	-0.1446	-0.21162	-0.15403	0.14153	0.32947
	0.7094	0.0036	0.0541	0.0046	0.0401	0.0588	0.0001
	179	178	178	178	178	179	179
PERPRI385	0.10745	-0.17165	-0.12528	-0.15606	-0.09997	0.16737	0.34635
	0.1523	0.022	0.0957	0.0375	0.1843	0.0251	0.0001
	179	178	178	178	178	179	179
RIXPS90	0.31429	-0.08354	0.00255	-0.03934	0.06739	0.25288	0.2284
	0.0001	0.2676	0.9731	0.6021	0.3714	0.0006	0.0021
	179	178	178	178	178	179	179

Appendix A1 continued

	COLLPCT	DENSITY	CHPOV90	PERPRI1090	PERPRI1085	RIXPS90
BCOM1086	0.50125	0.49289	-0.4327	-0.02805	0.10745	0.31429
	0.0001	0.0001	0.0001	0.7094	0.1523	0.0001
	179	179	179	179	179	179
R888	0.35608	0.16823	-0.58953	-0.21726	-0.17165	-0.08354
R888	0.0001	0.0248	0.0001	0.0036	0.022	0.2676
	178	178	178	178	178	178
M888	0.31171	0.18212	-0.47615	-0.1446	-0.12528	0.00255
M888	0.0001	0.015	0.0001	0.0541	0.0957	0.9731
	178	178	178	178	178	178
R1090	0.42367	0.23266	-0.59853	-0.21162	-0.15606	-0.03934
R1090	0.0001	0.0018	0.0001	0.0046	0.0375	0.6021
	178	178	178	178	178	178
M1090	0.40061	0.2724	-0.45789	-0.15403	-0.09997	0.06739
M1090	0.0001	0.0002	0.0001	0.0401	0.1843	0.3714
	178	178	178	178	178	178
PCINCOME	0.77215	0.44719	-0.61879	0.14153	0.16737	0.25288
	0.0001	0.0001	0.0001	0.0588	0.0251	0.0006
	179	179	179	179	179	179

Appendix A1 continued

	COLLPCT	DENSITY	CHPOV90	PERPRI1090	PERPRI1085	RIXPS90
BLACKPCT	-0.02053	0.15313	0.74247	0.32947	0.34635	0.2284
	0.785	0.0407	0.0001	0.0001	0.0001	0.0021
	179	179	179	179	179	179
COLLPCT	1	0.65559	-0.28554	0.29593	0.34769	0.40784
	0	0.0001	0.0001	0.0001	0.0001	0.0001
	179	179	179	179	179	179
DENSITY	0.65559	1	-0.00582	0.17528	0.37908	0.43938
	0.0001	0	0.9384	0.0189	0.0001	0.0001
	179	179	179	179	179	179
CHPOV90	-0.28554	-0.00582	1	0.13099	0.14001	0.17558
	0.0001	0.9384	0	0.0805	0.0616	0.0187
	179	179	179	179	179	179
PERPRI1090	0.29593	0.17528	0.13099	1	0.80908	0.23082
	0.0001	0.0189	0.0805	0	0.0001	0.0019
	179	179	179	179	179	179
PERPRI1085	0.34769	0.37908	0.14001	0.80908	1	0.2612
	0.0001	0.0001	0.0616	0.0001	0	0.0004
	179	179	179	179	179	179
RIXPS90	0.40784	0.43938	0.17558	0.23082	0.2612	1
	0.0001	0.0001	0.0187	0.0019	0.0004	0
	179	179	179	179	179	179

Pearson Correlation Coefficients
Prob > |R| under Ho: Rho=0

Appendix A2

Correlation Coefficients for 3rd Grade Levels

	BCOM386	R188	M188	R390	M390
BCOM386	1	0.19525	0.29969	0.32301	0.24778
	0	0.0076	0.0001	0.0001	0.0007
R188	0.19525	1	0.88655	0.58225	0.5502
R188	0.0076	0	0.0001	0.0001	0.0001
M188	0.29969	0.88655	1	0.64561	0.63684
M188	0.0001	0.0001	0	0.0001	0.0001
R390	0.32301	0.58225	0.64561	1	0.92415
R390	0.0001	0.0001	0.0001	0	0.0001
M390	0.24778	0.5502	0.63684	0.92415	1
M390	0.0007	0.0001	0.0001	0.0001	0

Appendix A2 continued

	BCOM386	R188	M188	R390	M390
PCINCOME	0.67423	0.29366	0.41362	0.50577	0.43322
	0.0001	0.0001	0.0001	0.0001	0.0001
BLACKPCT	-0.26854	-0.38981	-0.53424	-0.59268	-0.59798
	0.0002	0.0001	0.0001	0.0001	0.0001
COLLPCT	0.49963	0.20399	0.25172	0.2646	0.19069
	0.0001	0.0052	0.0005	0.0003	0.0091
DENSITY	0.49404	0.18554	0.18201	0.14376	0.06399
	0.0001	0.0112	0.0129	0.0503	0.3856
CHPOV90	-0.44131	-0.35396	-0.4908	-0.60901	-0.56529
	0.0001	0.0001	0.0001	0.0001	0.0001
PERPRI390	0.06183	-0.19013	-0.20596	-0.13667	-0.16025
	0.4018	0.0093	0.0048	0.0629	0.0289
PERPRI385	0.02404	-0.20701	-0.23799	-0.17285	-0.20318
	0.7447	0.0046	0.0011	0.0183	0.0054
PSCHPR388	-0.02114	-0.10115	-0.10232	-0.05615	-0.05144
	0.7746	0.1695	0.1646	0.4465	0.4856
PSCHPR386	-0.03116	-0.05136	-0.05074	-0.00481	-0.01952
	0.6729	0.4863	0.4916	0.9481	0.7915
RIXPS90	0.38365	-0.08192	-0.03135	-0.12976	-0.14765
	0.0001	0.2663	0.671	0.0775	0.0443

Appendix A2 continued

	PCINCOME	BLACKPCT	COLLPCT	DENSITY	CHPOV90
BCOM386	0.67423	-0.26854	0.49963	0.49404	-0.44131
	0.0001	0.0002	0.0001	0.0001	0.0001
R188	0.29366	-0.38981	0.20399	0.18554	-0.35396
R188	0.0001	0.0001	0.0052	0.0112	0.0001
M188	0.41362	-0.53424	0.25172	0.18201	-0.4908
M188	0.0001	0.0001	0.0005	0.0129	0.0001
R390	0.50577	-0.59268	0.2646	0.14376	-0.60901
R390	0.0001	0.0001	0.0003	0.0503	0.0001
M390	0.43322	-0.59798	0.19069	0.06399	-0.56529
M390	0.0001	0.0001	0.0091	0.3856	0.0001

Appendix A2 continued

	PCINCOME	BLACKPCT	COLLPCT	DENSITY	CHPOV90
PCINCOME	1	-0.38975	0.73856	0.45084	-0.60188
	0	0.0001	0.0001	0.0001	0.0001
BLACKPCT	-0.38975	1	-0.04346	0.1239	0.74279
	0.0001	0	0.5559	0.092	0.0001
COLLPCT	0.73856	-0.04346	1	0.65135	-0.29618
	0.0001	0.5559	0	0.0001	0.0001
DENSITY	0.45084	0.1239	0.65135	1	-0.02212
	0.0001	0.092	0.0001	0	0.7644
CHPOV90	-0.60188	0.74279	-0.29618	-0.02212	1
	0.0001	0.0001	0.0001	0.7644	0
PERPRI390	0.21377	0.36265	0.36445	0.25633	0.09985
	0.0034	0.0001	0.0001	0.0004	0.1751
PERPRI385	0.16286	0.41676	0.29601	0.20776	0.14407
	0.0263	0.0001	0.0001	0.0044	0.0498
PSCHPR388	0.15683	0.12292	0.16425	0.07337	-0.02771
	0.0325	0.0946	0.0251	0.3197	0.7073
PSCHPR386	0.14755	0.12723	0.16265	0.08534	-0.09914
	0.0445	0.0835	0.0265	0.2468	0.1782
RIXPS90	0.29677	0.16926	0.49247	0.49623	0.08793
	0.0001	0.0209	0.0001	0.0001	0.2327

Appendix A2 continued

	PERPRI390	PERPRI385	PSCHPR388	PSCHPR386	RIXPS90
BCOM386	0.06183	0.02404	-0.02114	-0.03116	0.38365
	0.4018	0.7447	0.7746	0.6729	0.0001
R188	-0.19013	-0.20701	-0.10115	-0.05136	-0.08192
R188	0.0093	0.0046	0.1695	0.4863	0.2663
M188	-0.20596	-0.23799	-0.10232	-0.05074	-0.03135
M188	0.0048	0.0011	0.1646	0.4916	0.671
R390	-0.13667	-0.17285	-0.05615	-0.00481	-0.12976
R390	0.0629	0.0183	0.4465	0.9481	0.0775
M390	-0.16025	-0.20318	-0.05144	-0.01952	-0.14765
M390	0.0289	0.0054	0.4856	0.7915	0.0443

Appendix A2 continued

	PERPRI390	PERPRI385	PSCHPR388	PSCHPR386	RIXPS90
PCINCOME	0.21377	0.16286	0.15683	0.14755	0.29677
	0.0034	0.0263	0.0325	0.0445	0.0001
BLACKPCT	0.36265	0.41676	0.12292	0.12723	0.16926
	0.0001	0.0001	0.0946	0.0835	0.0209
COLLPCT	0.36445	0.29601	0.16425	0.16265	0.49247
	0.0001	0.0001	0.0251	0.0265	0.0001
DENSITY	0.25633	0.20776	0.07337	0.08534	0.49623
	0.0004	0.0044	0.3197	0.2468	0.0001
CHPOV90	0.09985	0.14407	-0.02771	-0.09914	0.08793
	0.1751	0.0498	0.7073	0.1782	0.2327
PERPRI390	1	0.90921	0.51698	0.51225	0.21786
	0	0.0001	0.0001	0.0001	0.0028
PERPRI385	0.90921	1	0.55045	0.60589	0.14888
	0.0001	0	0.0001	0.0001	0.0426
PSCHPR388	0.51698	0.55045	1	0.74557	-0.05523
	0.0001	0.0001	0	0.0001	0.454
PSCHPR386	0.51225	0.60589	0.74557	1	-0.09982
	0.0001	0.0001	0.0001	0	0.1753
RIXPS90	0.21786	0.14888	-0.05523	-0.09982	1
	0.0028	0.0426	0.454	0.1753	0

Pearson Correlation Coefficients
Prob > |R| under Ho: Rho=0
N = 186

Appendix A3

Correlation Coefficients for Variables in 10th Grade Differences

	DPVST 90-88	DPVST 88-86	DPVST 85-82	DR10 90-88	DM10 90-88	DR10 88-86	DM10 88-86	DPCY	DCHPOV
DPVST 1090-88	1.000	-0.082	0.358	0.011	-0.051	-0.095	-0.065	-0.123	0.031
	-	0.275	0.000	0.889	0.503	0.207	0.389	0.104	0.680
DPVST 1088-86	-0.082	1.000	0.255	0.165	0.081	-0.094	-0.084	0.057	-0.018
	0.275	-	0.001	0.028	0.287	0.212	0.269	0.448	0.813
DPVST 1085-82	0.358	0.255	1.000	-0.080	-0.101	-0.021	-0.060	-0.134	-0.020
	0.000	0.001	-	0.290	0.181	0.781	0.430	0.076	0.787
DR1090-88	0.011	0.165	-0.080	1.000	0.765	-0.459	-0.390	0.100	0.023
	0.889	0.028	0.290	-	0.000	0.000	0.000	0.187	0.758
DM1090-88	-0.051	0.081	-0.101	0.765	1.000	-0.322	-0.433	0.068	0.087
	0.503	0.287	0.181	0.000	-	0.000	0.000	0.367	0.251
DR1088-86	-0.095	-0.094	-0.021	-0.459	-0.322	1.000	0.811	0.044	-0.085
	0.207	0.212	0.781	0.000	0.000	-	0.000	0.557	0.260
DM1088-86	-0.065	-0.084	-0.060	-0.390	-0.433	0.811	1.000	0.036	-0.010
	0.389	0.269	0.430	0.000	0.000	0.000	-	0.639	0.900
DPCINCOM	-0.123	0.057	-0.134	0.100	0.068	0.044	0.036	1.000	0.036
	0.104	0.448	0.076	0.187	0.367	0.557	0.639	-	0.634
DCHPOV	0.031	-0.018	-0.020	0.023	0.087	-0.085	-0.010	0.036	1.000
	0.680	0.813	0.787	0.758	0.251	0.260	0.900	0.634	-
DCOLLPCT	-0.108	-0.030	-0.137	0.085	0.110	0.107	0.033	0.760	-0.036
	0.151	0.692	0.069	0.261	0.147	0.156	0.661	0.000	0.633
DBLKPCT	0.010	-0.019	0.099	-0.134	-0.077	0.005	-0.012	0.020	0.153
	0.891	0.800	0.191	0.075	0.307	0.952	0.869	0.795	0.042
DBCOM 1088-86	0.127	0.124	0.112	-0.044	-0.071	0.030	0.060	-0.482	0.018
	0.092	0.101	0.139	0.562	0.347	0.695	0.430	0.000	0.813
DBCOM 1086-83	-0.111	-0.004	-0.088	0.149	0.131	-0.053	0.018	0.376	0.068
	0.142	0.956	0.243	0.048	0.083	0.482	0.812	0.000	0.372
DR888-86	0.004	0.067	-0.067	0.400	0.356	-0.038	0.074	0.171	0.075
	0.959	0.378	0.378	0.000	0.000	0.616	0.325	0.023	0.324
DM888-86	0.006	0.062	-0.130	0.330	0.475	-0.045	0.016	0.121	0.144
	0.936	0.409	0.084	0.000	0.000	0.554	0.834	0.108	0.056
DR1087-86	0.058	-0.076	0.045	-0.085	-0.093	0.608	0.514	0.054	-0.092
	0.440	0.313	0.556	0.262	0.221	0.000	0.000	0.472	0.225
DM1087-86	0.029	-0.110	0.012	-0.096	-0.169	0.575	0.653	0.048	-0.048
	0.697	0.145	0.870	0.202	0.025	0.000	0.000	0.522	0.524

Appendix A3 continued

	DCOLLPCT	DBLKPCT	DBCOM108 8-86	DBCOM 86-83	DR8 88-86	DM8 88-86	DR10 87-86	DM10 87-86
DPVST 1090-88	-0.108	0.010	0.127	-0.111	0.004	0.006	0.058	0.029
	0.151	0.891	0.092	0.142	0.959	0.936	0.440	0.697
DPVST 1088-86	-0.030	-0.019	0.124	-0.004	0.067	0.062	-0.076	-0.110
	0.692	0.800	0.101	0.956	0.378	0.409	0.313	0.145
DPVST 1085-82	-0.137	0.099	0.112	-0.088	-0.067	-0.130	0.045	0.012
	0.069	0.191	0.139	0.243	0.378	0.084	0.556	0.870
DR1090-88	0.085	-0.134	-0.044	0.149	0.400	0.330	-0.085	-0.096
	0.261	0.075	0.562	0.048	0.000	0.000	0.262	0.202
DM1090-88	0.110	-0.077	-0.071	0.131	0.356	0.475	-0.093	-0.169
	0.147	0.307	0.347	0.083	0.000	0.000	0.221	0.025
DR1088-86	0.107	0.005	0.030	-0.053	-0.038	-0.045	0.608	0.575
	0.156	0.952	0.695	0.482	0.616	0.554	0.000	0.000
DM1088-86	0.033	-0.012	0.060	0.018	0.074	0.016	0.514	0.653
	0.661	0.869	0.430	0.812	0.325	0.834	0.000	0.000
DPCINCOM	0.760	0.020	-0.482	0.376	0.171	0.121	0.054	0.048
	0.000	0.795	0.000	0.000	0.023	0.108	0.472	0.522
DCHPOV	-0.036	0.153	0.018	0.068	0.075	0.144	-0.092	-0.048
	0.633	0.042	0.813	0.372	0.324	0.056	0.225	0.524
DCOLLPCT	1.000	0.045	-0.435	0.175	0.093	0.072	0.117	0.138
	-	0.555	0.000	0.020	0.219	0.340	0.120	0.068
DBLKPCT	0.045	1.000	-0.209	0.012	-0.167	-0.147	0.068	0.042
	0.555	-	0.005	0.870	0.027	0.051	0.368	0.575
DBCOM 1088-86	-0.435	-0.209	1.000	-0.056	-0.006	-0.048	-0.032	-0.070
	0.000	0.005	-	0.462	0.934	0.528	0.676	0.354
DBCOM 1086-83	0.175	0.012	-0.056	1.000	0.218	0.142	-0.003	0.037
	0.020	0.870	0.462	-	0.003	0.060	0.971	0.624
DR8868	0.093	-0.167	-0.006	0.218	1.000	0.757	0.035	0.096
	0.219	0.027	0.934	0.003	-	0.000	0.642	0.206
DM8868	0.072	-0.147	-0.048	0.142	0.757	1.000	-0.018	0.010
	0.340	0.051	0.528	0.060	0.000	-	0.815	0.896
DR1087-86	0.117	0.068	-0.032	-0.003	0.035	-0.018	1.000	0.822
	0.120	0.368	0.676	0.971	0.642	0.815	-	0.000
DM1087-86	0.138	0.042	-0.070	0.037	0.096	0.010	0.822	1.000
	0.068	0.575	0.354	0.624	0.206	0.896	0.000	-

Note: n=177, all observations used in regressions.

Appendix A4

Correlation Coefficients for 3rd Grade Differences Model

	DPVST 390-8	DPVST 388-86	DPVST 388-85	DPSHV 388-86	DPSHV 385-83	DR3 90_88	DM3 90_88	DR3 88-86	DM3 88-86
DPVST390-88	1.000	-0.269	-0.104	-0.008	-0.008	0.069	0.138	-0.001	-0.047
	-	0.000	0.158	0.917	0.916	0.349	0.060	0.985	0.528
DPVST388-86	-0.269	1.000	0.058	0.388	-0.009	-0.058	-0.110	-0.084	-0.029
	0.000	-	0.429	0.000	0.900	0.429	0.135	0.256	0.692
DPVST388-85	-0.104	0.058	1.000	-0.001	0.263	-0.115	-0.086	-0.042	0.137
	0.158	0.429	-	0.993	0.000	0.118	0.243	0.571	0.063
DPSHV388-86	-0.008	0.388	-0.001	1.000	-0.201	-0.164	-0.039	0.019	0.001
	0.917	0.000	0.993	-	0.006	0.025	0.597	0.794	0.988
DPSHV385-83	-0.008	-0.009	0.263	-0.201	1.000	0.110	0.095	-0.011	0.039
	0.916	0.900	0.000	0.006	-	0.136	0.196	0.884	0.594
DR390_88	0.069	-0.058	-0.115	-0.164	0.110	1.000	0.770	-0.399	-0.377
	0.349	0.429	0.118	0.025	0.136	-	0.000	0.000	0.000
DM390_88	0.138	-0.110	-0.086	-0.039	0.095	0.770	1.000	-0.318	-0.424
	0.060	0.135	0.243	0.597	0.196	0.000	-	0.000	0.000
DR388-86	-0.001	-0.084	-0.042	0.019	-0.011	-0.399	-0.318	1.000	0.747
	0.985	0.256	0.571	0.794	0.884	0.000	0.000	-	0.000
DM388-86	-0.047	-0.029	0.137	0.001	0.039	-0.377	-0.424	0.747	1.000
	0.528	0.692	0.063	0.988	0.594	0.000	0.000	0.000	-
DPCINCOM	-0.035	0.132	0.029	0.038	0.136	0.051	-0.018	0.067	0.142
	0.631	0.072	0.695	0.602	0.063	0.488	0.803	0.363	0.053
DCHPOV	-0.006	0.057	0.098	0.077	-0.079	-0.065	-0.141	-0.046	-0.050
	0.930	0.441	0.184	0.294	0.284	0.375	0.055	0.533	0.502
DCOLLPCT	0.011	0.117	0.085	0.048	0.169	-0.004	-0.071	0.038	0.142
	0.882	0.113	0.248	0.513	0.021	0.961	0.334	0.609	0.053
DBLKPCT	-0.014	0.033	0.076	0.073	-0.021	-0.089	-0.121	0.046	-0.010
	0.848	0.654	0.301	0.325	0.772	0.228	0.099	0.537	0.890
DBCOM388-86	-0.003	0.092	-0.039	-0.032	0.025	0.049	0.043	-0.096	-0.037
	0.966	0.212	0.600	0.661	0.739	0.506	0.557	0.194	0.612
DBCOM386-86	0.037	0.044	-0.040	-0.017	-0.026	-0.034	-0.001	-0.055	-0.060
	0.615	0.555	0.590	0.815	0.720	0.645	0.993	0.452	0.419
DR188-86	0.010	0.018	-0.087	-0.016	-0.055	0.325	0.258	-0.085	-0.103
	0.888	0.808	0.237	0.825	0.456	0.000	0.000	0.247	0.162
DM188-86	0.026	0.037	-0.047	-0.015	-0.058	0.243	0.119	-0.049	0.055
	0.728	0.617	0.526	0.842	0.428	0.001	0.107	0.507	0.453
DR387-86	-0.037	-0.060	0.041	0.033	0.058	-0.108	-0.072	0.698	0.470
	0.614	0.419	0.581	0.652	0.431	0.141	0.327	0.000	0.000
DM387-86	-0.098	-0.055	0.245	0.032	0.100	-0.150	-0.095	0.495	0.668
	0.182	0.457	0.001	0.666	0.173	0.041	0.196	0.000	0.000

Appendix A4 continued

	DPCINCO	DCHPOV	DCOLLPC	DBLKPCT	DBCOM	DBCOM	DR1	DM1	DR3	DM3
DPVST3	-0.035	-0.006	0.011	-0.014	-0.003	0.037	0.010	0.026	-0.037	-0.098
90-88	0.631	0.930	0.882	0.848	0.966	0.615	0.888	0.728	0.614	0.182
DPVST3	0.132	0.057	0.117	0.033	0.092	0.044	0.018	0.037	-0.060	-0.055
88-86	0.072	0.441	0.113	0.654	0.212	0.555	0.808	0.617	0.419	0.457
DPVST3	0.029	0.098	0.085	0.076	-0.039	-0.040	-0.087	-0.047	0.041	0.245
88-85	0.695	0.184	0.248	0.301	0.600	0.590	0.237	0.526	0.581	0.001
DPSHV3	0.038	0.077	0.048	0.073	-0.032	-0.017	-0.016	-0.015	0.033	0.032
88-86	0.602	0.294	0.513	0.325	0.661	0.815	0.825	0.842	0.652	0.666
DPSHV3	0.136	-0.079	0.169	-0.021	0.025	-0.026	-0.055	-0.058	0.058	0.100
85-83	0.063	0.284	0.021	0.772	0.739	0.720	0.456	0.428	0.431	0.173
DR390-88	0.051	-0.065	-0.004	-0.089	0.049	-0.034	0.325	0.243	-0.108	-0.150
	0.488	0.375	0.961	0.228	0.506	0.645	0.000	0.001	0.141	0.041
DM390-88	-0.018	-0.141	-0.071	-0.121	0.043	-0.001	0.258	0.119	-0.072	-0.095
	0.803	0.055	0.334	0.099	0.557	0.993	0.000	0.107	0.327	0.196
DR388-86	0.067	-0.046	0.038	0.046	-0.096	-0.055	-0.085	-0.049	0.698	0.495
	0.363	0.533	0.609	0.537	0.194	0.452	0.247	0.507	0.000	0.000
DM388-86	0.142	-0.050	0.142	-0.010	-0.037	-0.060	-0.103	0.055	0.470	0.668
	0.053	0.502	0.053	0.890	0.612	0.419	0.162	0.453	0.000	0.000
DPCINCOM	1.000	0.039	0.740	0.018	-0.073	-0.202	0.017	0.207	0.043	0.086
	-	0.601	0.000	0.811	0.325	0.006	0.820	0.005	0.563	0.243
DCHPOV	0.039	1.000	-0.021	0.146	-0.027	-0.005	-0.038	0.055	-0.112	-0.115
	0.601	-	0.779	0.047	0.715	0.948	0.608	0.455	0.129	0.119
DCOLLPCT	0.740	-0.021	1.000	0.057	-0.129	-0.224	0.004	0.209	0.002	0.051
	0.000	0.779	-	0.440	0.079	0.002	0.957	0.004	0.974	0.486
DBLKPCT	0.018	0.146	0.057	1.000	-0.079	-0.091	-0.063	-0.060	0.082	-0.009
	0.811	0.047	0.440	-	0.283	0.219	0.394	0.416	0.263	0.904
DBCOM3	-0.073	-0.027	-0.129	-0.079	1.000	0.667	0.067	0.041	-0.155	-0.137
88-86	0.325	0.715	0.079	0.283	-	0.000	0.366	0.576	0.035	0.062
DBCOM3	-0.202	-0.005	-0.224	-0.091	0.667	1.000	0.025	-0.017	-0.114	-0.108
86-86	0.006	0.948	0.002	0.219	0.000	-	0.733	0.815	0.120	0.141
DR188-86	0.017	-0.038	0.004	-0.063	0.067	0.025	1.000	0.707	-0.074	-0.070
	0.820	0.608	0.957	0.394	0.366	0.733	-	0.000	0.313	0.344
DM188-86	0.207	0.055	0.209	-0.060	0.041	-0.017	0.707	1.000	-0.063	-0.015
	0.005	0.455	0.004	0.416	0.576	0.815	0.000	-	0.396	0.841
R387-86	0.043	-0.112	0.002	0.082	-0.155	-0.114	-0.074	-0.063	1.000	0.691
	0.563	0.129	0.974	0.263	0.035	0.120	0.313	0.396	-	0.000
M387-86	0.086	-0.115	0.051	-0.009	-0.137	-0.108	-0.070	-0.015	0.691	1.000
	0.243	0.119	0.486	0.904	0.062	0.141	0.344	0.841	0.000	-

Note: n=186.

BIBLIOGRAPHY

Adams, Francis (1875). *The Free School System of the United States*. Chapman and Hall: London.

Alves, M. J. and Willie, C. V. (1987). Controlled choice assignments: A new and more effective approach to school desegregation. *The Urban Review, 19(2)*, 67-88.

Aronson, J. R. and Munley, V. G. (1996). (Non)equivalence in a federalism, duel tax shares, flypaper effects and Leviathan. *Public Choice 89(1-2).*

Atlanta Business Chronicle (1999). September 10-16, p35A.

Ben-Akiva, M. E. and Lerman, S. R. (1985). *Discrete choice analysis: Theory and application to travel demand.* Cambridge, Mass: MIT.

Benson, P. and McMillen, M. M. (1991). *Private Schools in the United States: A Statistical Profile, with Comparisons to Public Schools.* US Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics, Washington DC: US Government Printing Office.

Borland, M.V. and Howsen, R.M. (1996). Competition, expenditures and student performance in mathematics; A comment on Couch et al. *Public Choice 87*, 395-400.

Boyd, W. L. and Walberg, H. J. (1990). *Choice in Education: Potential and Problems.* McCutchan: Berkeley, California.

Brennan, G. and Buchanan, J. (1977). Toward a tax constitution for leviathan. *Journal of Public Economics* v8, pp 255-273.

Brennan, G. and Buchanan, J. (1978). Tax instruments as constraints on the disposition of public revenues. *Journal of Public Economics* v9, pp 301-318.

Brennan, G. and Buchanan, J. (1980). *The Power to Tax: Analytical Foundations of a Fiscal Constitution.* Cambridge University: Cambridge.

Breton, A. (1996). *Competitive Governments: An Economic Theory of Politics and Public Finance*. Cambridge University: Cambridge.

Chubb, J. E. and Moe, T. M. (1990). *Politics, Markets and America's Schools.* Brookings Institution: Washington DC.

Chubb, J. E. and Moe, T. M. (1993). The forest and the trees: A response to our critics. in *School Choice: Examining the Evidence*, eds Edith Rasel and Richard Rothstein, Economic Policy Institute: Washington D.C.

Couch, J. F., Shughart W. F. II, and Williams, A. L. (1993). Private school enrollment and public school performance. *Public Choice* 76, pp 301-312.

Couch, J. F. and Shughart W. F. II (1995). Private school enrollment and public school performance: Reply. *Public Choice* 82, pp 375-379.

David, E. M. (1994). Blurring the color line: The desegregation of the Baltimore City public schools. *The Urban Review* 26:4.

Duncombe, W. and Yinger, J. (1997). Why is it so hard to help central city schools? *Journal of Policy Analysis and Management* 16:1, pp 85-113.

Eberts, R.W., Schwartz, E.K. and Stone, J.A. (1990). School reform, school size, and student achievement. *Federal Reserve Bank of Cleveland Economic Review* 26 (Quarter 2):2-15.

Edwards, J. and Keen, M. (1996). Tax competition and Leviathan. *European Economic Review* 40(1).

Findlay, R. and Douglas, J. (1993). The political economy of Leviathan. in *Trade, Development and the Political Economy*, ed. Ronald Findlay. Edward Elgar: Brookfield, VT.

Forbes, K. F. and Zampelli, E. M. (1989). Is Leviathan a mythical beast? in *The American Economic Review* 79:3 pp 568-577.

Friedman, M. (1955). The role of government in education. in *Economics and the Public Interest*, ed. R. Solo. Rutgers University: New York.

Friedman, M. with Friedman, R. D. (1962). *Capitalism and Freedom*, University of Chicago: Chicago.

Friedman, M. and Friedman, R. D. (1979). *Free to Choose: A Personal Statement* , Avon: New York.

Geertz, J. F. (1981). Centralization and government budget size. *Publius*, winter 11, pp 119-128.

Gerstner, L. V. Jr., Semerad, R. D., Doyle, D. P., and Johnson, W. B. (1994). *Reinventing Education: Entreprenership in America's Public Schools*. Dutton: New York.

Georgia Department of Education (1971-1994). *Unofficial Information on Non-Public Schools in Georgia Submitted to the State Department of Education*, (continued as *Directory of Non-Public Schools in Georgia* in 1984), Publications and Information Services, General Support Division, Office of Administrative Services, Georgia Department of Education, Atlanta.

Georgia Department of Education (1985-1990). *Georgia Public Education: State and Local Schools and Staff.* Publications and Information Services, General Support Division, Office of Administrative Services, Georgia Department of Education, Atlanta.

Georgia Department of Education (1986-1993). *Georgia Student Assessment Program Official State Summary.* Publications and Information Services, General Support Division, Office of Administrative Services, Georgia Department of Education, Atlanta.

Glenmary Research Center (1992). *Catholic Percent of Total Population by Counties of the United States: 1990*. Glenmary Reserch Center: Nashville, TN.

Gould, S. J. (1981). *The Mismeasure of Man*, Norton: New York.

Hassel, B. C. (1999). *The Charter School Challenge: Avoiding the Pitfalls, Fulfilling the Promise*. Brookings :Washington DC.

Hostetler, J. A. (1980). *Amish Society*, Johns Hopkins University Press: Baltimore.

Hoxby, C. M. (1994). *Do Private Schools Provide Competition For Public Schools*. NBER Working Paper Series No. 4978, NBER: Cambridge, Massachusetts.

Hoxby, C. M. (1996). The effects of private school vouchers on schools and students. In *Holding Schools Accountable: Performance-Based Reform in Education*. Brookings Institution: Washington DC.

Hoxby, C. M. (1998). The economics of school reform. *NBER Reporter* Spring 1998: 6-12.

Hoxby, C. M. (forthcoming). Does competition among public schools benefit students and taxpayers? *American Economic Review*. Previously published as NBER Working Paper Series No. 4979 (1994), NBER: Cambridge, Massachusetts.

Kronholz, J. (1999). Ohio school vouchers are struck down, But proponents hail ruling as victory. *Wall Street Journal*, May 28.

Lee, V. E. and Byrk, A. S. (1993). Science or policy argument: A review of the quantitative evidence in Chubb and Moe's *Politics, Markets, and American Schools*. and Science or policy argument? A rejoiner to Chubb and Moe. in *School Choice: Examining the Evidence*, eds Edith Rasel and Richard Rothstein, Economic Policy Institute: Washington D.C.

Lieberman, M. (1990). *Public School Choice: Current Issues/Future Prospects*. Technomic: Lancaster, Pennsylvania.

Madaus, G.F., Kellaghan, T., Rakow, E.A., and King, D.J. (1979). The sensitivity of measures of school effectiveness. *Harvard Education Review* 49 (June): 207-230.

Martinez-Vazquez, J., and Seaman, B. A. (1985). Private schooling and the Tiebout hypothesis. *Public Finance Quarterly* 13:3 pp. 293-318.

Moe, T. M. (1984). The new economic organization. *American Journal of Political Science* 28, pp 739-772.

Moore, D. and Davenport, S. (1990). School choice: The new improved sorting machine. In *Choice in Education* eds William Boyd and Herbert Walberg. McCutchan: Berkeley.

Musgrave, R. (1981). Leviathan cometh -- or does he? In *Tax and Expenditure Limitations* eds. H. Ladd and T.N. Tideman. COUPE Papers on Public Economics, 5, Washington D.C.: Urban Institute, pp 77-120.

Nelson, M. A. (1987). Searching for Leviathan: Comment and extension. in *The American Economic Review* 77:1 pp 198-204.

Newmark, C. M. (1994). Another look at whether private schools influence public school quality: Comment. *Public Choice* 82 pp. 365-373.

Oates, W. E. (1985). Searching for Leviathan: An empirical study. in *The American Economic Review* 75:4, pp 748-757.

Oates, W. E. (1989). Searching for Leviathan: A reply and some further reflections. in *The American Economic Review* 79:3, pp 578-583.

Olson, M. Jr. (1996). Distinguished lecture on economics in government: Large bills left on the sidewalk. *Journal of Economic Perspectives* 10(2), pp 3-24.

O'Neill, N. K., Mathis, D. A., and Hullender L. (1996). *Models for School Reform*. Research Atlanta: Atlanta.

Rouse, C. E. and McLaughlin M. (1998). *Can the Invisible Hand Improve Education? A Review of Competition and School Efficiency.* Working paper for the Commission on Behavioral and Social Sciences and Education at the National Academy of Sciences.

RPP International and the University of Minnesota (1997). *A Case Study of Charter Schools: First Year Report*, U.S. Department of Education, Office of Educational Research and Improvement: Washington D.C.

Santerre, R. E. and Bates, L. J. (1991). Leviathan or median voter: Who runs city hall? *Eastern Economic Journal* 17(1).

(1996). Performance and pay in the public sector: The case of the local tax assessor. *Public Finance Quarterly* 24:4 pp 481-493.

Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of Political Economy*, 64: 416-424.

US Department of Commerce (1981). *US Census of Population and Housing1980, Summary Tape File 3A, Georgia.* Bureau of the Census, Washington, DC.

US Department of Commerce (1991). US Census of Population and Housing 1990, Summary Tape File 3A, Georgia. Bureau of the Census, Washington, DC.

Williamson, O. E. (1985). *The Economic Institutions of Capitalism.* Free Press: New York.

Young, T. W. and Clinchy, E. (1992). *Choice in Public Education.* Teacher's College: New York.

Zax, J. S. (1989). Is there a Leviathan in your neighborhood? *The American Economic Review* 79, 3 pp 560-567.

Zax, J. S. (1989). The effects of jurisdiction types and numbers on local public finance. In *Fiscal Federalism: Quantitative Studies* ed. Harvey S. Rosen. University of Chicago: Chicago.

VITA

Christopher Roman Geller is a product of mostly public schooling, primarily in North Carolina. His parents and siblings attended a wide range of schools including private boarding, parochial, and public schools; both urban and rural; in the American South, East, Midwest, and two foreign countries. He has attended and taught in public and private colleges, and tutored in public and religious schools. He is now visiting public and private schools in the process of deciding where his son should attend when he begins school next year.

Chris was born on Moody Air Force Base in south Georgia on the sixteenth of September 1959. He began school in the private American School in Izmir, Turkey. He completed primary and secondary education in public North Carolina schools, finishing at East Carteret High School. He received his Bachelor of Arts with departmental and general honors and his Master of Arts, both in Anthropology at the University of Georgia. He then pursued two additional years of graduate studies in anthropology at Washington University in Saint Louis. After five years of employment with the Department of Family and Children's Services in Atlanta, he returned to school to earn his Ph.D. in economics from Georgia State University.

During his period with the Department of Family and Children's Services, he evaluated households for eligibility for the Food Stamp program and provided support services for welfare recipients to attend school. He has also worked broadly in construction, hospitality, and commercial fishing. He taught anthropology through the University College at Washington University. He has taught economics at Morehouse College, Georgia State University, and Kennesaw State University, all in metropolitan

Atlanta Georgia. Currently, he is lecturing in economics at Deakin University, and may be contacted at the School of Economics, Faculty of Business and Law, Deakin University, Geelong, VIC, Australia, 3217: email cgeller@deakin.edu.au.

In addition to investigating competition between private and public schools, Chris has pursued several academic interests. He has co-authored a book chapter on racial attitudes and perceptions in Atlanta. He has presented papers on welfare reform, household responses to income uncertainty, returns to education for "truly disadvantaged" students, and voting and electoral power.