Parental Pressure and Private School Competition: An Empirical Analysis of the Determinants of Public School Quality*

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Abstract

In the light of policy interest in measures to improve public school performance, this paper studies the effects of collective parental pressure and competition from private schools on public school quality. It sets out a new empirical model for understanding school quality determination which makes explicit the inter-connections among public school quality setting, parental pressure, and private school competition. Estimates of the model using an extensive new data set provide the first empirical evidence on the relative impacts of competition and parental pressure on school quality, and on the strength of interactions between them in the education production process. The findings indicate that once the decision of parents to become involved in school affairs is endogenized, parental pressure has a positive and significant effect on public school quality. In contrast, greater private school competition has a negative or insignificant direct impact on public school performance across a wide variety of specifications, a finding which undermines the view that positive productivity effects of competition will necessarily prevail. The paper also provides some evidence that parental pressure and competition are substitutes in the production of school quality, identifying a new channel through which competition affects public school performance.

1 Introduction

In the light of recent policy interest, this paper examines the role that incentives play in the determination of public school performance. It makes two related contributions.

First, the paper provides a new empirical framework for understanding public school quality determination, allowing incentives to affect school conduct. Previous research investigating the education production process has either ignored producer incentives entirely or, more recently, has emphasized increasing competition from public or private schools as a means of raising public school productivity. This work draws attention to an additional source of influence on school conduct, namely parental pressure working through parent-teacher organizations; where parents are mobilized, the notion is that it becomes more difficult for public schools to pursue objectives at odds with those of parents, leading to higher performance. The empirical model makes explicit how parental pressure, competition from private schools, and public school behavior are inter-related.

The paper's second contribution is empirical. Estimates of the model using an extensive new data set provide the first evidence on the relative impacts of parental pressure and competition on public school performance, and of the extent to which competition and parental pressure are complements or substitutes in the education production process, controlling for a host of other factors. As such, the estimates help resolve theoretical ambiguities relating to the effects of competition - whether competition has a direct positive or negative effect on school productivity, and whether competition reinforces or undermines parental pressure.[1]

The results indicate that once the decision of parents to become involved in school affairs is endogenized, parental pressure has a positive and significant effect on public school quality, thus serving as an important channel through which parents influence school performance. In contrast, greater ease of access to private school has a negative or insignificant impact on student achievement across a wide variety of specifications. This finding undermines the view that positive productivity effects of competition on public schools will overwhelm any adverse sorting effects.[2] While the direct effect of competition on school quality appears muted, the analysis draws attention to a new, indirect, channel through which competition affects school conduct, via its impact on parental pressure; I present some evidence indicating that pressure

[1] In some circumstances, increased competition may have the perverse effect of *reducing* public school productivity (and thus quality). This occurs when consumer heterogeneity makes it worthwhile for public schools to serve just the 'low-quality' portion of the market as competition increases (see McMillan (1998a)). Competition may also have an indirect (and adverse) effect on public school performance when it undermines parental pressure significantly (as in McMillan (1997)), though it is conceivable that by providing a credible exit option, competition may reinforce parental pressure.

[2] The current analysis of the effects of competition cannot distinguish productivity effects from sorting effects. In order to do this, sorting between public and private schools needs to be modeled explicitly, as discussed in Section 7.

and competition are substitutes in the education production process, with stronger competition weakening the positive impact of parental pressure on school quality.

The paper is organized as follows. The rest of this section discusses policy motivation for this work, as well as prior theoretical and empirical research in the area - both policy concerns and the related literature prompt a series of questions addressed in the analysis. Section 2 provides an overview of the empirical model, and Section 3 sets out the model out in detail. The data used to estimate the model are discussed in Section 4; the results are presented and interpreted in Section 5; and Section 6 considers extensions and next steps. The final section concludes.

Motivation

Motivation for this research comes from the current policy debate over public school reform and the prior education literature, including related theory work (see McMillan (1997, 1998a)).

Education reform occupies a position high on the policy agenda, not least because of widespread concern about public school quality.[3] According to a popular view, the root cause of the quality problem lies in the failure of public schools to use resources productively,[4] and with the same resources but stronger incentives, it is argued that public schools could provide higher quality education. One prominent type of reform emphasizes the external discipline of the market through increased competition, with competition proponents claiming that greater parental choice will force public schools to use resources more effectively by making them compete for enrollment (through the introduction of private school vouchers or open enrollment programs, for instance). A second type emphasizes internal discipline through greater managerial oversight and increased parental involvement, intended to make the public education system serve the interests of parents rather than bureaucrats or teachers;[5] examples here include extending site-based management and increasing the number of charter schools.[6] In the absence of large-scale experimentation, we know little about either the probable gains that would result from these two types of reform, or whether they would be complementary or not. This research sheds some light on these issues.

[3] For example: "A new CNN/Gallup poll finds that 53 per cent of Americans are dissatisfied with their local schools. Among inner-city parents, the numbers go even higher. Every survey shows that the quality of schools is the number one concern" (Wall Street Journal editorial, January 19, 1998).

[4] In the words of Caroline Hoxby (1996), "The current predicament of school finance is a failure of productivity rather than a failure of spending."

[5] Other reforms aim to foster a different type of parental involvement: parental support of the educational enterprise through parental actions in the home - supervising homework, for instance. In the empirical analysis, I provide measures of the impact of such activities on student achievement.

[6] Charter schools also serve to increase choice among public schools.

1.1 Prior Literature

Gaps in the prior literature also help motivate the analysis. The literature provides an incomplete picture of the mechanisms by which stronger incentives and better outcomes are linked; and our grasp of the precise effects of parents and parental involvement on schooling outcomes is also imperfect.

1.1.1 Family Background

A large body of research in the education production function literature indicates that family background characteristics exert a significant impact on student outcomes.[7] When a variety of controls for parental characteristics, such as parental income and education levels, are included in education production functions, these controls are invariably highly significant and explain a substantial portion of the variation in student outcomes. Yet this literature sheds less light on the important channels of causation from parents to schooling outcomes.[8] A number of possible channels can be identified:

- Children benefit simply from parental *type* - inherent ability, education, income etc.
- Children may also benefit from parental actions in the home - help with homework, for example.[9]
- Parents may provide volunteer time or money to help improve school quality, as a supplement to existing school resources.
- Characteristics of people living in the local community may also affect children's performance and the conduct of the school by reinforcing norms which, for example, favor academic excellence.
- School quality may be affected by collective parental pressure on school providers. This type of action has obvious spillovers, as one parent's actions can raise the quality of

[7] See Hanushek's influential (1986) survey. This also documents the finding that measured school inputs, such as class size and spending per pupil, have little systematic effect on student performance, with pessimistic implications for education policy. However, some recent work challenges this finding - see Ferguson and Ladd (1996), for example. [Note here the conclusions from recent research (Hanushek, Kain, and Rivkin): impact of school inputs positive but small.]

[8] In addition, the standard approach in the education production function literature fails to allow for the possibility that there is non-random sorting by households across schools on the basis of unobservable school or household characteristics, a possibility which makes separating the effects of school and family challenging. See Bayer (1999) for a thorough empirical analysis.

[9] Recent work has emphasized the role of parental actions in the home, showing how changes in school inputs induce changes in parental activities. See Houtenville (1996), for instance.

education provided to others.[10]

The current analysis focuses on the last of these - parental pressure - though it does provide some evidence on the impact of other channels in determining school performance.[11] Parental pressure constitutes only one dimension of parental involvement, but it is of particular interest because of its potential productivity effects and because it may also serve as a channel through which competition affects public school performance (if greater competition increases the impact of parental pressure, for example).

In the literature, collective parental pressure has been neglected as a determinant of school quality, in large part because of data limitations, yet case studies like that by Murnane and Levy (1998) suggest that pressure working through parent-teacher associations (PTAs) can have a substantial effect on school performance. A school in which parents play a prominent role will find the pursuit of other objectives - that is, objectives not supported by parents - less easy, and will be more likely to provide high quality education; by mobilizing, parents can force the school to devote more effort to raising performance, as measured for instance by test scores.[12] This paper provides some of the first econometric evidence on the determinants and productivity consequences of collective parental pressure.[13]

1.1.2 Incentives

This research contributes to another part of the prior literature, concerning producer incentives. Most empirical papers in the field abstract from incentive issues entirely (see Dynarski *et al.*

[10]Parental pressure may also have the character of a private good, for instance if parents attempt to secure benefits for their children at the expense of others. Whether this is the case is testable; Table 8 below sheds some light on the matter.

[11]The data used in the analysis (described in Section 5) allow parental pressure to be distinguished from other aspects of parental involvement, to some degree. Thus, in addition to the effects of parental pressure, I measure the impact on student achievement of parents helping with homework and talking about school activities with their children.

[12]The connection between social capital and the quality of government has been emphasized by Robert Putnam (1995). In this research, I make the link explicit, between one form of social capital - namely collective action on the part of parents - and the quality of public schooling. I also quantify the size of the effect of collective action on school quality. In this analysis, parental pressure has the character of a privately-provided public good. Issues concerning under-provision due to free-riding are addressed in McMillan (1997).

[13]Sui-Chu and Willms (1996) examine the effects of different dimensions of parental involvement on student reading and mathematics scores. One dimension is labeled 'school participation,' which combines volunteering at school and attending parent-teacher organization meetings. The authors find that "Parents' participation at school ha[s] a moderate effect on reading achievement, but a negligible effect on mathematics achievement." They do not allow for the possibility that parental participation may be endogenous to school quality. Nor does their analysis consider the impact of competition from private schools on either the level or the productivity impact of parental participation, and they do not control for district characteristics when estimating the effects of school participation on achievement. The current analysis addresses these considerations.

(1989) for one example), and assume that public schools operate efficiently; this approach has also been adopted in theory work relating to schooling.[14] However, recent empirical research finds evidence of inefficiency among public schools,[15] and competition advocates contend that greater competition will help reduce inefficiency, even though the mechanisms at work have not been made very explicit. In one of the few theoretical papers analyzing the efficiency effects of competition, Manski (1992) presents simulation results which indicate that increased competition (through the introduction of a voucher) will enhance production efficiency, even though it also leads to increased sorting, as those households with higher incomes or stronger tastes for education switch their children to private school. These findings support the received wisdom, according to which competition has positive efficiency effects but at the same time gives rise to greater stratification of students, the latter with potentially undesirable consequences for school quality.

The Distribution of Households

It is worth stressing that theory does not give unambiguous predictions about the productivity effects of greater competition. Thus part of the received wisdom is open to question. I show in a related theory paper (McMillan (1998a)) that competition may raise or lower public school productivity, depending on the shape of the distribution of households within a community[16] as well as the costs of raising effort.

The key notion in the theory is that different types of household will typically differ in their reservation levels of public school quality, below which they exit to private school,[17] and this reservation level will rise as competition increases, given that greater competition entails making private schooling options more readily available. The shape of the distribution of households determines the number of households on the margin of attending private school. If

[14] While school productivity issues have been relatively neglected, a number of interesting papers deal with the equity effects of greater competition, notably Epple and Romano (1998) and Nechyba (1996, 1999). Nechyba's 1996 paper provides a thorough treatment of the impact of vouchers on residential choice across a set of communities. He shows how a voucher may, somewhat surprisingly, raise school quality in the poorest districts through its effects of household location decisions. His later paper compares the impacts of uniform versus targeted vouchers in a multi-community setting, and shows how the equity consequences of a voucher improve as migration effects become stronger.

[15] See, for example, the paper by Grosskopf *et al.* (1995). This paper and others use data envelopment analysis (DEA) to gauge the extent to which public schools operate within the production frontier, providing a measure of productive inefficiency. It is important to emphasize that productive 'slack' is not observed directly, but rather is inferred on the basis of measured inputs, family background controls, and a school output measure. Especially where the controls are incomplete, the diagnosis of the extent of slack using DEA will not always be appropriate. Difficulties in inferring that slack exists will be returned to below.

[16] In the model, households vary solely according to income, but the key idea is more general: households could be heterogeneous in terms of their taste for private schooling, religious affiliation etc.

[17] For higher income households, for instance, the threshold will be higher.

that number is small, and the costs of raising quality high, then it is more likely that public schools will choose to *reduce* quality and serve households at the bottom end of the distribution (who will typically have a lower reservation quality level anyway) as competition increases.[18] Thus, the efficiency benefits of competition should not be assumed to arise automatically.[19]

Empirical Evidence

Empirical evidence regarding the productivity effects of greater competition is limited. Yet in two quite recent papers, Caroline Hoxby (1994a, 1994b) finds strong support for the view that incentives do matter: schools use inputs more effectively when competition increases for exogenous reasons.[20] While increases in competition might be expected to induce greater sorting of households across public school districts and between public and private sectors, with negative consequences for school performance, her results imply that any adverse sorting effects are outweighed by strong, positive productivity effects.[21] Hoxby's thought-provoking work raises several questions. Just what is the underlying mechanism by which increased competition affects public school conduct? Are adverse sorting effects largely non-existent, perhaps because students are already stratified across the public sector? Does the threat of losing students really galvanize public school providers in all cases, or are there circumstances in which competition has more effect than others? Consideration of these issues helps shape the current analysis.

The discussion of incentives above suggests that, within the current system, both parental pressure and competition from private schools may have an impact on school conduct. Thus in the empirical framework, I allow for the possibility that public schools are more productive (in the sense of helping to produce higher test scores, controlling for other things) when operating in an environment with more intense parental pressure or greater ease of access to private schools. With the aid of this framework, I am able to gauge the relative importance of incentives

[18] The mechanism is as follows. Consider a setting in which there are two types of household - 'high' and 'low' - and where, pre-voucher, a public school serves both types. When competition increases (say through the introduction of a private school voucher), there will tend to be greater sorting between public and private sectors, with the high types now more likely to switch to private school. The public school can retain the high types by raising quality, but doing so is costly, and if the proportion of high types is small and the costs of raising effort great, it may be optimal to lower effort, let the high types leave and serve just the low types.

[19] The analysis also suggests that greater sorting may *itself* have adverse efficiency consequences, calling into question the usual distinction between (negative) sorting and (positive) production efficiency effects of vouchers.

[20] An important contribution in her work involves recognizing that standard measures of competition, such as the number of private schools or the number of school districts within a given area, are likely to be endogenous to public school quality. As such, they need to be instrumented for. Hoxby's insight is made use of in the empirical analysis in Section 6 below.

[21] Her findings also have the appealing implication for policy that all public schools may improve once exposed to greater competition, at odds with the widely-voiced concern that competition will lead some public schools to decline precipitously.

from these two sources and to assess the importance of interactions between them.

Interactions

The role of interactions is highlighted in a second theory of public school quality determination (McMillan (1997)). Building on the insightful discussion of 'voice' versus 'exit' by Hirschman (1970), this theory considers whether a voucher will raise school quality by increasing school productivity,[22] paying attention to induced effects on parental pressure. When both parental pressure and competition are allowed to influence public school behavior, the productivity impact of an increase in competition is shown to hinge critically on the way the two interact. The theory calls attention to two forms of interaction. The first form relates to interactions between parental pressure and competition in the production function - does the marginal impact of parental pressure change in a more competitive environment? The second relates to interactions in terms of the *levels* of competition and parental pressure - does competition have a significant impact on the *volume* of parental pressure?

If competition and parental pressure are complements in the production of education quality, perhaps because the threat of leaving makes parental voice more powerful, then greater competition will lead to unambiguous improvements in quality (via increases in productivity) in a world in which competition is constrained to have positive productivity effects.[23] Yet if parental pressure and competition are substitutes in either of the senses described, the introduction of a voucher can lead to a *reduction* in public school productivity and thus quality, an outcome with important policy implications. At least two mechanisms can account for this reduction. According to the first, the marginal impact of voice is weakened by competition because of a sorting effect: the more vocal parents are also the ones more likely to be on the margin of switching to private school. These parents move to private school when competition increases, so a given unit of voice in public school has less impact - those who remain in the public school and apply voice are less effective 'voicers.' An alternative mechanism can operate even if all parents are identical, except for their propensity to exit to private school. Here, changes in competition affect the *volume* of parental pressure applied by parents. If greater competition leads to a significant reduction in parental pressure due to changes in enrollment, then the public school may actually face weaker incentives overall to apply effort. In sum, whereas the first theory showed that competition itself may reduce school productivity directly, the second theory shows that, even when the direct effect of competition is constrained to be productivity-enhancing, public school quality may still fall once interactions with parental

[22] It also provides the first analysis in the literature of the decision parents take to engage in collective actions to improve school quality, showing how organizations like PTAs can serve to coordinate parents' actions and deter schools from under-performing.

[23] Similarly, if increasing competition raises the level of collective parental pressure in a school significantly, this is also likely to improve school quality (assuming that parental pressure has a positive marginal product).

pressure are allowed.

Theory alone can do little to advance the debate about the efficiency effects of competition, however. It cannot say what the relative impact of incentives from different sources on school performance will be; nor can it determine whether in practice parental pressure and competition will be mutually reinforcing. These are empirical issues taken up in the current paper.

1.2 Research Questions

Based on the prior discussion, the analysis addresses the following four questions:

1. What are the determinants of parental pressure? Is parental pressure solely a function of parental *type*, or might market conditions or features of the school finance regime matter also?

2. Does collective parental pressure working through school PTAs have an influence on the school production process?

3. Does greater ease of access to private school have an impact on public school performance? What is the relative impact of competition versus collective parental pressure? And under what circumstances does competition have most effect?

4. Are competition and parental pressure complements or substitutes in the education production process? Are the interactions between the two strong?

The first question is important from a policy perspective. If the level of parental pressure depends on more than parental type, and if such pressure has positive effects on school productivity (which is an issue in Question 2), then reforms may be able to strengthen incentives by calling forth more parental pressure without changing the mix of parents in a school. The appeal of such reforms rests on the notion that the *actions* of parents of a given type (socioeconomic status or education level) can make a difference to school conduct and student outcomes if they decide to become more involved.[24] If, instead, parental pressure is determined solely by parental type then school reforms will be effective only insofar as they influence the mix of types in schools, and some schools are likely to gain at the expense of others.

Regarding the second question, parental involvement has been studied widely in the education literature, providing evidence that it is associated with better student performance (see Epstein (1991), for example). Yet that literature generally ignores wider influences on school behavior - the degree of private school competition and the structure of school finance, for instance - which may lead to confounding the impact of parental involvement with other

[24]Murnane and Levy's (1998) study discusses a case in which the involvement of low-income parents was raised substantially, with powerful effects on school performance.

factors. In the current paper, I control carefully for parental type and these other factors, and measure the extent to which collective parental pressure affects school quality, allowing for reverse causation from school quality to the degree of parental participation. As for the third and fourth questions, the relative strengths of competition and parental pressure have not been compared empirically, nor has the issue of how the two interact been addressed.[25]

1.3 The Empirical Approach

To explore the role of incentives in determining school quality using data from the existing schooling system, I set out an empirical model which allows public schools to be influenced by competition for enrollment from private schools and parental pressure. Though there are few explicit performance incentives under the current system, parental pressure and competition may affect school productivity to a greater or lesser degree (as discussed earlier). The strategy is thus to use exogenous variation in factors which affect parental pressure and ease of access to private school to gauge the relative impacts of parental pressure and competition on public school performance. Before turning to a detailed description of the approach and the data, I set out the model.

2 Model Overview

This section provides a brief overview of the main features of the model. It begins by introducing the assumptions about supplier behavior. It then explains how incentives may affect school conduct, and provides the rationalization for the way parental pressure is modeled.

The central goal of the analysis is to understand better the determinants of public school quality. While problems with defining quality are non-trivial, it is fair to say that student achievement makes up an important component of quality, and that achievement tests provide one (imperfect) quality measure. In the empirical analysis, I equate quality with student achievement on standardized tests, partly for simplicity and partly because it has figured so prominently in the school reform debate, and I measure the effects of changes in incentives on the levels of average school test scores.

To bring incentive issues to the fore, the model captures the potential conflict of interest between public schools and parents. Parents are assumed to value academic excellence: they want schools to achieve the highest test scores possible. Public schools, in contrast, do not strive to maximize school quality as an end in itself - they maximize a separate payoff function. Consistent with the evidence of Kirst (1984) and others that public schools in practice have multiple objectives, schools in my stylized setup care about quality insofar as it affects enrollment. But they also care about other unspecified ends. In this research, I remain agnostic as

[25] at least, to the best of my knowledge.

to whether these other ends are socially worthwhile or not - they may involve enjoying an 'easy life,' or they may involve things like trying to make students more well-rounded. Regardless of what form they take, these other ends lead public schools to divert their energies away from raising test scores. Interesting hypotheses can then be framed in terms of whether school efforts directed towards such measurable ends change with variation in incentives.

The school's choice variable is effort devoted to raising school quality (as measured by test scores), and public schools set effort to maximize the school payoff. Effort is unobservable, but is hypothesized to be influenced by incentives - competition from private schools and pressure from parents - and the ability of parents to raise school effort and school quality depends on their collective power. By modeling the choice of effort explicitly, I solve for optimal effort in terms of observables. This solution can then be substituted into the school production function, which I estimate to show how quality is influenced by competition and parental pressure.[26]

Parental Pressure in Bargaining

In terms of the empirical model's characterization of the game played by households and schools, think of parents as being represented by a form of 'parent union,' the PTA, which bargains over a pie with the public school. (The pie is given by the rents earned by the public school in the absence of any parental pressure, rents which are likely to be increasing as outside options become less accessible.) Parental utility rises with public school quality, while higher quality tends to reduce the school payoff due to the convex cost of effort. Both parents and the school have threat points, that of parents given by the utility from the private school option, and that of public school given by the payoff they would earn if the active parents enrolled elsewhere (because pressure were lower). In turn, the bargaining power of each side influences how overall rents are divided. We might expect the school to have more power if it operates in an uncompetitive market and/or if it is unionized, while PTAs tend to wield more influence as more parents become active and as those parents are of higher socioeconomic type. The rationale is that a more active PTA will be better able to monitor school effort, and in turn, by coordinating, will be able to punish with greater force. The punishment could be direct

[26] An interesting alternative approach is offered by Downes (1996). He compares two different models of bureaucratic behavior, using data from the public school system in California. In the first, public schools implement the choices of the electorate; in the second, they maximize rents, which appear in the form of an administrative staff far larger than a quality maximizer would choose. Testing between the two, Downes finds in favor of the rent maximization hypothesis. It is plausible to think that rents are not earned solely through the accumulation of a big staff. This paper explores a more general alternative, in which teachers earn rents (noting again that 'rent' is a politically loaded word - rents may accrue from the pursuit of ends which may be socially worthwhile but which do not involve raising student achievement) through their setting of effort, though the disadvantage of this approach is that effort is not observable to the econometrician, requiring the use of theory as described in the text.

through complaints, or indirect, through appeals to a higher authority.[27] Thus a public school which faces greater competition from private schools and stronger pressure for parents will tend to supply greater effort (towards ends valued by parents).

In practice, the interactions between school and parents are repeated. I compress the game down to one period, though it involves two stages. In the first stage, parents decide whether to be an active participant in the PTA, based on a conjecture about the effect their incremental efforts will have on school quality setting. In the second stage, the school then takes the level of pressure applied by parents as given and chooses effort. It is because parents commit to being active participants that the actions of the school are constrained.[28] Thus the ability to commit is critical in this formulation. Though it is somewhat forced, suppose in the one-shot setting that the parents sink a time investment in the PTA prior to the school's effort choice. That investment then affects the school's payoff, by affecting the disutility it incurs from parents due to low effort. I now turn to a detailed description of the model.

3 The Model

The model describes a local education market, assumed to be in equilibrium. It has three main components, captured in a three-equation system. In the first equation, public schools set quality (via their choice of effort), taking account of competition for enrollment from private schools and collective pressure from parents, working through the school PTA. The second captures the aggregate level of parental pressure (measured using active participation in the school PTA) in a school. In the third, private school share in the local education market is endogenized, with parents choosing between public and private schools based on the availability of private school options and the quality provided by public schools.[29] I discuss the derivation of each equation in turn.

[27] Unfortunately, I do not have any information in the data set on penalties for under-performance.

[28] It might be argued that parental pressure per se will be ignored unless backed by an exit threat. In a bargaining setting, this case is equivalent to one in which all the power resides with the public school. If the parents are given a better outside option, perhaps through the introduction of a voucher, then the public school is forced to raise effort simply because parents' reservation utility has gone up. An alternative case arises when parental bargaining power rises above zero initially. Then parents have an incentive to coordinate their activities in a bid to get a larger share of the pie by raising school quality.

[29] At this stage, while the analysis models total enrollment in private school, it abstracts from sorting by parents of different types across schools (and also across communities) because of data limitations. In other words, changes in the composition of the student body are not modeled explicitly, even though such changes help explain some of the findings described in Section 5. I discuss ways of correcting for possible biases due to sorting in Section 6.

3.1 Public School Quality Setting

The public school (indexed by i) is assumed to choose effort e_i to maximize its payoff, taking the average pressure applied by parents in school i (denoted $\bar{m}_i$) as given. The school payoff is given by

$$R(e_i) = V_i N(e_i) - \psi(e_i) - \delta P(e_i, \bar{m}_i) \tag{1}$$

where δ is a parameter to be estimated. Equation (1) says that school i's payoff is equal to total revenues earned from enrolling $N(e_i)$ students - the school is assumed to get a fixed amount V_i per pupil admitted - minus the cost of effort, minus the disutility due to the pressure the school faces when it applies effort e_i. The school might care about higher revenues as they afford greater scope for 'gold-plating' (spending extravagantly around the school); for now, I normalize V_i to 1 because I do not have accurate school-level data on this variable. The school faces a trade-off in making its effort choice. On the one hand, effort raises quality which increases enrollments and school revenues; on the other, there are increased costs from raising effort in the form of the private cost of effort, captured by the $\psi(.)$ term.[30] Optimal effort will balance these gains and losses.

The novel feature of the school objective function is the inclusion of the term giving the school's disutility due to parental pressure $P(.,.)$. While effort is unobservable to the econometrician, and to higher authorities to some extent, parents are often in a good position to monitor effort, especially if they are better educated. Hence, they may act as informal regulators. Once they have gathered information about effort, which is assumed to be observable at a cost, they can apply pressure to raise school effort and bring about improvements in quality. Their ability to do this effectively is hypothesized to depend on their collective power, and power increases in the number of parents who are active in the PTA as well as the proportion of active parents who are highly educated. Because being active in the PTA is costly, parents will balance these costs against the gains from greater pressure in terms of higher school quality - as pressure increases, so do the incentives the school has to keep quality high. Suppose that the disutility-of-pressure function takes the following form:

$$P(e_i, \bar{m}_i) = \bar{m}_i(\bar{e}_i - e_i), \tag{2}$$

where $\bar{e}_i$ is the maximum level of effort the school will supply before switching to its next best activity. Thus the disutility of pressure declines as effort rises and as average pressure, measured by $\bar{m}_i$, falls.

I make several other functional form assumptions.[31] For simplicity, assume that public school enrollment is given by

$$N(e_i) = \mathbf{W}_i'\gamma \times e_i + \epsilon_D(i) \tag{3}$$

[30] I abstract from the monetary cost of raising effort.

[31] This discussion draws on Wolak (1994).

where $\mathbf{W}_i$ is a vector of demand shifters that affect public school enrollment (including the degree of local competition discussed below), γ is a parameter vector to be estimated, and e_i is school i's effort. Increased competition from private schools will reduce public school market share - measures of competitiveness are included in the $\mathbf{W}_i$ vector.[32] I also suppose that $\psi(e_i) = e_i^2/2$, a simple quadratic function. The enrollment error $\epsilon_D(i)$ is assumed to have mean zero.

The public school chooses effort based on expected enrollment, so the public school payoff function becomes

$$R(e_i) = \mathbf{W}_i'\gamma \times e_i - \frac{{e_i}^2}{2} - \delta\bar{m}_i(\bar{e}_i - e_i). \tag{4}$$

Maximizing with respect to e_i, the first-order condition is

$$\mathbf{W}_i'\gamma - e_i + \delta\bar{m}_i = 0, \tag{5}$$

which can be solved for optimal effort:

$$e_i^* = \mathbf{W}_i'\gamma + \delta\bar{m}_i. \tag{6}$$

Depending on the parameter estimates, effort rises with average pressure if $\delta > 0$, and rises with competition from private school if the relevant element of γ is positive.

The Production Technology

The school faces a quality production technology, with quality depending on measured inputs and effort, controlling for family and community characteristics. For convenience, quality is assumed to be unidimensional - in the empirical implementation, it is given by an average test score.[33] The average quality outcome in school i is determined according to the production function

$$Q_i = Q(e_i^*, L_i, I_i, N_i, \mathbf{Z}_i, \mathbf{D}_i, \epsilon_q(i)|\beta). \tag{7}$$

The first two terms represent school inputs, L_i giving units of labor in school i and I_i representing materials; and N_i gives enrollment in school i to allow for any scale effects. Average quality also depends on a vector of controls for family characteristics, given by $\mathbf{Z}_i$, and a vector of district characteristics $\mathbf{D}_i$. The term e_i^* represents school effort, which is unobservable to the econometrician; however, e^* can be written in terms of observables, as in (6). Finally, $\epsilon_q(i)$ is a structural error on the production side, and β is a vector of parameters.

To derive a tractable estimating equation, I assume the production function is as follows:

$$Q_i = \beta_0 {L_i}^{\beta_2} {I_i}^{\beta_3} \mathbf{Z}_i^{\beta_4} \mathbf{D}_i^{\beta_5} \exp(\beta_1 e_i^*) \exp(\epsilon_q(i)). \tag{8}$$

[32] More realistically, enrollment should depend on quality which in turn depends on effort, rather than effort directly.

[33] This is an important simplification. There are likely to be several dimensions of quality, with different appeal to different households.

Substituting the optimal effort level gives us an estimating equation in quality, after taking natural logs:

$$\ln Q_i = \ln \beta_0 + \beta_1(\mathbf{W}_i'\gamma + \delta \bar{m}_i) + \beta_2 \ln L_i + \beta_3 \ln I_i + \beta_4' \ln \mathbf{Z}_i + \beta_5' \ln \mathbf{D}_i + \epsilon_q(i). \qquad (9)$$

Thus public school quality depends on the two incentive measures - parental pressure and competition from private school[34] - as well as controls for school inputs, household characteristics, and characteristics of the community more widely.

Estimates from equation (9) are relevant to Research Questions 2 and 3 above as they measure the relative importance of parental pressure and competition from private schools in the determination of public school quality.[35]

3.2 Parental Pressure

The second equation captures the aggregate level of parental pressure, as measured by active participation in the school PTA. In the background, individual households choose how involved to become, and as collective parental pressure has a local public good element, free-rider issues are likely to arise - the current analysis abstracts from these. In this subsection, I sketch the household optimization problem and give some motivation for the equation I estimate, rather than derive a closed-form solution for the optimal level of parental involvement by each household.

To model the determination of aggregate parental pressure in a school requires an assumption to be made about the nature of the 'contributions' game that parents are playing. The simplest case analytically is to assume that parents cooperate, so we can think of them as maximizing a single objective function. As a further simplification, suppose that all households are alike and that the aggregate level of parental pressure in a school can be understood by modeling the optimization problem of a representative household. Suppose also that the representative household's level of pressure applied can be treated as a continuous variable, with all households acting symmetrically. (In fact, some households are active and others are not - this is a fact I return to later using individual data.)

The utility of the representative household is defined over consumption and school quality. Households are able to influence school conduct by applying pressure, but parental pressure is costly to apply. Thus the household's optimal level of pressure will balance the marginal gains from higher school quality against the marginal costs in terms of foregone consumption.

[34] Recall that ease of access to private school enters the vector of public school demand shifters.

[35] In Section 6, I provide estimates of an alternative specification which allows for the impact of parental pressure to be influenced by the strength of local competition. These estimates relate to Question 4, which asks whether parental pressure and competition are complements or substitutes in the education production process, a negative sign indicating that they are substitutes.

The Game

I envisage a two-stage game in which the parents move first, choosing the level of pressure m_i which maximizes their utility, and the public school moves second, choosing effort to maximize rents taking as given the overall level of parental pressure.[36] In essence, households act (collectively) as Stackelberg leaders, committing to a certain level of active PTA membership.

Suppose the utility of a household whose child attends school i depends on consumption and public school quality. The household chooses m_i to maximize

$$U(m_i) = U\Big(\bar{y}_i - k(m_i), Q(m_i)\Big) \tag{10}$$

where $k(m_i)$ gives the cost of time spent being active. The optimal level of pressure m_i^* will satisfy

$$-\frac{\partial U}{\partial c}k'(m_i) + \frac{\partial U}{\partial Q_i}\frac{\partial Q_i}{\partial m_i} = 0, \tag{11}$$

noting that $\frac{\partial Q_i}{\partial m_i}$ can be calculated from the school's problem. Equation (11) will typically imply that the representative household's pressure contribution depends on their income level, the opportunity cost of time, and a vector of controls, including other characteristics of the representative household.

In my empirical implementation, I treat the household's decision problem as being that of the representative household described above, with one important modification. The parental involvement data described in the next section are limited as a household's participation choices are represented by dummy variables (corresponding to 'Yes, I am active' or 'No, I am not'), rather than being continuous. However, the proportion of parents active in the PTA does vary between zero and one, so I use this proportion, $\bar{m}_i \in [0,1]$, as the measure of (continuous) pressure chosen by identical parents sharing the mean characteristics of parents in the schools in my data set.[37]

I assume average pressure is a linear function of average income and other household characteristics $\mathbf{Z}_i$, a vector of district controls $\mathbf{D}_i$, and total enrollment, to capture possible scale effects of parental pressure. We might expect parental pressure to have more effect in a smaller school, causing parents to raise their marginal contributions of this collective

[36] Once parents have chosen a school, it seems plausible that they would make a commitment to maintaining school quality, a commitment which helps to force the school to apply effort.

[37] In a related paper (McMillan (1999), in progress), I make use of individual household data, rather than school-level averages, to model the individual household's optimization problem. The model has a similar flavor to the one sketched above, though I consider the Nash case in which an individual household chooses whether to be active in the PTA, taking as given the (involvement) choices of other households. An individual parent's decision to be active in a PTA will depend partly on the actions of other parents, and by building this interdependence into the structural model, I can gauge the extent of free-riding. I can also recover parameters of the individual utility function, and thus understand better the determinants of parental pressure in a school (see Question 1). The first Appendix to this paper provides a brief summary of the individual model.

good. Pressure is also allowed to depend on public school quality, Q_i, and a measure of the competitiveness of the local schooling market, s_i. Thus

$$\bar{m}_i = \alpha_0 + \alpha_1 Q_i + \alpha_2 s_i + \alpha_3 N_i + \mathbf{Z}_i'\alpha_4 + \mathbf{D}_i'\alpha_5 + \epsilon_m(i), \tag{12}$$

where I assume that the proportion of active parents is measured with error.

Estimates of equation (12) will help to answer Question 1, which asks whether parental pressure is determined solely by fixed parental characteristics ('type'), or whether market conditions and the quality of public schooling have some influence also. In terms of the impact of public school quality, we might expect parental pressure to be higher where public school quality was lower, as under-performance on the part of the public school would create room for collective parental influence to increase school quality, and with it household utility. More intense local competition could conceivably raise parental pressure if competition helped to lend more weight to parental concerns, perhaps by giving parents a credible exit threat. Yet increased competition could also reduce parental pressure if sorting were significant, and the parents who exited to private school were more inclined to be active.[38] To the extent that active parents generate sizeable externalities, their loss could have adverse effects on the participation decisions of other parents who remained in the public sector. The empirical analysis which follows resolves the potential ambiguity and provides measures of the importance of the interaction between parental pressure and competition.

3.3 Competition

The third equation describes the determination of private school market share. This is likely to be influenced by a number of factors. As public school quality falls, so private school market share will tend to increase; similarly, in communities with higher average incomes, more households can afford to send their children to private school, and this will raise private school share. Private schools find entry easier in certain communities, regardless of public school quality. Hoxby (1994a) argues that higher concentrations of a given religious denomination in an area (for exogenous reasons) allow more private schools of that denomination to be supported, increasing the availability of private schooling options. Further, private school tuition can be more heavily subsidized in those schools, helping to place more households on the margin of attending private school. Thus exogenous denominational variables are likely to affect private school share independent of public school performance.

The following equation measures private school share s_i in the local education market:

$$s_i = \mu_0 + \mu_1 Q_i + \mu_2 \bar{m}_i + \mathbf{Z}_i'\mu_3 + \mathbf{D}_i'\mu_4 + \mathbf{C}_i'\mu_5 + \epsilon_\mu(i). \tag{13}$$

[38] In the Data section below, I provide interesting descriptive statistics indicating that parents who sort into private school have a higher propensity to be active in both school and non-school affairs.

The right-hand side includes the two endogenous variables from the previous two equations in the system: public school quality Q_i, and the parental pressure measure $\bar{m}_i$. Parameter estimates will thus shed light on the strength of the reverse causation from poor public schools to high private school share, and in addition, on whether there are strong 'quantity' effects from high parental pressure to private school share. As parents become more involved in public school activities, perhaps for taste reasons, so private school share might fall - a priori, it is difficult to know the sign and strength of this relationship. Additional controls on the right-hand side include a vector of district characteristics $\mathbf{D}_i$, and a vector of county level variables $\mathbf{C}_i$, which can include measures of county religious composition.[39]

3.4 The System

To summarize the system: The first equation, given by (9), describes the quality setting decision of the public school in the sample. In addition to controls for student and parent characteristics (race, parental income and parental education), the right-hand side includes two incentive measures: parental pressure and competition. The second equation in the system, (12), models the determination of aggregate parental pressure as a function of parental characteristics, family size, private school share, and public school quality. Third, private school share at the district level is given as a function of district and county level characteristics, public school quality, and the level of parental pressure (see equation (13)).[40] This form for the system captures possible interdependencies between public school quality setting, parental pressure, and competition. In the light of the research questions discussed in Section 2, estimating it not only enables me to measure the impact of incentives from parental pressure and competition on school performance (Questions 2 and 3); I can also explore the factors which influence aggregate parental pressure (Question 1), and ease of access to private school.

4 Data

To estimate the system described in the previous section, I have assembled an extensive new data set, combining detailed information about school inputs, the characteristics and actions (including collective actions) of parents, and local market conditions. This enables me to control for a far wider set of individual, school, and community characteristics than has been possible previously. In particular, I can explore the joint effects of parental pressure and competition on public school performance, as well as interactions between parental pressure and private school competition.

[39] In Section 6, I examine the implications of including these measures in the set of instruments which identify the impact of competition on public school performance.

[40] I discuss precise specifications and the exclusion restrictions needed to identify the parameters in Section 4, after I have presented the data.

The school, student, and parent data for the study come from the restricted access version of the National Education Longitudinal Survey (NELS), which I link with the School District Data Book (SDDB) and other sources providing contextual information. NELS is composed of three waves, the first carried out in 1988, the second in 1990 and a third in 1992; in this paper, I use data only from the first year (the 'Base Year').[41] The NELS data have three appealing features:

- First, NELS is very large. The first wave includes approximately 25,000 eighth graders[42] nationally, drawn from a random sample of over 1,000 schools, both public and private.

- Second, NELS provides a wealth of information about school, student, and parent characteristics. NELS has four component questionnaires - for the student, for one of the student's parents (or guardian),[43] for at least two of the student's teachers, and the principal at the school attended by the student. In each wave, students take a battery of four tests (in reading, mathematics, science and social science) designed by the Educational Testing Service, providing reliable performance measures which are comparable across students (and also across waves). In addition, NELS is perhaps the richest source available relating to parental involvement, permitting its determinants and effects to be analyzed. Importantly, (observable) parental type is distinguishable from parental actions.

- Third, the restricted access version of the NELS data set can be linked to a variety of other data sets. I use public school district identifiers to link each public school in the sample to the school district and county it is in using codes from the SDDB. The SDDB itself merges information on school districts from the 1990 Census of Population, the 1987 Census of Governments, and the NCES Common Core of Data, providing rich socio-economic information about the local market the school operates in. I also link the school data to information on religious affiliation at the county level derived from the Survey of Churches and Church Membership in the United States (1980).

In the remainder of this section, I discuss the features of the data in some detail.

4.1 Parental Involvement

Parents are able to influence school quality through a variety of channels, discussed in Section 1 above. Parental involvement is likely to have three components: supplying resources and time, gathering information and applying pressure. Here I focus on the latter two, controlling

[41] Even if data from subsequent waves were to be used, the only variation in competition would be cross-sectional. This is a limitation of the available data.

[42] Each of these students is followed in subsequent waves.

[43] Unfortunately, no parental questionnaire was conducted for the second wave of the survey.

for the provision of resources in the analysis below. On the information gathering front, the data include four measures describing the extent to which parents contact the school - about academic performance, academic programs, or fund raising and volunteering. Cross-tabulations for over 21,000 parents indicate that more parents in the sample contact the school about academic performance (63 percent) than about academic programs (30 percent). Further, only around 20 percent of parents ever contact the school about volunteering or fund raising. It could be argued that these forms of contact have a monitoring component - parents who contact schools more regularly will tend to be more informed. There are also variables measuring how often parents discuss school matters with their children.

In terms of applying pressure, I construct dummies using the individual data according to whether parents are members of parent-teacher organizations, take part in PTA activities, and attend PTA meetings respectively.[44] Overall, 38 percent attend PTA meetings, 33 percent of parents are members of parent teacher organizations, and 27 percent take part in PTA activities. Parents who are PTA members in name only are unlikely to make much difference to the incentives faced by the school. Hence, in the remainder of the analysis, I treat the proportion of parents who take part in PTA activities as my measure of collective parental pressure, though the main findings are not sensitive to this (see Table 6).

4.2 The School Sample - Public versus Private

The first wave of the data set contains a random national sample of 1035 schools taken in 1987, of which 802 are public and 233 are private. Most of the analysis in this paper focuses on public schools, in particular their performance. Before moving to the public school sub-sample, it is instructive to compare the average characteristics of the public and private schools in the NELS data. This comparison brings out marked differences between the two sectors in terms of school inputs, the characteristics of their respective clientele, and school admission practices.

In Table 1, I present a selection of descriptive statistics comparing the 738 public schools and 192 private for which the data were complete. First, note that mean reading test scores are around five points higher in private schools; the same is true for mathematics scores. That test scores are on average higher in private schools is a widely documented phenomenon.[45] The public schools in the sample enroll almost twice as many students on average as the private schools, and while they employ more teachers, pupil-teacher ratios are around 20 percent

[44] From these, I form averages for each school across the households sampled, and use these averages in the estimation reported in the next section.

[45] A substantial literature, beginning with Coleman *et al.* (1981), has analyzed the reasons for higher private school achievement. While there has been intense controversy about whether this private school effect persists once selection has been accounted for adequately, one finding which does appear robust is that Catholic schools (which account for around 80 percent of private school enrollments) raise graduation rates for many students, at least at secondary level (see Neal (1998)).

lower. At the same time, public school teacher salaries are over 30 percent higher, which goes a long way toward explaining the oft-noted cost differences between the two sectors. While the starting salary for teachers is less than $14,000 in 50 percent of private schools, only two percent of public schools pay less than $14,000.[46] In contrast, 50 percent of public schools versus one percent of private schools pay more than $19,000. Not unrelated to this, 69 percent of public schools are covered by a collective bargaining agreement; only 5 percent of private schools are.

In terms of the average characteristics of the clientele of the two sectors, average parental income is over $30,000 higher in private school, almost double the level in public schools, and the parents of private school children have around a year and a half more schooling, which helps to explain the test score gap (either because of greater human capital or higher genetic endowment). In terms of racial composition, private schools enroll a lower proportion of minorities, while the proportion of Catholics is substantially higher. Of interest to the current analysis, active parental participation in school PTAs is appreciably higher in private schools (53 versus 21 percent), and private school parents seem more active in general - 32 percent of private school parents are active in other organizations versus 19 percent of public school parents.

The public schools in the sample do not charge tuition, and all but a handful do not select (in the sense of having fewer acceptances than applicants). In contrast, 31 percent of private schools have acceptance rates less than one, and around 20 percent accept less than half of all applicants.[47] Further, over 40 percent of private schools in the sample take account of student ability when making admissions decisions, indicating that selection is an issue to be taken seriously.

4.3 The Public School Sample

For the remainder of this paper, I focus on the public school sub-sample.[48] The unit of observation is a public school drawn from the NELS data set for which a full set of the variables of interest were available. This gives me a sample of 738 public schools. For each observation, I have three types of data:

- school characteristics drawn directly from NELS;
- average parent and student characteristics associated with each school;

[46] computed elsewhere.

[47] Of course, a public school in a wealthy community may be able to exclude low socio-economic status students through zoning and residency requirements for school attendance.

[48] The justification for this is largely policy-related. As I discussed in Section 1, policy makers and the general public are concerned about the under-performance of many parts of the public schooling system. Understanding the factors which determine *public* school performance is thus a priority.

- data relating to the district and county in which the public school is located.

Descriptive statistics on the main variables used in the analysis are reported in Table 2, divided into the three categories.[49]

Panel (a) presents data on school characteristics. My school performance measure is the (log of the) reading score, averaged over the eighth graders chosen from each public school in the sample - around 21 eighth graders were chosen at random from each school.[50] I also have information about various schooling inputs (total school enrollment, eighth grade enrollment, the number of teachers, starting teacher salaries, number of years in the school year etc.) and whether the school is covered by a collective bargaining agreement.

Panel (b) lists the student and parent controls. For the students and their parents sampled from each school, I take averages across the 20 or so students to create a set of race, income, parental education, and religious affiliation variables (for instance, the proportion of students in each public school sampled of Hispanic origin). NELS also provides information about home resources (whether the household owns a computer, for instance), family structure (whether students are from a two-parent family, and the number of children in each family), whether parents set rules about doing homework or watching television, and information about parental activities in the home, for instance helping their children with homework. Of particular interest are my measures of parental activism. The variable ACTIVE measures the proportion of parents in the eighth grade sample who are members of other organizations, such as neighborhood organizations; the variable PTACT measures the proportion of parents in the school who take part in PTA activities.[51]

Panel (c) provides information drawn from the SDDB and the Survey of Churches and Church Membership (1980). I separate school district variables from county variables. Both sets include demographic characteristics (racial composition and distributions for educational attainment for the entire population), measures of community wealth (median household income, median housing values, percentage unemployed), and population counts for different age categories. Comparing means for district and county variables conceals important differences between the two. Many [say what proportion - over 70 observations, drawn from different districts with widely differing characteristics. Such differences between pairs of district and county variables will play a crucial role in identifying my competition measure, as discussed in the next section. I also construct measures at the county level of the proportion of the population who are adherents of some religion, and also the proportion who are Catholic (the variable

[49] The Data Appendix provides additional information.

[50] Carrying out the analysis using school average mathematics scores gives essentially the same results - see below.

[51] I also have information about students reported by the school, including the proportion of students at the school level who are of limited English proficiency, the proportion in gifted and talented programs and the proportion who have free school meals.

PCCATH). The variable SCHNO measures the number of private schools in the county in 1980 (drawn from the NCES Private Schools in America Survey), providing an indication of private school availability.

In sum, the data provide useful measures corresponding to the endogenous variables in the empirical model, as well as a immensely rich set of potential controls from different sources. The data are at four distinct levels of aggregation.[52] First, I have information aggregated across all the eighth graders sampled from a particular school in the data set. At the second level, I have information about the average characteristics of all the children in these schools. Third, the data include information about the school district characteristics for each public school in the sample. Fourth, I include county level information, for the counties in which the schools are found. At each level, I can control for a wider range of potential influences on school and parental behavior than has been possible previously; the data allow me to explore issues which were difficult to address before.

5 Results

5.1 Basic Production Function Specification

I begin this section with a discussion of my basic specification for the public school production function. Column (1) of Table 3 gives weighted least squares estimates[53] of the school production function using school level data from the base year ($n = 738$). The dependent variable is the log of a public school's average reading score, the output of the production process which I focus on. The right hand-side includes measures of school inputs - log of total enrollment and log of the number of teachers (implying a certain pupil-teacher ratio) - and an indicator of whether the school has a collective bargaining agreement. I control also for school racial composition using four racial dummies (the omitted category is WHITE), the logs of average income and education levels of parents of the children in the sample, as well as the share of these families in which both parents are present. To allow for possible 'congestion' effects in the home, whereby a child in a large family receives less parental attention than a child in a small family, I control for the average number of children per household, and the proportion of parents who help their children with homework.[54]

I have two measures which capture the strength of incentives to perform efficiently faced by the school. The relevant measure of competition in my data is given by PCPRIV, the share of children in the school district who are enrolled in private school. This provides an

[52] Later, I add a fifth, using individual student and parent data.

[53] I weight by the number of pupils sampled in each public school in the data set.

[54] I have experimented with a richer set of household and school controls, using regressors whose inclusion in a production function is hard to justify. Doing so does not have a significant impact on the findings. The appeal of the simple specification is that a strong case can be made in principle for including each variable.

indication of the availability of private schooling and thus ease of private school exit.[55] For parental pressure, I use the proportion of eighth grade parents who take part in (unspecified) PTA activities (given by the variable PTACT). The rationale for including this is that a higher proportion of active parents should be better able to apply pressure on an under-performing school.

5.2 Basic Production Function Estimates

All the racial composition measures enter the production function in column (1) negatively and all but the Asian/Pacific Islander variable are highly significant, indicating that average reading scores fall as the proportion of whites declines. Consistent with the earlier literature, higher average parental income and education raise school performance significantly: a 10 percent increase in average parental income raises average reading scores by around half a percent, while a 10 percent increase in average parental education in a school raises average reading scores by over 5 percent, a substantial amount.

Both the coefficient estimates on the log of school enrollment and the number of teachers are statistically significant, which is not always the case in the literature. As the point estimates are effectively equal and opposite in sign, I rerun the same specification including the pupil-teacher ratio instead (not reported in the table). The coefficient on this new variable is -0.0014, implying that a reduction in the school's pupil-teacher ratio will raise average test scores; again the coefficient is statistically significant. To give an idea of the economic significance of this point estimate, a 10 percent reduction in the pupil-teacher ratio below the mean, reducing it by just under 2 students per teacher, would raise average reading scores by around a quarter of a percent, which is fairly insignificant economically.[56] The collective bargaining indicator is indistinguishable from zero - effects of unionization appear insignificant. The average number of children enters negatively, with borderline significance, while the proportion of parents helping with homework has a positive though insignificant effect.

My main interest centers on the impact of market conditions and parental pressure on student achievement. In this specification, both are treated as exogenous. It is clear from the

[55] Two important caveats should be made here. First, high private school share in a district does not mean that private school spaces are necessarily available. Second, even if private school share is high and spaces are available, very few households may be on the margin of attending private school; if public school enrollment is inelastic to changes in school quality, public schools may be little influenced by private school presence. This second consideration suggests a modification to the measure of private school availability, adjusting for the degree of heterogeneity of households in the local market; I return to this in Section 7 below.

[56] I have estimated specifications adding other school variables - (log of) the number of days in the school year, log of total eighth grade enrollment, whether school uniforms are worn, whether the school has a gifted and talented program - without any substantial effect on the results. When I add the log of the number of days in the school year to the basic specification, for instance, this has a negative, though insignificant, coefficient and the other coefficients are very similar to the ones reported.

coefficient on PCPRIV that the measure of local competition has a negative effect on public school quality: a 10 percentage point rise[57] in PCPRIV in column (1) will lower average test scores by around three-quarters of one percent. This is consistent with the idea that private schools 'cream-skim' from the public schools; by taking the better students, private schools gain at the public schools' expense. It also consistent with competition having negative productivity effects on public schools. At the same time, parental pressure (as measured by PTACT) seems to have no effect when PTACT is treated as exogenously determined.

5.3 Endogeneity

The previous results treat the two incentives measures - for competition and for parental pressure - as exogenous to public school quality. Yet there are strong reasons to question this exogeneity assumption. As public schools get worse, private school enrollment will probably rise as parents move their children out of the public sector. So the inclusion of private school share on the right-hand side will lead to a downward bias on the 'competition' coefficient (as discussed in Hoxby (1994a)). Similarly, where public schools do badly for unobserved reasons, we might expect parents to become more involved to counteract the poor school quality, again leading to a downward bias in the coefficient on the parental pressure variable. To allow for the potential endogeneity of my incentive measures, I adopt an instrumental variables approach.

Parental Involvement Instruments

To instrument for parental pressure, my strategy is to use certain characteristics of individual parents, aggregated to the school level. I focus on the variable ACTIVE, which gives the proportion of parents who are members of organizations other than the PTA which have other parents of children in the school as members. This variable is highly correlated with the proportion of parents who take part in PTA activities,[58] the coefficient on ACTIVE from a regression of the PTA variable on a constant and ACTIVE being around 0.4, with a P-value of 0.0001. But it must also be uncorrelated with the error term in the public school production function, which will be the case if it can be legitimately excluded from the production function. In the NELS parent questionnaire, the survey instrument provides two examples of the type of organization which are relevant: neighborhood and church organizations. These have no direct connection with the running of public schools, supporting the case that ACTIVE does not belong in the test score equation. Instead, it provides an indication of parental taste for collective action, independent of school quality, which explains the correlation with PTA

[57] For instance, moving from a district with a 10 percent private school share to a 20 percent share.

[58] Putnam (1995) notes that participation in one form of activity which creates social capital is usually correlated with other forms of activity among individuals. As an aside, he also stresses the link between social networks and the quality of local governance, a specific version of which I measure in this paper.

participation.[59]

To test formally whether PTACT is endogenous, I perform a Durbin-Wu-Hausman test and find that the null hypothesis of exogeneity may be rejected.[60]

Competition Instruments

For competition instruments, I use county level demographics: the proportion of the county's population who are black, the county median household income, and the proportion of the population with a college degree - a larger set of potential county-level instruments is available, though the chosen three seem most likely to influence private school share. I also use the proportion of the county's population that is Catholic, both on its own and in conjunction with the other three measures. To justify this instrumenting strategy, one must show that county demographics are both orthogonal to the error term in the public school production function and highly correlated with the endogenous variable of interest, in this case the private school enrollment share at the district level. I argue that both conditions are satisfied, the former in large part because of the quality of my data.

The concern with using demographic characteristics as instruments is that the composition of communities is itself endogenous to, among other things, school quality, and so cannot satisfy the required orthogonality condition.[61] In practice, the composition of counties is unlikely to be completely independent of public school quality; what is more relevant is the degree of dependence. That *school district* composition is influenced by the quality of a given school in that district is easy to believe; that a county's composition is influenced by the quality of a given school in a district is less apparent.

We can imagine cases in which there are unmeasured local characteristics which affect the performance of a given public school (picked up in the error term of the public school production function). These characteristics may be correlated with county demographics, thus violating the required orthogonality condition for the instruments. To counteract this concern, I ensure that I control carefully for demographic and other characteristics at the district level in the school production function. If there are unobservable characteristics affecting school performance at the local level, they are far more likely to be correlated with district rather than corresponding county variables. By including a set of local controls at the district level,

[59] As I describe below, I include a number of other variables - measures of parental activity and controls for local characteristics - to reduce the likelihood that ACTIVE picks up unobserved characteristics of parents and the community which are correlated with the error in the production function.

[60] In the first stage, I regress the supposed endogenous variable PTACT on the excluded instruments. Taking the fitted value from this regression, I form the prediction error, and add that to the production function, which I estimate using least squares. The coefficient on the fitted value is -0.189, with a t-statistic of -3.382, allowing the null hypothesis of exogeneity to be rejected.

[61] Recently, for example, the San Jose Mercury News (June 21, 1998) reported that the poor quality of public schools in Santa Clara county made recruitment of executives from elsewhere in the US difficult.

I remove as much of the remaining variation in the public school's error term which could be correlated with community characteristics as possible.[62]

The other property - that the county demographic instruments should be correlated with the district private school share - is also satisfied. While public schools typically draw students from a single district (due to residency requirements), the same does not hold for private schools, who often draw from a much wider geographic area. Thus, even controlling for district demographic characteristics, we would expect county demographic variables to have some explanatory power in predicting district private school enrollments. The 'first-stage' regressions in the instrumental variables procedure indicate that this in fact holds.[63] The identification of the endogenous competition measure rests on the differences between county and district demographics in this 'first stage' regression.

To summarize, in my model the justification for using county-level characteristics as instruments is that they satisfy the two required properties: as I already control carefully for district characteristics in the production function, there is unlikely to be much variance in the production function error term which is still correlated with these county variables; further, because of the fact that private schools tend to enroll from a wider geographic region than a district, county demographics help to explain a district's private school share. Thus I instrument for a district's private school share using economic and demographic characteristics from the county in which the school is located: the percentage of the population who are black (CPCBLACK), county median household income (CMHHINC), and the percentage of county residents who have a college degree (CPCEDDEG). Using these instruments, the model is overidentified, permitting a partial test of the exclusion restrictions. Such tests support the chosen instrument strategy, as discussed below.

I also use the proportion of Catholics in each county (PCCATH in Table 2), following Hoxby's (1994a) approach, both alone and in conjunction with the other three measures. The results from doing so are discussed below.

[62] Hoxby (1994a) uses denominational measures (including the proportion of Catholics in the population) at the county level as instruments for private school share. A similar instrumenting strategy to my own - using characteristics from a much wider geographic area - is employed by Evans *et al.* (1992); they treat demographics at the metropolitan level as exogenous to peer composition within schools. In support of this approach, they note that more mobility in the US is within metropolitan statistical areas (MSAs) than between MSAs - of those families living in MSAs in 1980 who moved between 1975 and 1980, two-thirds moved within the same MSA. When they treat county-level variables as exogenous to school peer composition, they find results similar to those using MSA data.

[63] Testing the exclusion of the county demographic instruments from the first stage regression produces an F-statistic of over 15, allowing the restricted specification to be rejected at the 99.9999 percent level.

Instrumental Variable Estimates

In column (2) of Table 3, I report production function estimates using the same regressors, but now treating PTACT and PCPRIV as endogenous, and instrumenting with the variables ACTIVE, CMHHINC, CPCEDDEG, and CPCBLACK described above. Note that the race, school input, and family background coefficients are very similar to the weighted least squares estimates, with the exception of the coefficient on Asian/Pacific Islander, which is now close to zero. However, the negative effect of private school presence on public schools becomes more negative on instrumenting, falling from -0.075 to -0.216. This is at odds with the downward bias story rehearsed earlier (in which poor public schools increase private school share, so that reverse causation contaminates the least squares estimates). The new point estimates imply that changes in county demographics sufficient to raise private school share in a district by 10 percentage points would *lower* public school test scores by around two percent. However, it should be noted that the P-value for the coefficient on the competition measure is only 0.186.[64]

At the same time, I find that collective action on the part of parents (measured by the share of parents who are active in the school PTA) has a significant positive impact on public school performance, over and above the effects of parental demographics and community controls.[65] The coefficient rises from around zero to 0.152, with a P-value of 0.037. This is consistent with the downward bias story rehearsed above: without correcting for endogeneity, parental pressure will seem to have less impact than it really has because it tends to increase when public schools under-perform. (I present more evidence in support of this interpretation below.)

In terms of the quantitative significance of the structural coefficient on the parental pressure variable, from the reduced form of the production function, an exogenous increase of 0.25 in ACTIVE (its mean is 0.19) would increase public school test scores by around 1.5 percent. From the structural estimates, a large portion of this increase comes about through an increase in the level of parental pressure.

The model in column (2) is overidentified, as there are four (excluded) instruments for the two endogenous variables. I compute test statistics for these overidentifying restrictions, asymptotically distributed as chi-squared(2). The test statistic of 3.619 for the specification in column (2) falls well-within the 5 percent critical value of 5.991 (its P-value is around 0.18), meaning that the joint null hypothesis that the model is correctly specified (the instruments should not be included as regressors) and that the instruments are valid cannot be rejected.

Column (3) presents a variant of the same production function, this time using the share

[64] In a variety of alternative specifications (not shown), instrumenting *does* raise the structural coefficient on the competition measure, consistent with the downward bias story, but the resulting 'competition' coefficients are still insignificantly different from zero.

[65] Previous efforts to gauge the importance of parental involvement more generally (see Epstein (1991), for instance) have paid insufficient attention to potential biases due to reverse causation, from school performance to the level of parental involvement.

of Catholics in the county population as the sole instrument for district private school share. Again, the coefficients on the school inputs and average parental and student characteristics are similar to the weighted least squares estimates in column (1). The impact of parental pressure now declines slightly, from 0.152 to 0.143, though the P-value rises to 0.03. Consistent with the downward bias story associated with the competition measure, the coefficient on private school share moves closer toward zero but is still slightly negative. Only in the weighted least squares version is private school share statistically significant at the 5 percent level, and it is significantly negative.[66]

Additional Controls

It is important to stress that all the specifications for the public school production function reported in this paper include a number of additional controls, in an effort to remove as much of the variation in the public school error term as possible. As additional family background controls, I include the proportion of parents who are adherents of various religious denominations. I also control for the proportion of parents who discuss schooling with their children, the proportion who help their children with homework, and the proportion who impose rules about doing homework and watching television, with further controls for the average number of siblings, and the proportion of two-parent families. The data contain measures of the proportion of parents who volunteer to help at the school, and when I include this as a control in the production function, the measured effect of parental pressure on public school quality increases markedly.[67] To capture unobserved local characteristics, I include controls for district wealth (using MEDHHINC), the distribution of educational attainment in the district (measured using the proportion with a degree), and measures of district racial composition.

The inclusion of these measures helps to ease the concern that the chosen instruments are correlated with unobserved characteristics of parents or the local community which affect student achievement. Parents who are active in other organizations tend to be more active in the school PTA, as evidenced by the first-stage regressions. They might also be more inclined to be active in their children's lives, monitoring their behavior more intensely perhaps. Such monitoring might have a positive effect on student achievement, leading to the false inference that PTA activism was responsible for the gain. However, I am already controlling carefully for parental monitoring of their children, and for parental involvement in the home more generally, so this line of objection is weakened. The concern that county demographics capture

[66] When I combine all four potential county level instruments - MEDHHINC, PCBLACK, PCEDDEG, and PCCATH - the estimates on all the variables are very similar to column (2), except for the coefficient on private school share, which is around -0.08.

[67] Because volunteering is likely to be subject to the same kind of endogeneity problem as my measure of parental activism in the PTA, and because additional instruments do not readily suggest themselves, I choose to omit it from the specifications reported here.

unobserved local characteristics is similarly diffused by the inclusion of the district variables.

To give some indication of the robustness of the production function specification, if I add state dummies to the production function in Table 3, the coefficients on the competition and parental pressure measures remain essentially unchanged. For instance, if I use the county instruments as in column (2), the coefficient on PCPRIV is -0.087 (standard error 0.14), and the coefficient on PTACT is 0.161 (standard error 0.06). The test of overidentifying restrictions here is as before. Then if I include Herfindahl indices for the district and county racial composition (the sum of the squared proportions of the five racial groups) as additional controls, again there is little change to the competition and parental involvement coefficients. These Herfindahl indices convey information about the degree of racial homogeneity at the community level. Using the county instruments, the coefficient on PCPRIV is -0.19 (standard error 0.16), while the coefficient on PTACT is 0.12 (standard error 0.05). Here, the test of overidentifying restrictions is 1.925, with a P-value of around 0.38. So the null hypothesis again cannot be rejected, at even the 35 percent level. If I include both state dummies and the Herfindahl indices as controls, similar coefficients arise: PCPRIV has a coefficient of -0.08 (s.e. of 0.16), and PTACT has a coefficient of 0.18 (s.e. of 0.06). The test of overidentifying restrictions is 0.693, even closer to zero than before.

If I use mathematics scores, instead of reading scores, as the dependent variable in the education production function, the same general pattern of findings as discussed above.[68]

In sum, the evidence in Table 3 indicates that weighted least squares leads to a significant downward bias in the coefficient on the parental pressure variable. Once instrumented for appropriately, collective parental action has a positive and significant effect on school quality. In terms of the competition measure, instrumenting gives mix results. In some cases, the coefficient on the competition measure increases when instrumented for, as might be expected. But such an outcome does not occur uniformly, and in any event, the resulting structural coefficient remains insignificantly different from zero.[69] In the next sub-section, I present system estimates.

[68] As a different possible output measure, I have also used the *dispersion* of the reading score (its standard deviation among eighth graders in a school) as a public school output measure, and I find some evidence that the dispersion increases in more competitive environments, other things being equal.

[69] If I estimate the education production function, as in Table 3, but include only the competition measure (district private school enrollment share or PCPRIV), thus dropping my "parental pressure" variable, the coefficient on private school enrollment share is still negative. For example, with the county competition instruments, the PCPRIV coefficient is -0.124 with a standard error of 0.143 and P-value 0.385. Thus the impact of private school share (when instrumented for) remains similar, regardless of whether measures of parental involvement are included.

5.4 System Estimates

To examine the inter-relations among public school quality, parental pressure, and private school share, I estimate the three-equation system described in Section 4. The first equation in the system, equation (9), describes quality setting by the public school, school quality depending on school inputs, a measure of the degree of local competition, and the level of parental pressure, in addition to parental and community controls (the same specification as in Table 3). The second equation, (12) above, measures the level of parental pressure, a function of parental characteristics and taste for collective action, as well as public school quality and the degree of local competition. The third, (13), measures district private school share, depending on local demographics and the quality of the public school (determined within the system). The system is estimated using three-stage least squares, weighting by the number of students per school in my sample.[70]

The estimates of the three equations are given in Table 4, with panel (a) giving the production function, panel (b) parental pressure, and panel (c) the private school share. Instruments vary across columns. The first column reports a specification in which the instruments for private school share are given by CMHHINC, CPCEDDEG, and CPCBLACK, as in column (2) of Table 3; the second column reports a specification which uses the proportion of Catholics in the county, as in column (3) of Table 3. In Table 4(a), I present estimates of the public school production function, the first equation in the system. Note that the coefficient on private school share is very similar to that in Table 2, column (2) - negative though not significant at the five percent level. The parental pressure coefficient is highly positive and significant, and the other estimates are very much as before.

Turning to Table 4(b) column (1), the proportion of parents who take part in PTA activities rises with the income and education levels of parents. Based on the coefficients of the reduced-form of the parental pressure equation reported in Table 5, column (2), a 10 percent increase in parental income implies that the percentage of parents active in the school PTA will rise by over half a percentage point. It is also highly correlated with ACTIVE: a 10 percentage point increase in the proportion of parents active in other organizations is predicted to raise the proportion of parents active in the school PTA by around 3 percentage points (based on the reduced-form coefficient estimates derived from the system in Table 5). Consistent with the bias story rehearsed above, in the structural equation parental activism declines as public school test scores rise. Parental pressure also declines as schools get larger, in support of the view that free-riding increases with school size; the reduced-form estimates imply that a 10 percent increase in total school enrollment lowers the proportion of parents active in the school

[70] In addition to providing information about the determinants of parental pressure at the school level and district private school share, three-stage least squares yields more efficient estimates of the production function parameters than those reported in Table 3.

PTA by just under half a percentage point. Having more siblings reduces parental activism, perhaps because time becomes more scarce. The district private school enrollment share has a positive effect on parental activism in the structural equation, but the coefficient is imprecisely estimated. Thus the claim that the *volume* of parental pressure increases in more competitive markets receives only limited support.

Table 4(c) presents estimates of the determinants of private school share at the district level. A higher percentage of blacks at the county level significantly raises private school share, perhaps because of 'white flight.'[71] High county income levels also raise private school share: based on the reduced-form estimates, a 10 percent increase in county median household income is predicted to raise private school share by around a third of a percentage point. If the public school in my sample has a collective bargaining agreement (making it more likely that the district is unionized), private school share also rises. This may be because unionized schools are perceived as being less responsive to parental needs, though the collective bargaining indicator is associated with higher test scores in the public school production function (see panel (a), column (1)). There is evidence that higher test scores in the public school reduce private school share, but this effect is weak and offers minimal support for the downward bias story rehearsed above. Parental activism in the public school has no discernible effect on private school share at the district level.

Column (2) of Table 4 reports the estimates obtained when using just the Catholic county proportion as an instrument for private school share. Three differences from the column (1) estimates are worth pointing out. First, the structural coefficient on parental pressure is now even more strongly positive, with a P-value of 0.009. Second, the competition measure in the production function now has a positive coefficient, though it is insignificantly different from zero.[72] Third, turning to panel (c), the log of the average reading score in the public school now has a significant negative effect on private school share, consistent with the downward bias story.

Overall, the three-stage least squares estimates with respect to the production function offer a similar picture to those reviewed in the previous subsection. The impact of parental pressure on school performance is significantly positive when instrumented for, while the estimates of the impact of competition are, to a limited extent, sensitive to the choice of instrument. However, regardless of instrument choice, the estimates indicate that competition has an effect on public school performance that is statistically indistinguishable from zero.

The estimates of the second and third equations in the system provide limited support for

[71] The reduced-form coefficients of the private school share equation given in Column (3) of Table 5 imply that a 10 percentage point increase in proportion of black in a county raises the district private school enrollment share by around 1.4 percentage points.

[72] When I use all four county level demographic variables to instrument for private school share (not reported in the table), the private school coefficient is slightly negative.

the view that there are strong 'quantity' effects working from either competition to the amount of parental pressure, or from parental pressure to district private school share. It is worth noting that the production function specification reported in Tables 3 and 4 is restrictive in that it does not permit interactions between competition and parental pressure in the production function. In the next subsection, I present estimates of a system which includes such interactions. Before that, I consider alternative measures of parental involvement.

Other Parental Pressure Measures

The prior discussion has emphasized parental pressure as a determinant of school conduct, and the analysis has focused on the variable PTACT as parental pressure measure. Yet parents do far more than just engage in collective action, and my data include alternative parental involvement measures.

Table 6 presents alternative estimates of the system, replacing PTACT with variables VOLUNT and PTA in columns (1) and (2) respectively. VOLUNT measures the proportion of eighth grade parents interviewed who volunteer at the school, while PTA measures the proportion of parents who are members of (rather than being active in) the school PTA. Parents who volunteer supply the school with additional labor; they are also in a better position to monitor school personnel. The PTA variable is closer to PTACT. Both capture different aspects of parental involvement in school affairs. Comparing with column (1) of Table 4 shows similar results to those obtained using PTACT, the proportion of parents active in the school PTA. In each case, the parental involvement measures have a strong positive effect on school performance and are positively related to the ACTIVE variable. (It is noteworthy that the competition measure has a far stronger negative effect on public school performance when the PTA measure is used instead of PTACT or VOLUNT, though the reason for this is not entirely clear. In addition, low test scores have a stronger stimulating effect on PTA membership than on either PTA activism or the level of volunteering.)

These findings indicate that a variety of forms of parental involvement (albeit highly correlated) serve the same end: to help the school focus on raising academic achievement.[73] Further, controlling for other things, poor public school performance induces more parental involvement of various forms in the school.

Interactions

In Table 7, I re-estimate the public school production performance equation with the following change: I now allow for the impact of parental pressure to vary with the degree of competition. First consider panel (a), column (1) (which corresponds to the same panel in Table 4 but

[73] Whether the school spends less time producing other worthwhile social 'goods' or simply wastes fewer resources remains untested in my work, even though it is an important issue.

without the interaction). When the interaction term is added, the direct effect of parental pressure on public school performance remains strongly positive and significant. Private school competition now has a direct positive effect on public school quality, though the standard error is large. At the same time, the coefficient on the interaction term PTACT×PCPRIV is negative and significant, implying that impact of parental pressure *falls* when competition is greater. This lends support to the notion that parental pressure and competition are substitutes in the education production process.

Again, the use of PCCATH as an instrument for private school share leads to stronger inferences about the impact of competition in the production process, as in panel (a) column (2) of Table 7, although the interaction term is still negative and highly significant.

While the structural estimates are informative as to channels of influence, we are also interested in seeing how changes in exogenous variables, and especially instruments, work through the system to influence the three endogenous variables. Because of the non-linearity in the production function (due to the interaction between parental pressure-competition), computing the effects of changes in exogenous variables.[74] The procedure I adopt is as follows: first, I solve the system with the interaction in Mathematica, using the parameter estimates from column (1) in Table 7. If multiple solutions arise, I check to see whether the implied values of the endogenous variables evaluated at the means of the exogenous variables are close to their observed means. This usually allows me to rule out one of the pair of solutions which arise. I substitute in the mean values of all exogenous variables except one, and I compute the effect of a given change in that exogenous variable on the three endogenous variables in turn.

In terms of changes in the ACTIVE variable, these have very slightly positive effects on school performance: a one standard deviation increase gives rise to around a 0.1 percent increase in test scores once the negative interaction is taken account of. The effects on parental participation are stronger, PTACT rising by over a percent, while the effects on private school share are positive but slight. Changes in county level median household income (which served as an instrument for private school share) have slight negative effects on public school performance: a one standard deviation increase in county median income lowers average test scores by .06 of a percent. But it should be noted that this takes at face value the positive coefficient on private school share in Table 7, column (1), even though the estimate is insignificantly different from zero.

Interpretation

The estimates from the system help to answer the questions raised in Section 1. In terms of the determinants of parental pressure at the school level, the results in panel (b) of Table 4 indicate

[74] Indeed, the system typically has two solutions, though one can be ruled out as it implies a negative value for parental pressure, evaluated at the means.

that characteristics of parents themselves - their income and education levels - have a great deal of predictive power in explaining active PTA participation. The same is true for parental tastes for participation in general; these are associated with more parental involvement in schools. Interestingly, in neither specification does the existence of private school alternatives have a significant impact on the *volume* of parental participation at the school level. In turn, parental involvement in public school appears to have very little effect on private school share.[75]

In terms of the impact of parental pressure on public school performance, the results provide support for the view that parental pressure has a positive impact on school performance over and above the effects of parental income and education levels. Allowing for the potential endogeneity of parental pressure is critical here. Without doing so, the coefficient on parental pressure is likely to be biased downward, as parents have more of an incentive to attempt to influence school conduct when the school under-performs. In contrast, the results imply that competition from private schools has a negative or insignificant effect on school performance, even when allowing for reverse causation from poor public schools to high private school enrollment.

The analysis does not decompose the overall private school effect into its component parts; this issue is taken up in the next section, which discusses extensions. The usual decomposition separates sorting and productivity effects of competition. Sorting effects are likely to have a negative influence on public school quality, for two distinct reasons. In the first case, private schools select on the basis of ability, and this leaves the lower tail of the ability distribution in the public schooling system, accounting for lower public school test scores. This type of effect works independently of any peer effects. In the second case, private schools select *and* there are strong positive peer effects working from high- to low-ability students. Now the removal of high ability students from the public schooling system has an additional negative effect on public school performance as positive peer effects disappear.

Positive productivity effects of competition are certainly consistent with the overall impact of private school competition on public school performance implied by the estimates in Tables 4 and 7. However, if they are positive, they are at the very least offset by other negative effects. To the extent that the public schooling system is itself highly stratified, sorting between public and private sectors will be less important, making it less likely that that strong negative sorting

[75] In a related theory paper (McMillan (1997)), I explore the effects of the actions of other parents on an individual's participation decision. Table 8 in the current paper provides preliminary evidence on this using individual data, indicating that there are spillover benefits from collective action: the impact of the collective action variable comes not from the actions of a student's own parents, but rather from the aggregate level of parental pressure in the school as a whole (see Table 8(a) for least-squares estimates of the production function, and Table 8(b) for instrumental variables estimates). Results also indicate that average parental education levels and socio-economic status are strong predictors of both student and school performance, while measured school inputs have a weaker impact - these conform to earlier findings in the literature.

effects are present.[76] As made clear in Section 1, the productivity impact of competition need not be positive anyway - again, this is consistent with the findings reported here.[77] In the Extensions section, I discuss ways of shedding more light on the impact of competition from private schools. Understanding this better has very important implications for policy.

The theory highlighted the importance of interactions between voice and exit. While the evidence of strong effects on the *levels* of each is muted, I do find some evidence that the marginal impact of voice declines as competition increases. As is clear from the interaction term in Table 7(a), the marginal impact of parental pressure on school performance declines significantly when we move to markets with greater ease of access to private school. Thus, rather than being reinforced by competition, this result implies that parental pressure has less impact when competition becomes more intense. Consistent with this finding would be a story in which increased private school availability leads to greater sorting across parental socio-economic groups. As the more effective mobilizers among parents switch to private school, so the impact of a given unit of collective pressure on the part of parents declines. Even if the volume of collective pressure is unchanged, its overall impact is lower.

6 Next Steps

I discuss briefly five tasks that remain in the empirical work.

6.1 Community Sorting

The estimates in the previous sections were obtained without allowing for either selection into communities or selection on the part of private schools. In this sub-section, I consider an approach to correct for any bias due to selection into communities (known as 'Tiebout bias'). The estimates obtained when allowing for community selection serve as a specification check on the earlier findings where no correction was made.

Correcting for Bias

An illuminating discussion of the Tiebout-bias problem appears in Rubinfeld *et al.* (1987). The essence of the problem is that individuals have unobserved characteristics, including tastes, and they choose their community partly depending on these tastes for observable characteristics of the community (such as school quality, the focus of the current analysis). Community sorting

[76] The analysis already conditions on the basis of observables. It would be interesting to explore the extent to which private school competition induces greater sorting on the basis of unobservables. In Section 5 below, I provide a very brief discussion of a way to do this.

[77] Furthermore, the previous discussion called into question the sorting versus productivity effect distinction, as sorting itself is likely to have productivity consequences.

is unlikely to be perfect in practice, so individuals with different observable and unobservable characteristics end up in the same community. To the extent that the observable characteristics of the community (as well as individual characteristics) are correlated with unobservable individual tastes, it becomes difficult to apportion school achievement between unobserved and observed individual characteristics.[78]

A sophisticated approach to correct for the Tiebout-bias problem is described and implemented by Bayer (1999).[79] This involves modeling community choice on the part of households explicitly, using a discrete choice framework. The parameters of the household utility function, in which utility depends on community characteristics, school quality, and consumption, are estimated using a simulated method-of-moments technique, matching predicted and actual community characteristics. This approach makes demanding data requirements, relating in particular to information about each of the communities in the individual's choice set. Rather than assembling the requisite data, the solution proposed by Rubinfeld *et al.* can be used to correct for non-random community selection without having to model the individual discrete choice process explicitly, even though it adds a significant amount of complexity to the estimation.

The focus of the Rubinfeld *et al.* analysis is to recover parameters describing individual demands for local public goods (such as expenditures on schooling), while correcting for Tiebout bias. Individual desired expenditures are revealed in their data from a survey question.[80] A demand equation which makes use of this information is estimated jointly with a separate equation capturing the degree of mismatch between an individual household's desired level of spending and the actual level in the community they choose. In the individual household's chosen community, this mismatch will be the lowest among the alternatives. It is likely to be lower if there is a wider range of communities to choose from, if the individual households have made their community selection more recently, and if the community is more homogeneous (little variation in tastes within a community means that strong correlations between tastes and school quality will be of minor importance).

This type of solution can be implemented using the individual household data in the estimation, and it does involve adding a demand side to the system already being estimated. For each household, the NELS parent questionnaire asks several questions relating to parental satisfaction with the quality of education being provided.[81] These survey responses can be

[78] There may also be characteristics of the *community* which are unobservable to the econometrician but observable to households who choose to live there. If these unobservables are correlated with the error term in the school's behavioral equation, and household characteristics are used as regressors in this equation, then similar bias arises - sorting on the basis of community unobservables means that household characteristics are not exogenous.

[79] See also Epple and Sieg (1998) for a related approach.

[80] The question asked whether homeowners would like more, the same, or less spending on public education.

[81] Question 75, for example, asks : "How satisfied are you with the education your eighth grader has received

used to infer whether desired quality is greater or less than observed quality (measured by a test score); they can also be used to estimate demand parameters in the same fashion as Rubinfeld *et al.* In terms of a sorting equation, I have information on the degree of (observable) heterogeneity in each district, and I also have measures of the range of community choices available. Critically, characteristics explaining the degree of mismatch must not appear in the school production function equation or the 'desired school quality' equation if the parameters of interest are to be identifiable. As the degree of community choice is difficult to exclude from the production function on the basis of the evidence I have already presented, my focus will be on community heterogeneity (making an inference about the underlying dispersion of tastes on the basis of this).

6.2 Other Tasks

For the second task, the children I observe in the sample have already had public school chosen for them, and the estimates should condition on this fact, allowing for selection into public school. Data limitations present an important obstacle to correcting for school selection: though I know a great deal about the characteristics of the public school which parents chose, I know almost nothing about the private schools in each household's choice set. This makes it very difficult to estimate the parameters of the school choice equation precisely. Despite the difficulties involved, I am experimenting with the addition of a selection equation to the system, capturing choice of school sector, using measures of private school availability and population density, both influencing the availability of other schooling options. More work remains to be done here.

Third, I will supplement my competition measure with information relating to community heterogeneity. The theory discussion in Section 1 drew attention to the shape of the distribution of household types as a determinant of the toughness of competition faced by public schools. To the extent that a district or a county is more heterogeneous in terms of income, education, or religious adherence, so the public school enrollment elasticity with respect to school quality is likely to be lower, providing public schools with more insulation from competitive forces. Whether this is the case should be apparent once I refine the measure of competitiveness used.

The fourth task will be to examine peer effects more closely. If peer effects are strong, private school selection may have adverse consequences on public school performance through sorting. Different forms of peer effect can be distinguished, including collective action peer effects which work through the actions of parents (evidence above suggests these are strong), and direct effects of a student's classmates. The relative sizes of these effects remain to be determined.

In a related paper (McMillan (1998b), in progress), I apply the framework developed here

up to now?" (Very satisfied/ Somewhat satisfied/ Not satisfied at all)

to explore the channels through which school finance variables affect public school performance. In particular, I examine how moves to state financing influence the performance effects of parental pressure and competition. Though results are preliminary, they indicate that state financing leads to a reduction in the impact of parental pressure and to a weakening of the effects of competition on school quality. This weakening of discipline helps to explain why state financing is associated with poorer public school performance.

Fifth, the analysis has focused on *average* effects of private school competition. Yet it is quite likely that the impact of competition will vary depending on the underlying distribution of households - for instance, the degree of racial or income heterogeneity at the district or county level. In future work, I will allow the potential effects of competition to vary, by stratifying the sample based on whether counties are relatively homogeneous or heterogeneous in terms of race or income.[82]

7 Conclusion

This paper makes two related contributions. First, it provides a new conceptual framework for understanding public school quality determination, paying attention to the role of incentives, and particularly incentives due to parental pressure. In the framework, public school quality setting is allowed to depend on the strength of incentives due to both parental pressure and competition from private schools. In turn, the amount of pressure applied on public schools by parents is endogenized, being influenced by the strength of local competition and also by the level of public school quality; and private school enrollment will depend on, among other things, public school quality and possibly the level of parental pressure. The system of equations making up the empirical model provides a natural way of capturing interactions among public and private schools and parents; and estimating the system allows questions not addressed in the prior literature to be examined.

The paper's second contribution is empirical, and comes from measuring both the importance of incentives in the determination of public school quality and the strength of the interactions between parental pressure and competition in the education production process. The estimates indicate that collective parental pressure has a strong positive impact on school performance, once the potential endogeneity of parental involvement is allowed for. In contrast, private school competition has a negative or insignificant effect on public school quality, a finding which holds across a variety of specifications. This result undermines the view that competition will have a positive productivity effect that overwhelms any adverse sorting effects on public school quality (though additional research is needed on the potential sorting effects of increased competition). Furthermore, there is some evidence that parental pressure and

[82] It is worth adding that I have paid scant attention to competition *among* public schools. Such competition deserves to be analyzed more fully elsewhere.

competition are substitutes in the education production process - more intense competition from private schools appears to weaken the positive impact of parental pressure on public school performance rather than strengthen it. One natural explanation for this result is that greater competition leads to the exit of the most vocal parents, and the parents left behind in the public school are less effective at applying pressure.

Results from this work have relevance for policy. Given widespread interest in improving public school performance by strengthening incentives, economists have been inclined to emphasize greater competition as the most effective way to improve public schools. Yet this paper provides some grounds for being cautious about using competition from private schools as a means of raising public school performance; the evidence does not support the view that competition will have overwhelmingly positive productivity effects on public schools. Caution is still due, however, when extrapolating from the workings of the existing system to the likely effects of private school vouchers. Under a large-scale voucher program, substantial private school entry is likely, giving rise to changes in competitiveness going well beyond the changes apparent in cross-sectional data. The effects of a voucher on public school quality and sorting between public and private sectors remain highly uncertain.

The evidence in the paper indicates that parental pressure can have strong effects on public school quality. Yet it is not clear what policy lever is available that might induce greater parental involvement; the experience with charter schools, which give parents more say in school affairs, should prove useful here. Even if a lever is available, raising parental involvement will not come for free, not least as it entails a sacrifice of parental time.

Table 1: Comparing Public and Private Schools

Average Characteristics of Each Type of School

Variable definition	Public ($n = 738$)	Private ($n = 192$)
eighth grade reading score	49.6	55.2
eighth grade mathematics score	49.8	55.0
total school enrollment	727.2	392.9
number of teachers in school	41.5	25.4
pupil-teacher ratio	17.7	21.6
teacher salary (dollars)	18,156.6	13,849.0
proportion of schools with collective bargaining agreement	68.7	5.2
annual parental income (dollars)	34,892.7	65,501.9
parental education (years)	13.9	15.4
percent black	11.1	7.1
percent Hispanic	8.6	4.9
percent Catholic	28.4	47.1
percent Jewish	1.3	6.3
percent parents taking part in PTA activities	21.0	53.4
percent parents active in other organizations	19.1	32.1

Table 2: Definition of Variables from the Public School Sample

($n = 738$)

(a) School Characteristics

Variable	Definition	Mean	Std.Dev.	Min.	Max.
MREADBY	average eighth grade reading score	49.593	4.352	36.000	63.737
LMREADBY	log(average eighth grade reading score)	3.900	0.089	3.584	4.155
TENROL	total school enrollment	727.225	405.264	15.000	3940.000
LTENROL	log(total school enrollment)	6.440	0.589	2.708	8.279
DAYS	total number of days in school year	178.921	2.194	174.000	181.000
LDAYS	log(total number of days in school year)	5.187	0.012	5.159	5.198
TEACHERS	number of teachers in public school	41.542	18.690	5.500	80.000
LTEACH	log(number of teachers in public school)	3.603	0.541	1.705	4.382
COLLBARG	collective bargaining indicator for school	0.687	0.465	0.000	1.000
SCSAMPL	number of eighth graders drawn from each school	20.694	5.236	1.000	48.000

(b) Average Parent and Student Characteristics in Eighth Grade Sample

Variable	Definition	Mean	Std.Dev.	Min.	Max.
API	proportion Asian/Pacific Islander	0.037	0.073	0.000	0.667
BLACK	proportion black	0.110	0.192	0.000	0.955
HISP	proportion Hispanic	0.086	0.160	0.000	0.900
NATAM	proportion Native American	0.009	0.038	0.000	0.692
INCOME	average parental income (thousands of dollars)	34.893	15.815	6.824	140.105
LINCOME	log(average parental income in dollars)	10.370	0.427	8.828	11.850
PARED	average parental education (years)	13.857	0.970	11.312	17.273
LPARED	log(average parental education in years)	2.626	0.069	2.426	2.849
TRADFAM	proportion parents in two-parent families	0.619	0.165	0.030	1.000
CHILDREN	average number of children per family	2.346	0.524	1.000	4.636
RULEHW	proportion households with rules about homework	0.764	0.118	0.087	1.000
HELPHW	proportion parents who help with homework	0.315	0.130	0.000	1.000
CATHOLIC	proportion Catholics in eighth grade sample	0.283	0.230	0.000	1.000
JEWISH	proportion Jewish	0.013	0.051	0.000	0.522
MOSLEM	proportion Moslem	0.002	0.012	0.000	0.111
OTHCHRIS	proportion in other Christian denominations	0.081	0.089	0.000	0.818
PROTSTNT	proportion Protestant	0.534	0.245	0.000	1.000
PTACT	proportion parents who take part in PTA activities	0.210	0.137	0.000	1.000
ACTIVE	proportion parents active in other organizations	0.192	0.126	0.000	1.000

(c) District and County Characteristics

Variable	Definition	Mean	Std Dev.
PCPRIV	proportion enrolled in private school in the district	0.118	0.072
MEDHHINC	district median household income ($ thousands)	30.124	10.287
PCAPI	proportion Asian/Pacific Islander in the district	0.024	0.060
PCBLACK	proportion black in the district	0.107	0.151
PCHISP	proportion Hispanic in the district	0.090	0.160
PCEDDEG	proportion with a college degree in the district	0.175	0.096
PCUNEMP	proportion unemployed in the district	0.067	0.033
CMHHINC	county median household income ($ thousands)	29.609	7.973
CPCAPI	proportion Asian/Pacific Islander in the county	0.023	0.047
CPCBLACK	proportion black in the county	0.111	0.124
CPCHISP	proportion Hispanic in the county	0.088	0.150
CPCEDDEG	proportion with a college degree in the county	0.178	0.071
CPCUNEMP	proportion unemployed in the county	0.067	0.025
CPCPRIV	proportion enrolled in private school in the county	0.119	0.062
PCCATH	proportion Catholic in the county	0.196	0.167
SCHNO	number of private schools in the county (in 1980)	94.700	194.600

Table 3: Public School Production Function[a]

($n = 738$)

Variable	(1) WLS	(2) IV[b]	(3) IV[c]
Constant	2.112**	2.249**	2.169**
	(0.122)	(0.151)	(0.134)
% Asian/Pacific Islander	-0.033	-0.012	-0.029
	(0.030)	(0.037)	(0.034)
% black	-0.097**	-0.099**	-0.101**
	(0.022)	(0.024)	(0.023)
% Hispanic	-0.038*	-0.044*	-0.053**
	(0.017)	(0.020)	(0.015)
% native American	-0.133**	-0.129*	-0.118*
	(0.047)	(0.050)	(0.050)
log(average parental income)	0.045**	0.033**	0.036**
	(0.010)	(0.012)	(0.012)
log(average parental education)	0.547**	0.517**	0.533**
	(0.011)	(0.064)	(0.061)
proportion of parents who help with homework	0.017	0.012	0.016
	(0.016)	(0.017)	(0.017)
log(school enrollment)	-0.029**	-0.021*	-0.020*
	(0.008)	(0.009)	(0.009)
log(number of teachers)	0.031**	0.031**	0.030**
	(0.008)	(0.008)	(0.008)
collective bargaining indicator	-0.005	0.012	0.005
	(0.005)	(0.007)	(0.006)
proportion of parents active in school PTA	0.003	0.152*	0.143*
	(0.016)	(0.072)	(0.066)
district private school enrollment share	-0.075*	-0.216	-0.061
	(0.036)	(0.163)	(0.097)
R-squared	0.658		

[a] Dependent variable: log(public school average reading score).

[b] Excluded instruments: ACTIVE, CPCEDDEG, CMHHINC, CPCBLACK (see Table 2).

[c] Excluded instruments: ACTIVE, PCCATH (see Table 2).

In all three specifications, additional household controls not shown: proportion of households with rules about doing homework, proportion of parents who discuss schooling with their children, and controls for religious affiliation, and family structure. Additional district controls not shown: PCEDDEG, MEDHHINC, and racial composition measures (described in Table 2).

Estimated standard errors in parentheses.

** denotes significance at 1 percent level.

* denotes significance at 5 percent level.

Table 4: System Estimates using Three-Stage Least Squares

($n = 738$)

Table 4(a): Public School Production Function[a]

Variable	(1)	(2)
Constant	2.239**	2.164**
	(0.151)	(0.152)
% Asian/Pacific Islander	-0.020	-0.049
	(0.035)	(0.037)
% black	-0.102**	-0.115**
	(0.024)	(0.025)
% Hispanic	-0.034	-0.024
	(0.019)	(0.020)
% native American	-0.108*	-0.118*
	(0.047)	(0.051)
log(average parental income)	0.031*	0.033**
	(0.012)	(0.013)
log(parental education)	0.524**	0.538**
	(0.063)	(0.066)
proportion of parents who help with homework	0.009	0.010
	(0.016)	(0.018)
log(total school enrollment)	-0.016	-0.016
	(0.009)	(0.010)
log(number of teachers)	0.028**	0.030**
	(0.008)	(0.001)
collective bargaining indicator	0.016*	0.007
	(0.007)	(0.006)
% parents active in school PTA	0.157*	0.202**
	(0.067)	(0.078)
district private school enrollment share	-0.244	0.042
	(0.161)	(0.140)

[a] Dependent variable is log(average school reading score).

The production function includes the same additional controls described beneath Table 3. All three equations in the system include controls for religious affiliation (not shown).

Estimated standard errors in parentheses.

** denotes significance at 1 percent level.

* denotes significance at 5 percent level.

Table 4(b): Parental Pressure[b]

Variable	(1)	(2)
Constant	2.465**	2.362**
	(0.659)	(0.637)
% parents active in other organizations	0.383**	0.389**
	(0.056)	(0.056)
log(average parental income)	0.121**	0.120**
	(0.028)	(0.028)
log(average parental education)	0.565**	0.557**
	(0.194)	(0.186)
average number of siblings	-0.029*	-0.026**
	(0.013)	(0.013)
log(total enrollment)	-0.060**	-0.059**
	(0.010)	(0.010)
log(average reading score)	-1.202**	-1.167**
	(0.290)	(0.276)
% private school enrollment share	0.225	0.202
	(0.159)	(0.147)

[b] Dependent variable is the proportion of parents active in the school PTA.

Table 4(c): Private School Share[c]

Variable	(1)	(2)
Constant	0.338	0.765**
	(0.276)	(0.273)
log(average parental income)	-0.023	0.011
	(0.013)	(0.013)
log(average parental education)	0.091	0.096
	(0.086)	(0.087)
% black in county	0.178**	....
	(0.030)	....
median household income in county	0.035**	....
	(0.006)	....
% with college degree in county	-0.028	....
	(0.052)	....
% Catholic in county	....	0.128**
	....	(0.017)
collective bargaining indicator	0.032**	0.029**
	(0.005)	(0.005)
% parents active in school PTA	-0.001	-0.022
	(0.044)	(0.047)
log(average reading score)	-0.097	-0.289*
	(0.130)	(0.130)

[c] Dependent variable is the district private school share.

Table 5: Reduced-Form Estimates using WLS[a]

($n = 738$)

Variable	(1) LMREADBY	(2) PTACT	(3) PCPRIV
Constant	2.167**	-0.266	0.269*
	(0.125)	(0.287)	(0.126)
% Asian/Pacific Islander	-0.022	-0.012	0.067
	(0.031)	(0.070)	(0.030)
% black	-0.089**	-0.068	-0.041*
	(0.021)	(0.049)	(0.022)
% Hispanic	-0.027*	-0.031*	-0.047**
	(0.018)	(0.040)	(0.018)
log(average parental income)	0.050**	0.060**	0.025**
	(0.010)	(0.024)	(0.010)
log(average parental education)	0.503**	0.031	-0.020**
	(0.059)	(0.136)	(0.061)
proportion of 2-parent families	0.027	-0.021	-0.021
	(0.016)	(0.038)	(0.017)
average number of children per household	-0.010	-0.017	-0.007
	(0.005)	(0.011)	(0.005)
proportion of parents who help with homework	0.016	0.025	-0.004
	(0.016)	(0.036)	(0.016)
log(school enrollment)	-0.027**	-0.059**	-0.004
	(0.008)	(0.018)	(0.008)
log(number of teachers)	0.031**	-0.001	0.030
	(0.008)	(0.008)	(0.080)
collective bargaining indicator	-0.003	-0.018	0.027
	(0.005)	(0.010)	(0.005)
Catholic	-0.028*	0.000	0.067**
	(0.012)	(0.029)	(0.013)
ACTIVE	0.058**	0.300**	-0.033*
	(0.021)	(0.048)	(0.021)
CPCBLACK	-0.050	-0.203**	0.141**
	(0.033)	(0.076)	(0.033)
CPCEDDEG	0.031	-0.153	0.000
	(0.053)	(0.123)**	(0.054)
CMHHINC	-0.002*	-0.039	0.028
	(0.006)	(0.015)	(0.006)
R-squared	0.657	0.256	0.516

[a] Estimates are based on the system appearing in Table 4.
Number of children sampled from each school used as weights.
Omitted regressors include religious and district level controls.

Table 6: System Estimates using Three-Stage Least Squares

- different measures of parental involvement

($n = 738$)

Table 6(a): Public School Production Function[a]

Variable	(1)[b]	(2)[c]
Constant	1.917**	2.532**
	(0.129)	(0.236)
% Asian/Pacific Islander	-0.025	-0.028
	(0.031)	(0.022)
% black	-0.079**	-0.041**
	(0.020)	(0.016)
% Hispanic	-0.044**	-0.024*
	(0.014)	(0.010)
% native American	-0.111*	-0.067*
	(0.043)	(0.031)
log(average parental income)	0.047**	0.021**
	(0.010)	(0.013)
log(parental education)	0.569**	0.458**
	(0.060)	(0.074)
proportion of 2-parent families	0.021	0.020
	(0.015)	(0.011)
average number of children per household	-0.008*	-0.010*
	(0.005)	(0.004)
proportion of parents who help with homework	0.017	0.023*
	(0.015)	(0.011)
log(total school enrollment)	-0.007	-0.016*
	(0.009)	(0.006)
log(number of teachers)	0.020**	0.015*
	(0.008)	(0.006)
collective bargaining indicator	0.008*	0.059**
	(0.007)	(0.010)
parental involvement	0.190*	0.208**
	(0.077)	(0.052)
district private school enrollment share	-0.194	-0.828**
	(0.127)	(0.052)

[a] Dependent variable is log(average school reading score).

[b] This column uses VOLUNT as the parental involvement measure.

[c] This column uses PTA as the parental involvement measure.

Compare with the system estimates in Table 4 column, (1).

Table 6(b): Parental Involvement[d]

Variable	(1)	(2)
Constant	0.276	2.215**
	(0.451)	(0.976)
% parents active in other organizations	0.280**	0.389**
	(0.039)	(0.084)
log(average parental income)	0.025	0.258**
	(0.020)	(0.043)
log(average parental education)	0.137**	1.727**
	(0.133)	(0.290)
average number of siblings	-0.005*	-0.062**
	(0.009)	(0.019)
log(total enrollment)	-0.064**	0.003
	(0.007)	(0.014)
log(average reading score)	-0.111	-2.347**
	(0.200)	(0.434)
% private school enrollment share	0.219*	0.432
	(0.097)	(0.210)

[d] Dependent variable is the proportion of parents active in the school PTA.

Table 6(c): Private School Share[e]

Variable	(1)	(2)[d]
Constant	0.396	1.051**
	(0.264)	(0.363)
log(average parental income)	0.005	-0.010
	(0.014)	(0.016)
log(average parental education)	0.380	0.190
	(0.078)	(0.106)
% black in county	0.127**	0.077
	(0.024)	(0.039)
median household income in county	0.035**	0.012*
	(0.006)	(0.005)
% with college degree in county	0.172	0.078*
	(0.045)	(0.039)
collective bargaining indicator	0.037**	0.051**
	(0.005)	(0.008)
parental involvement	0.000	0.199**
	(0.048)	(0.068)
log(average reading score)	-0.373	-0.377**
	(0.125)	(0.125)

[e] Dependent variable is the district private school share.

Table 7: System Estimates using Three-Stage Least Squares

Adding Interaction

($n = 738$)

Table 7(a): Public School Production Function[a]

Variable	(1)	(2)
Constant	1.909**	1.923**
	(0.237)	(0.190)
% Asian/Pacific Islander	-0.063	-0.073
	(0.051)	(0.043)
% black	-0.078*	-0.085**
	(0.032)	(0.028)
% Hispanic	-0.000	-0.012
	(0.029)	(0.033)
% native American	-0.075*	-0.104*
	(0.063)	(0.056)
log(average parental income)	0.027*	0.036**
	(0.017)	(0.014)
log(parental education)	0.638**	0.613**
	(0.096)	(0.079)
proportion of parents who help with homework	0.016	0.016
	(0.021)	(0.019)
log(total school enrollment)	-0.023	-0.025*
	(0.012)	(0.011)
log(number of teachers)	0.038**	0.038**
	(0.012)	(0.001)
collective bargaining indicator	0.022*	0.008
	(0.009)	(0.007)
% parents active in school PTA	0.772**	0.514*
	(0.270)	(0.215)
district private school enrollment share	0.688	0.662
	(0.456)	(0.362)
interaction term	-5.259**	-3.425*
	(2.035)	(1.592)

[a] Dependent variable is log(average school reading score).

The production function includes the controls described beneath Table 3, and additional district race variables.

Estimated standard errors in parentheses.

** denotes significance at 1 percent level.

* denotes significance at 5 percent level.

Table 7(b): Parental Pressure[b]

Variable	(1)	(2)
Constant	2.429**	2.278**
	(0.621)	(0.583)
% parents active in other organizations	0.386**	0.385**
	(0.056)	(0.055)
log(average parental income)	0.120**	0.118**
	(0.027)	(0.027)
log(average parental education)	0.567**	0.531**
	(0.189)	(0.175)
average number of siblings	-0.028*	-0.024**
	(0.013)	(0.013)
log(total enrollment)	-0.060**	-0.059**
	(0.010)	(0.010)
log(average reading score)	-1.192**	-1.126**
	(0.271)	(0.247)
% private school enrollment share	0.204	0.248
	(0.157)	(0.130)

[b] Dependent variable is the proportion of parents active in the school PTA.

Table 7(c): Private School Share[c]

Variable	(1)	(2)
Constant	0.600*	0.809**
	(0.300)	(0.287)
log(average parental income)	-0.016	0.004
	(0.014)	(0.013)
log(average parental education)	0.151	0.184*
	(0.092)	(0.088)
% black in county	0.156**	1.199**
	(0.034)	(0.034)
median household income in county	0.026**	0.029**
	(0.006)	(0.006)
% with college degree in county	-0.022	-0.031
	(0.051)	(0.052)
% Catholic in county	....	0.166**
	....	(0.017)
collective bargaining indicator	0.031**	0.018**
	(0.005)	(0.005)
% parents active in school PTA	0.008	-0.057
	(0.0418)	(0.041)
log(average reading score)	-0.215	-0.333*
	(0.142)	(0.135)

[c] Dependent variable is district private school share. Additional right-hand side variables not shown: CPCAPI, CPCHISP, and CPCUNEMP.

Table 8(a): Public School Production Function Estimates (Coefficient Estimates using Least Squares - Individual Data)

$n = 12140$

Variable	Coefficient	Std. Error	P-valve	Sample Mean
constant	4.717	0.729	0.000	1.000
parents active in PTA	0.016	0.004	0.000	0.210
proportion of other parents active in PTA	-0.021	0.015	0.155	0.210
log(socio-economic status)	0.050	0.005	0.000	0.870
log(parental education)	0.049	0.006	0.000	0.630
2-parent family	0.010	0.003	0.003	0.640
parents help with homework	0.031	0.003	0.000	0.310
log(total school enrollment)	-0.008	0.008	0.351	3.540
log(days in school year)	-0.174	0.139	0.213	5.180
collective bargaining indicator	-0.003	0.003	0.466	0.650

Dependent variable: log(individual reading score)
R-squared = 0.20

Table 8(b): Public School Production Function Estimates (Coefficient Estimates using Instrumental Variables - Individual Data)

$n = 12140$

Variable	Coefficient	Std. Error	P-valve	Sample Mean
constant	4.470	0.755	0.000	1.000
parents active in PTA	0.070	0.020	0.000	0.210
proportion of other parents active in PTA	0.258	0.083	0.002	0.210
log(socio-economic status)	0.046	0.005	0.000	0.870
log(parental education)	0.045	0.006	0.000	0.630
2-parent family	0.008	0.004	0.040	0.640
parents help with homework	0.030	0.003	0.000	0.310
log(total school enrollment)	-0.008	0.008	0.291	3.540
log(days in school year)	-0.147	0.144	0.307	5.180
collective bargaining indicator	0.009	0.005	0.055	0.650

Dependent variable: log(individual reading score)
R-squared = 0.19

Appendix - Individual Involvement Model

In this appendix, I describe a way of modeling the individual household's 'pressure contribution' decision which can be incorporated into the three-equation system presented in Section 4.[83] I also discuss briefly a procedure for estimating this 'individual' model.

Consider the case in which parents play a Nash game among themselves in determining their level of parental participation in school affairs. Under the Nash assumption, household j in school i will choose m_{ij} to maximize utility, taking as given the level of participation of all other parents (denoted by $\bar{m}_{i(-j)}$). For convenience, consider the first household, for whom $j = 1$. Its utility is given by

$$U(m_{i1}) = \Big(y_{i1} - k(m_{i1})\Big)^{\alpha_1} \big(Q(\bar{m}_i(m_{i1}))\big)^{\alpha_2}. \tag{14}$$

Thus the household considers only the incremental benefits of its own actions, given what everyone else does. The average level of parental participation can be decomposed as follows:

$$\bar{m}_i = \frac{\sum_{j=1}^{J(i)} m_{ij}}{J(i)} = \frac{1}{J(i)}\Big(m_{i1} + (J(i)-1)\frac{\sum_{j=2}^{J(i)} m_{ij}}{J(i)-1}\Big) \equiv \frac{1}{J(i)}\Big(m_{i1} + (J(i)-1)\bar{m}_{i(-1)}\Big), \tag{15}$$

where $J(i)$ is the number of households in school i.

Treating $m_{ij} \geq 0$ as continuous, each household will choose its level of participation to maximize utility given in (14). The closed-form solution for the optimal participation level of household 1 in school i, conditioning on the actions of everyone else, is

$$m^*_{i1} = \frac{y_{i1}}{w_{i1}} - \frac{\alpha_1}{\alpha_2 \beta_E \delta} + \frac{\bar{m}_{i(-1)}}{\alpha_2 \beta_E \delta}. \tag{16}$$

Under the Nash assumption, household 1's optimal choice at school i is declining in the average level of the remainder of the households. (Think of w_{i1} as data relating to individual family characteristics, including whether they are active in other organizations, whether single parent, and whether highly educated.)

A Two-Stage Procedure

I follow a two-stage procedure to make use of the individual data. In the first stage, each of the $J(i)$ households in school i makes a participation decision, taking as given the choices of other households, as in the previous equation. The next stage is to solve the system of $J(i)$ equations, expressing each household's participation choice in terms of exogenous variables, no longer conditioning on the choices of other households. Rather than being continuous, observed participation is a binary one-zero variable, so the first stage involves a multivariate probit (multivariate across households in each public school) using the full sample of public schools. From this probit, I can predict the average level of participation in each school, based on the individual participation decision. This fitted value for each school can then be used to obtain unbiased estimates from the full system of three equations.

Data Appendix

This appendix describes the construction of a number of the variables drawn from the NELS data which are used in the Base Year analysis.

[83] This is developed more fully in McMillan (1999), in progress.

Test Scores

Each student in the NELS sample took four tests: reading, mathematics, science, and social science. The scores are graded on a curve, each with a mean of 50 and a standard deviation of 10. I average individual scores across all eighth graders sampled to create school-level averages.

Student Controls

There is clearly overlap between student and parent controls (race, for the most part, home resources etc.) but I make a loose distinction among the variables as follows.

The NELS base year does not provide a measure of prior achievement for any student. But relevant to ability, it does provide information as to whether the student has a handicap (as reported both by parent and teacher) and whether the child is classified as being of 'limited English proficiency' (BYLEP). I also construct dummies to gauge whether the child is in a class for gifted students (GIFTCLAS), and whether they are in 'enriched' classes for English and mathematics. (These measures also provide information about school policy: the provision of classes for gifted students may have implications for student achievement overall.)

There is a considerable amount of data reporting subjective student opinions about the school environment. I select the variables which one would expect to have most bearing on student achievement. Thus I include a measure of the extent to which the student feels safe in school (FEELSAFE), whether they assess drugs to be a problem (DRUGS), weapons (WEAPON), physical conflicts with teachers (PHYSCONT), whether fighting disrupts learning (DISRUPTL).

Each student falls within one of five exhaustive racial categories: Asian and Pacific Islander (API), black (BLACK), hispanic (HISP), native American (NATAM), and white (WHITE).

In terms of home resources, I use dummies to capture whether the house has an independent study room (STUDY), whether the household has a computer (COMP), and whether it has a reasonable selection of books (BOOKS=1 if the family has an atlas, a dictionary, an encyclopedia, and 50 books (inclusive)).

Parent Controls

I make a distinction between parental data which relates to type (for the purposes of this analysis, things which are exogenous) and to actions. Central among the former is a composite index of parental socio-economic status (SES). This reflects parental income, education level, and occupation. I also include an index of parental education (PARED), which measured the highest grade completed of either parent.

Question BYP29 provides information on religious background, with 16 possible categories including 'none.' I construct dummies for Protestant, Catholic, Jewish, Moslem, and Other Christian, among others.

Whether parents are non-English speakers is captured using the dummy NOTESPKP. I include characteristics of their families: whether a mother and father are present (using dummy TRADFAM), the number of dependents (DEPENDS), the number of children in each family (CHILDREN), and the number of siblings still at home (HOMESIBS).

Parental Actions

There are several useful parental 'action' questions. The first set, BYP58A-F, relates to contact between parents and school, but initiated by parents.[84] I create five dummies:

- CONTAPE equals 1 if the parents contacted the school about academic performance;
- CONTAPR equals 1 if parents have contacted the school about an academic program;
- CONTB equals 1 if parents have contacted the school about behavior;
- CONTFR switches on if the parents have contacted the school about fund raising;
- and CONTV equals 1 if parents have contacted the school about volunteering.

Of particular interest are the responses to question BYP59. These capture parental activities at the school level.

- PTA, a dummy indicating membership of a parent-teacher organization;
- PTATTEND, a dummy switching on if parents attend PTA meetings;
- PTACT, a dummy switching on if parents take part in PTA activities;
- VOLUNT, one if parents act as a volunteer at the school;
- ACTIVE, one if parents are members of any organization other than the PTA which has parents of other children at the school as members. Two examples are given in the survey instrument: neighborhood organizations, and church organizations.

The last dummy can be taken as an indicator of active types, possibly those with more organizational ability.

Questions BYP74A-K record parents' opinions about the school, namely how true they think it is that:

- 'The school places a high priority on learning' (dummy OPHPL switches on if the answer is in the affirmative);
- 'My child is challenged at school' (OPCHALL);
- 'The school is a safe place' (OPSAFE);
- 'Parents have an adequate say in school policy' (OPSAY);
- 'Parents work together in supporting school policy' (OPCOOP);

School Variables

Measures of school inputs and the characteristics of the student population are also used. In terms of the former,

- DAYS, the number of days in the school year (BYSC6);
- ATTRATE, the eighth grade attendance rate (BYS11);
- G8ENROLL, the percent of eighth graders enrolled at the end of the year (BYSC12);

[84] There is also information on school-initiated contact.

- TEACHERS, the number of full time regular teachers (BYSC17);
- TEACHSAL, the base salary for beginning teachers with a BA (BYSC19);
- COLLBARG, a dummy indicating whether the school's regular teaching staff are covered by a collective bargaining agreement (BYSC23);
- PUBSCH is a dummy which switches on for a public school (BYSC30);
- GIFTED, a dummy indicating whether the school has a gifted and talented program (BYSC40);
- UNIFORM, a dummy equaling one if a school uniform is required.

Other school information is as follows:

- PCTNATAM, the percentage of eighth graders who are Native American (BYSC13A);
- PCTAPI, the percentage who are Asian Pacific islanders (BYSC13B);
- PCTHISP, the percentage of eighth graders who are hispanic (BYSC13C);
- PCTBLACK, the percentage of black eighth graders (BYSC13D);
- PCTWHITE, the percentage of white eighth graders (BYSC13E);
- MINOR, the percent minority in the school (G8MINOR);

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