
Parental Effort, School Resources, and Student Achievement

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ABSTRACT

This article investigates an important factor in student achievement—parental involvement. Using data from the National Education Longitudinal Study (NELS), we estimate a value-added education production function that includes parental effort as an input. Parental effort equations are also estimated as a function of child, parent, household, and school characteristics. Our results suggest that parental effort has a strong positive effect on achievement that is large relative to the effect of school resources and is not captured by family background variables. Parents appear to reduce their effort in response to increased school resources, suggesting potential “crowding out” of school resources.

I. Introduction

There is a long-standing debate whether improving school financial resources will improve student achievement. Some have found positive effects (Hedges and Greenwald 1996; Krueger 1999) while others have found negligible or even negative effects (see Hanushek 1996). Researchers have focused on specific factors such as teacher characteristics (for example, Rivkin, Hanushek, and Kain 2005), peer effects (Hanushek et al. 2003), class size (Angrist and Lavy 1999; Hoxby 2000), or birth order and family size (Hanushek 1992).

In this paper, we investigate another important factor in student achievement—parental involvement—and the role it plays in student achievement. We also examine

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the factors associated with parental effort, including school resources, and whether parents magnify or diminish the effects of school resources. It is our central premise that parental time allocation may respond to changes in school resources and other factors, and therefore may not be well captured by time-invariant variables that attempt to capture family-specific factors such as parental education or family fixed effects. For example, Murnane and Levy (1996) found that of fifteen Austin, Texas schools that were given \$300,000 a year as part of a settlement, thirteen saw little improvement, while the two schools that did see an improvement had invested heavily in getting parents involved. In theory, parents could scale back involvement in their children's education, thus attenuating any positive effects of increased financial support for education.

We use the National Education Longitudinal Study (NELS) to estimate a traditional education production function and then include parental effort measures to investigate the effect of parental effort and its potential interaction with other inputs. We then look into the association of parental effort with other child, parent, household, and school characteristics. Our results suggest that parental effort has a strong positive direct effect on student achievement that is large relative to the effect of school resources. Our analyses also show that parents may respond to an increase in school resources by reducing their effort. Taken together, these findings suggest that parents offset or "crowd out" the effects of improved school resources. In our data, however, we do not find evidence of substantial crowd out, mostly because of the small magnitude of the estimated parents' responses to school resources.

II. Brief Discussion of the Literature

A. *Education Production Literature*

Since the landmark 1966 Coleman Report—which found evidence that poor black children did perform better in integrated middle-class schools—researchers from a number of disciplines have sought empirical evidence of which inputs influence student achievement. This literature spawned a debate around whether financial resources influence student achievement; notably summarized by Hanushek (1996), who finds a negligible, and perhaps even negative effect, and Hedges and Greenwald (1996) and Krueger (1999) who find positive effects. As the literature has progressed, the specificity of the production function has increased as data sources become richer, allowing researchers to focus on the role of specific characteristics, for instance, teacher characteristics (for example, Rivkin, Hanushek, and Kain 2005), peer effects (Hanushek et al. 2003), class size (Angrist and Lavy 1999 and Hoxby 2000), and birth order and family size (Hanushek 1992).

The Coleman Report also highlighted family background as a key component of educational production. Most often a set of family variables are included, such as parental education and income (for example, Murnane, Maynard, and Ohls 1981; Hanushek 1992; Goldhaber and Brewer 1997; Ehrenberg and Brewer 1994, and Ferguson and Ladd 1996). Early on, Hanushek (1992) notes the difficulty of capturing the quality of parental time and, due to data limitations, uses family background variables as a proxy. Others use panel data methods to control for observed and

unobserved family variables (for example, Hanushek et al. 2003), whereby the family is captured by a fixed effect.

B. Going Beyond Family Background

The literature on household production and time-allocation models parental effort as a matter of constrained choice. That literature focuses on housework, childcare, and female labor supply issues (for example, Leibowitz 1974, 1977; Hill and Stafford 1977, 1980; Kooreman and Kapteyn 1987, and Kim 2001). Mother's education plays a central role, for it was found to have the most impact on time spent with children. In this paper, we delve deeper into the role that direct parental effort plays in the production of academic achievement and factors associated with parental time allocation.¹

III. Theoretical Framework

To guide our empirical specification, we draw upon the household production and time-allocation theory (Becker 1965 and Becker and Tomes 1976). Our framework is similar to that put forward by Todd and Wolpin (2003) but is simplified to focus on the role of parental effort. We assume that parents maximize utility derived from their child's achievement (A), a composite good (C), and leisure (L),

$$(1) \quad \max U(A, C, L),$$

subject to (i) an achievement production function that mixes parental effort (E) with available schooling resources (S^o),

$$(2) \quad A = f(E, S^o),$$

(ii) a time constraint, where total time (T) is the sum of hours worked (H), leisure (L), and parental effort (E),

$$(3) \quad T = H + L + E,$$

and (iii) a budget constraint,

$$(4) \quad p^S S^o + p^C C = wH + Y,$$

where p^S and p^C are prices; w is a market wage, and Y is nonlabor income.

After some simplifying assumptions, this model yields effort supply and leisure demand functions.² The amount of achievement demanded is determined by the

1. The dynamic of family inputs has implications that extend to other areas in education research. For example, the education literature acknowledges that parents choose their neighborhood based on the quality of local public schools or choose to send their children to private schools. Witte (1996) summarizes knowledge on factors determining choice (for example, what makes parents decide to send their children to private schools) and the effects that those choices (magnet schools, private schools, etc.) have on student achievement. Nechyba (2000) models the effect of vouchers in the presence of mobile households.

2. Separability makes achievement and effort a normal good, $\partial E / \partial Y > 0$. Assuming a nonseparable utility function makes the income effect ambiguous and the three effects more complex and ambiguous, as well. However, the general interpretation of the opposing effects in the comparative statics holds.

amount of effort supplied and the production function. Comparative static results (available upon request) reveal that the response of parents to a change in school resources ($\partial E/\partial S^o$) is theoretically ambiguous, owing to a negative income effect, a negative achievement effect, and an ambiguous productivity effect. The negative income effect stems from the fact that a change in school resources changes the household's disposable full income assuming that parents must pay for the change.³ The negative achievement effect reflects the fact that an increase in school resources allows parents to lower their effort while maintaining the chosen level of academic achievement. The ambiguous productivity effect hinges on whether school resources and parental effort are substitutes or complements in production. For instance, a small class size may facilitate greater teacher attention so that parental tutoring is not as necessary (substitutes). Or, more resources may mean more challenging homework and other activities for parental involvement (complements).

The total effect of school resources on achievement is the sum of an indirect effect ($\partial A/\partial E \times \partial E/\partial S^o$) and a direct effect ($\partial A/\partial S^o$). Presumably, effort has a nonnegative effect on achievement ($\partial A/\partial E \geq 0$). So, if parental effort decreases with an increase in school resources ($\partial E/\partial S^o < 0$), then the indirect effect of school resources is negative, which may help explain the weak results for school resources sometimes found in the literature.

School production function and achievement studies often include an extensive list of household variables to proxy for parental effort and other household resources, or eliminate the effects of such variables using panel data or natural experiments. An implication of this model is that household inputs such as parental effort may not be static in the face of changing school resources.

IV. Empirical Analysis

To pursue the implications of this model, we estimate two sets of descriptive regressions. In the first set, we examine (a) the association between parental effort and student achievement, (b) whether different types of parental effort have differing effects, and (c) whether the usual household variables are sufficient to capture parental effort. In the second set, we look at the factors related to the supply of parental effort, including school resources. In additional analyses, we examine the interactions of parental effort and school resources in the production of achievement and whether treating parental effort as endogenous affects our general conclusions.

A. Data Source

We utilize data from the NELS, which is a comprehensive longitudinal national survey of 24,599 eighth grade students (from 815 public schools and 237 private schools), their parents, teachers, and school administrators. Along with the survey, each student took standardized tests in reading, mathematics, science, and social

3. Different methods of funding the increase in schooling will have different impacts on parental full disposable income. For instance, increasing local property taxes will likely affect parents' income differently than increasing revenues from a state lottery or from students' fees.

studies. The NELS follows and retests the same students from eighth grade to tenth grade to twelfth grade and surveys them every two years thereafter. Specifically, we use data from the eighth and tenth grade student surveys and examinations, the eighth grade parent survey (there is no parental survey in tenth grade), and the tenth grade administrator survey. We focus on the earlier years of the NELS because we believe that parental effort is likely to be most influential the younger the child. Panel data techniques are not feasible due to inconsistencies in the way parental effort is measured.

B. Variables

Table 1 provides definitions and descriptive statistics for parental effort, student achievement, school characteristics, and other variables used to estimate achievement production functions and parental effort supply equations.⁴ We explore five variables from the tenth grade student survey that reflect parental effort (*E*): how frequently parents (1) discuss activities or events of particular interest to the child, (2) discuss things the child studied in class, (3) discuss selecting courses or programs at school, (4) attend a school meeting, and (5) volunteer at the child's school.⁵ The response categories for all five survey items are never, sometimes, or often. The first two variables have been used in the education literature as measures of home-based parent involvement in the education process (for example, Muller and Kerbow 1993). We prefer these two variables also, believing they are closest in spirit to the effort envisioned in our theoretical framework, and we call them (plus the third discuss measure) "dinnertime" measures of parental effort. In contrast, we view "meetings" and "volunteer" as more "school-related" effort measures because the child is farther removed. The latter three measures also may suffer from reverse causality, whereby poor school systems actively recruit parent volunteers and wealthy systems put on more events and hold more meetings and provide more course choices.

We use two approaches to represent school resources (*S*): (1) a summary measure—per-pupil expenditures on instructional salaries, and (2) a set of five school characteristics—the student-teacher ratio, the lowest salary received by a teacher, the percentage of teachers with a master's or a doctoral degree, the percentage of the student body *not* in the school's subsidized lunch program, and the percentage of nonminority students in the student body. Lowering the student-teacher ratio, raising teachers' salaries, and increasing teachers' credentials are often cited as ways to improve the quality of schools and the performance of students. A child's school experience is also greatly influenced by the students with whom he or she associates. The latter two characteristics reflect the extent to which a child's peers come from income constrained families (who in turn may provide fewer educational opportunities).

4. Means and standard deviations are reported for continuous variables, while frequencies and relative frequencies are reported for dummy variables.

5. Similar questions appear in the eighth grade student survey, but the response categories and reference period are significantly different, thus making panel data analysis infeasible. In addition, the effort-related questions appear in the eighth grade parent survey but are quite different from the student survey questions.

Table 1
Variable Definitions and Descriptive Statistics

Variable	Description		Mean or Percent	Standard Deviation
Parental effort measure				
Discuss activities	In the first half of this school year, how often have you discussed the following with either or both of your parents or guardians ... Activities or events of particular interest to you?	Never	18.9	39.1
		Sometimes	56.7	49.5
		Often	24.4	43.0
Discuss studies	<stem above> ... Things you've studied in class?	Never	18.4	38.8
		Sometimes	61.8	48.6
		Often	19.8	39.8
Discuss selection	<stem above> ... Selecting courses or programs at school?	Never	16.6	37.2
		Sometimes	63.4	48.2
		Often	19.9	40.0
Attend meetings	In the first half of the school year, how often did either of your parents or guardians do any of the following ... Attend a school meeting?	Never	47.1	49.9
		Sometimes	38.7	48.7
		Often	14.1	34.9
School volunteer	<stem above> ... Act as a volunteer at your school?	Never	76.0	42.7
		Sometimes	16.8	37.4
		Often	7.2	25.9
School characteristics				
Per-pupil spending ^a	amount spent on instructional salaries (in thousands) divided by the number of students enrolled in the fall at the school district level, adjusted for state cost-of-living. Source: 1990 Common Core Data files.		2.05	5.1
Student-teacher ratio	ratio of students to full-time regular teachers in the school		16.1	4.3
Lowest teacher salary ^a	lowest salary paid to a teacher at the school (in thousands)		19.9	3.1
Advanced degrees	percentage of teachers with a Masters or Ph.D. degree		51.5	23.5
Percent nonminority	percentage of students in the school that are nonminorities		76.1	28.4
Percent nonfree lunch	percentage of students not in the school's free or reduced price lunch program		82.1	19.5

(continued)

Table 1 (continued)

Variable	Description	Mean or Percent	Standard Deviation
Child characteristics			
Achievement	child's scores on standardized reading and mathematics examinations in 1990 (tenth grade)	103.0	18.1
Prior achievement	child's scores on standardized reading and mathematics examinations taken in 1988 (eighth grade)	93.8	15.2
Female child	child is female	50.7	50.0
Nonwhite child	Child is nonwhite	21.9	41.3
Single mother	child lives in a single mother/female guardian household. (Base-year information)	14.2	34.9
Single father	child lives in a single father/male guardian household. (Base-year information)	2.7	16.2
Mother's education	number of years the mother/female guardian spent in school. (Base-year information)	12.9	3.2
Father's education	number of years the father/male guardian spent in school. (Base-year information)	11.9	5.8
Family characteristics			
Number of siblings	number of siblings, including step-brothers and step-sisters	2.4	1.7
Family income ^a	total family income from all sources in 1987 (in thousands). (Base-year information)	42.4	3.5
Geographic locations			
Nonurban school	child's school is not in a central city	74.4	43.6
North Central region	child's school is in a north central state	29.3	45.5
South region	child's school is in a southern state	34.7	47.6
West region	child's school is in a western state	17.3	37.8

Source: Authors' calculations using the National Education Longitudinal Study, 1988 and 1990.

Notes: Means and standard deviations are reported for continuous variables, while frequencies and relative frequencies are reported for dummy variables.

a. All dollar figures are in thousands and adjusted for cost-of-living take into consideration variations across states. McMahon (1991) is the source of adjustment factors.

Using five school characteristics in an achievement production function may be problematic, given the potential for multicollinearity and the loss of sample due to missing data, leading to possible attrition bias.⁶ In contrast, using per-pupil

6. In preliminary analyses, we have attempted to construct a summary measure of school characteristics using factor analysis and principal components. The factor analysis reveals, however, that the measures do not aggregate well because the school resources measures are unique. Principle component analysis reinforces this conclusion by producing first and second principle components that explain large portions of the variation in the measures of school resources. This means that *two* indices or summary measures are required, and the interpretation of the second principle component's index is not clear.

expenditures provides a summary measure of school resources and our largest sample. Although it is an incomplete measure of school resources, we believe it is correlated with the overall level of resources devoted to instruction at the school.⁷ In addition, many past studies use per-pupil expenditures, and a distinction is made between instructional and other expenditures (for example, Hanushek 1996).

We utilize standardized math and reading test scores to capture student achievement (A). The questions used to derive the scores are “consistent” across the eighth grade examination and tenth grade examination. Following the education production function literature, we estimate value-added achievement equations by including the eighth grade scores on the right-hand side; it captures past school and household inputs as well as the unobserved child/household endowment.⁸ There is no “consistent” measure of achievement prior to the eighth grade scores, which is what leads us to estimate effort and achievement equations for tenth graders.

The remaining explanatory variables include child and family characteristics that likely affect effort through preferences or resource constraints and affect achievement as an input or a variable that affects the ability to coordinate production. In addition to past achievement, child characteristics include gender and race. Our set of family characteristics captures opportunity costs, preferences, and resources: parents’ education, the number of siblings, family income, and single parenthood. Finally, to control for other exogenous influences, we include a nonurban dummy variable, as well as regional dummy variables.

C. Sample Restrictions

In preparing the NELS data set for estimation, we restrict the sample to those with complete information for the relevant variables and to public school children. Of the 17,310 public school students that took the base-year exam, 1,775 students are dropped because they did not complete first follow-up examinations. Of the remaining 15,535 students, 5,153 students are dropped because they lacked information on child, parent, and household variables. We use the remaining 10,382 students to estimate various specifications of achievement and parental effort equations. To deal with missing values for individual parental effort and school resources variables without greatly compromising sample size, we use the maximum number of observations for each regression and report its sample size.⁹

7. They are strongly correlated in our data. When these five school characteristics are regressed on per-pupil expenditure, the adjusted R -squared is 0.38.

8. While a value-added specification is common, it is not without its limitations (for example, see Hanushek and Taylor 1990; Todd and Wolpin 2003).

9. If we require complete information across all regressions, our sample size would be 5,257 students. We have looked into the effects of our sample restrictions. The observations that are included in our study are more economically advantaged than those who are deleted, with the interesting exception of parental effort. We have also estimated the regressions using the smaller uniform sample size and the results are qualitatively the same. In addition, including a wider set of household variables (which further reduces sample size) also did not substantively change the results.

III. Findings

A. *Student Achievement*

Table 2 contains ordinary least squares estimates of the achievement production function excluding parental effort and five alternative specifications of parental effort.¹⁰ The first column of Table 2 contains a typical value-added education production function. Consistent with the findings of the production function literature, prior achievement, and parental education are positively related to achievement and the number of siblings is negatively related to achievement. Per-pupil expenditures are positively related to achievement.

With regard to parental effort, all three dinnertime parental effort measures are positively related to student achievement. Of the two school-related effort measures, only attending meetings has a positive and statistically significant relationship with student achievement. The estimated magnitudes of the effects are also meaningful. For instance, changing from “never” to “sometimes” discuss is estimated to increase achievement by more than four (six) additional years of education for the mother (father) or \$1,000 in additional per-pupil expenditures. The positive impact of parental effort also grows with the intensity of effort; in other words, the estimated effect of “always” discuss is larger than “sometimes,” although the difference is not statistically significant. Adding parental effort to the production function does not substantially diminish other relationships, however. This suggests that our parental effort measures are bringing new, independent information to the production function. At the same time, their omission does not seem to strongly bias the coefficients of the usual variables of interest, which is a reassuring result for researchers using data without such measures.

We also estimate the model using the school characteristics discussed above rather than our summary measure. (Results are available upon request.) None of the five school characteristics have a statistically significant relationship with student achievement, whether entered singly or together, although the signs are generally in the expected direction with the exception of the percent nonminority students. Nonetheless, the estimated effects of parental effort are very similar to those reported in Table 2.

Also in regressions not reported here, we allow the production relationship to be more complicated by including interactions between parental effort and school resources. In general, very few statistically significant coefficients emerge and those few that are significant almost always act to negate the primary (beneficial) effects. In the five expenditure regressions, for example, only one interaction term is significant (discuss course selection sometimes) and its sign and magnitude acts to eliminate the positive primary effects of effort and expenditures. This pattern is also evident in the five regressions that include the school characteristics except that even fewer coefficients are statistically significant.¹¹ Our analysis therefore provides little

10. Since there is more than one student per school, we adjust all standard errors for clustering at the school level throughout this article.

11. One interesting exception is volunteering and school characteristics, although the lack of significant primary effects and the typically negative interaction coefficients caution against placing too much emphasis on these results.

Table 2
Achievement Production Function with Alternative Measures of Parental Effort

Variables	Including Effort					
	Excluding Effort	Discuss Activities	Discuss Studies	Discuss Selection	Attend Meetings	School Volunteer
Intercept	4.339*** (3.24)	4.158*** (3.03)	4.082*** (2.93)	3.820*** (2.78)	4.805*** (3.51)	4.711*** (3.41)
Effort (sometimes)	—	1.008*** (3.15)	0.910*** (2.67)	1.234*** (3.53)	0.907*** (3.09)	0.117 (0.34)
Effort(often)	—	1.491*** (3.59)	1.058** (2.56)	1.731*** (3.64)	1.301*** (3.75)	0.102 (0.15)
Per-pupil spending	0.638** (2.02)	0.675** (2.11)	0.638** (1.98)	0.663** (2.07)	0.591* (1.85)	0.631* (1.95)
Prior achievement	1.004*** (111.3)	0.999*** (106.2)	1.001*** (107.6)	1.000*** (106.8)	1.000*** (106.8)	1.001*** (105.9)
Female child	-0.174 (-0.7)	-0.269 (-1.07)	-0.276 (-1.10)	-0.298 (-1.20)	-0.258 (-1.01)	-0.216 (-0.84)

Nonwhite child	-0.163 (-0.48)	-0.195 (-0.57)	-0.183 (-0.53)	-0.179 (-0.53)	-0.286 (-0.84)	-0.224 (-0.64)
Single mother	1.407* (1.88)	1.159 (1.54)	1.084 (1.44)	1.136 (1.50)	1.218 (1.59)	1.295* (1.69)
Single father	2.259 (1.39)	2.659 (1.59)	2.677 (1.62)	2.698 (1.63)	2.452 (1.47)	2.823* (1.70)
Mother's education	0.192*** (3.59)	0.202*** (3.67)	0.206*** (3.77)	0.203*** (3.72)	0.192*** (3.53)	0.212*** (3.77)
Father's education	0.184*** (3.74)	0.157*** (3.19)	0.156*** (3.19)	0.157*** (3.19)	0.159*** (3.18)	0.164*** (3.30)
Number of siblings	-0.182** (-2.33)	-0.161** (-2.03)	-0.165** (-2.08)	-0.156* (-1.95)	-0.165** (-2.09)	-0.186** (-2.35)
Family income	0.003 (0.67)	0.002 (0.45)	0.002 (0.55)	0.002 (0.43)	0.0011 (0.27)	0.0027 (0.65)
Nonurban school	-0.794** (-2.17)	-0.896** (-2.38)	-0.842** (-2.23)	-0.903** (-2.42)	-0.833** (-2.22)	-0.833** (-2.19)
Sample size	8,607	8,351	8,345	8,362	8,212	8,184

Source: Authors' calculations using the National Education Longitudinal Study (NELS).
 Notes: Ordinary least squares coefficients. Statistical significant coefficients at the 1, 5, and 10 percent levels are indicated with ***, **, and *, respectively, and *t*-statistics are in parentheses. The underlying standard errors are adjusted for clustering at the school/classroom level, and Huber/White/sandwich standard errors are estimated. Three regional dummy variables were also included.

evidence that a more complicated production relationship exists. Furthermore, if one does exist, the evidence points to effort and school characteristics being substitutes; in other words, the positive effect of school resources is diminished as the level of parental effort grows. In the context of our theoretical framework, this suggests that the “productivity effect” is either zero or negative, leading to an unambiguously negative effect of school resources on parental effort ($\partial E/\partial S^o$). We turn to our parental effort regressions to explore this further.

B. Parental Effort

Table 3 contains ordered probit estimates of the parental effort equations for the five measures.¹² As in Table 2, there is substantial consistency in the results across the five measures. The signs of the coefficients, when statistically significant, are consistent across the five measures; for instance, mother’s education is positively associated with all five measures of parental effort. The differences that do exist suggest that volunteer and perhaps meetings are the most different from the rest, which confirms our priors about the similarities of our three dinnertime measures. Consistent with the findings of the time-allocation literature, mother’s and father’s education and family income is positively related to parental effort for all five measures. Number of siblings is negatively associated with parental effort (except for school volunteer), which may reflect parental time constraints. Interestingly, single parenthood is positively related to parental effort—perhaps, like an additional sibling, being married represents a constraint on the time spent with a child.

With regard to the characteristics of the child, nonwhite status appears to have little association on parental effort, with one exception—it is positively associated with the frequency of attending meetings. Daughters receive significantly more dinnertime effort—a higher frequency of discussing activities, studies, and course selection. Prior achievement, which is used in the achievement production function literature to capture past school and household inputs, is positively associated with parental effort (except for the school volunteer variable). This suggests that parental effort builds upon prior effort and inputs.

Do school resources diminish parental effort as suggested by theory and our achievement production results? Table 3 reports our results when using per-pupil expenditures, and estimates using school characteristics are available upon request. In both instances the coefficients on school resources, when statistically significant, overwhelmingly suggest a negative relationship with parental effort. Per-pupil expenditures have a negative and frequently statistically significant relationship with all three dinnertime measures and the volunteer variable. In the unreported school characteristic regressions, teacher salary diminishes all five parental effort measures and is statistically significant in all but course selection. Student/teacher ratio is also of the expected sign and occasionally significant in all three dinnertime measures. Two exceptions emerge from this exercise. First, the frequency of attending meetings decreases as class size grows (school resources decrease). This finding hints at our earlier concern that the number of meetings available to parents may be driven by school resources; the larger the class size, the less available the teachers may be

12. Estimating these equations via OLS produces very similar results. Likewise, estimating these equations using school characteristics instead of per-pupil expenditures yields similar results unless otherwise noted.

Table 3
Parental Effort Equation using Alternative Measures of Parental Effort

Variables	Discuss Activities	Discuss Studies	Discuss Selection	Attend Meetings	School Volunteer
Per-pupil spending	-0.078** (-2.21)	-0.032 (-0.91)	-0.067* (-1.73)	0.068 (1.49)	-0.116** (-2.02)
Prior achievement	0.009*** (7.74)	0.002** (1.97)	0.004*** (3.70)	0.005*** (4.35)	-0.001 (-0.22)
Female child	0.165*** (5.02)	0.208*** (6.84)	0.245*** (6.53)	0.009 (0.25)	-0.043 (-1.04)
Nonwhite child	0.014 (0.33)	-0.039 (-0.92)	0.030 (0.58)	0.132** (2.20)	-0.003 (-0.05)
Single mother	0.137 (1.47)	0.409*** (4.56)	0.159* (1.65)	0.259** (2.51)	0.287 (1.94)
Single father	0.438*** (2.92)	0.493*** (3.45)	0.454*** (2.87)	0.508** (2.47)	0.397 (1.54)
Mother's education	0.032*** (4.08)	0.031*** (4.23)	0.039*** (4.50)	0.044*** (4.34)	0.035*** (3.68)
Father's education	0.019*** (3.33)	0.032*** (5.53)	0.019*** (3.00)	0.026*** (3.91)	0.035*** (3.67)
Number of siblings	-0.032*** (-2.95)	-0.035*** (-3.37)	-0.045*** (-4.19)	-0.032*** (-2.85)	-0.002 (-0.16)
Family income	0.002*** (3.67)	0.002*** (3.65)	0.002*** (2.95)	0.003*** (4.57)	0.003*** (4.59)
Nonurban school	0.106** (2.36)	0.043 (0.94)	0.093* (1.79)	-0.015 (-0.26)	0.148** (2.13)
Sample size	8,351	8,345	8,362	8,212	8,184

Source: Authors' calculations using the National Education Longitudinal Study (NELS).

Notes: Ordered probit coefficients. Statistical significant coefficients at the 1, 5, and 10 percent levels are indicated with ***, **, and *, respectively, and *t*-statistics are in parentheses. The underlying standard errors are adjusted for clustering at the school/classroom level, and Huber/White/sandwich standard errors are estimated. Three regional dummy variables were also included.

for parent meetings. Second, the peer-related measures of school resources do not affect parental effort the same way that school-related measures do. Rather, parental effort is either unaffected or increases as the economic circumstances of the child's student body improves.

C. Issues of Endogeneity

Thus far, we have used descriptive regressions to explore the relationships among parental effort, school quality, and student achievement. However, our theoretical framework (as well as the entire time-allocation literature) suggests that such effort

is a matter of choice and is therefore potentially endogenous.¹³ As a robustness check, we estimate a two-stage process that treats parental effort as a choice, using predicted parental effort in the achievement equation. We use whether the family had rules on chores as an instrument for parental effort since they may capture how organized the household is with respect to time allocation and how involved parents are with their children in nonacademic matters. As such, they may be strongly correlated with parental effort yet not with student achievement.¹⁴ The effect of parental effort remains positive across all specifications and is always statistically significant except for whether the parents volunteer.

V. Concluding Remarks

This paper explores the theoretical and empirical role that parental effort plays in the production of student achievement. Our simple theoretical framework reveals that parental effort is affected by the level of school resources and, although the effect is theoretically ambiguous, it appears likely to be negative. This suggests that parents may either magnify or diminish the effects of improved school resources on student achievement. It also suggests that parental effort may not be well captured by simply including time-invariant variables such as parental characteristics or family fixed effects, as is the typical practice when estimating student achievement equations.

Our empirical analysis employs data from the NELS to shed light on these issues and also to answer the more basic question of “does parental effort improve student achievement?” The value-added, student-achievement production functions we estimate provide a resounding “yes”; parental effort is consistently associated with higher levels of achievement. The magnitude of the effect of parental effort is also substantial—along the order of an additional four to six years of parental education or more than \$1,000 in per-pupil spending. Our parental effort measures also bring new information to these models. Their inclusion has surprisingly little impact on the estimated effect of the usual family background characteristics (parental education and age, number of siblings, and income), and different types of parental effort (for example, dinnertime discussions versus volunteering) exert different impacts on achievement.

What factors are associated with parental effort, and do school resources play an important role? The parental effort equations we estimate reveal that, as expected, parental education and measures of time constraints (for example, number of children) are important, yet not all parental effort measures behave identically.

13. One could argue that school resources are potentially endogenous as well inasmuch that parents choose the schools their children attend via their residential location. In results available upon request, we also model per-pupil expenditures as endogenous, employing both school district and state demographic and policy (for example, choice) characteristics as instruments. The results are quite robust and, if anything, provide even stronger evidence that effort increases achievement ($\partial A / \partial E > 0$) and that school resources diminish effort ($\partial E / \partial S < 0$).

14. In preliminary analyses, we have included additional instruments, such as a proxy for the parents' wages and other measures of time constraints, and the results are very similar. Again, every variable we add decreases our sample size and so we focus on the most parsimonious model and largest sample. (Results are available upon request.)

Daughters, for example, appear to receive higher levels of dinnertime discussion but their parents are no more likely to volunteer or attend school meetings. Likewise, the role of school resources differs. The scenario that most closely matches our time-allocation model—dinnertime effort measures and school-specific resources—strongly suggests a negative relationship between the two. In contrast, as we move toward our other effort measures or to measures of the student body rather than the school, the relationship becomes less clear.

For researchers estimating student achievement equations, our results have mixed implications. Parental effort appears to have a strong effect on student achievement that is not adequately captured by the usual family background characteristics researchers include. There is also evidence that parents may react in such a way as to diminish the effect of school resources on achievement. Both results suggest that omitting parental effort from student achievement equations could cause a serious bias. Yet, we find no evidence of such bias—omitting parental effort appears to have little effect on our estimates of the effects of either family or school variables on student achievement.

While we attempt to deal with the possible endogeneity of both parental effort and school resources—and find little change in our results—satisfactorily modeling and identifying these relationships remains a challenge, requiring still richer data. The ideal data to study these questions also would contain more detailed parental effort information on much younger children over a long period of time. Nonetheless, our results strongly point to the potentially critical role that parental effort plays in the production of student achievement. Parental effort is important to consider both because it is a relatively productive input and because it has the *potential* to offset any increased financial support, although the crowd-out estimated for our data is inconsequential. Both findings support the anecdotal evidence provided by Murnane and Levy (1996), in which schools that invested heavily in getting parents involved were the only ones to show improvement. Congress also recognized the importance of parental effort when it passed the Goals 2000: Educate America Act by adding an eighth goal that “calls on schools to adopt policies and practices that actively engage parents and families in partnerships to support the academic work of children at home and shared educational decision-making at school” (p. 1, U.S. Department of Education 1998). Our research indicates that such an emphasis is a promising avenue to improved student achievement.

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