Allocating Resources to Student Achievement --
Home versus School, Boys versus Girls

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A small but growing number of studies of student achievement are focusing on the interaction between the school and the household (e.g., Houtenville, 1997, Nechyba, McEwan and Older-Aguilar 1999, McMillan 2000, Kim 2001, and Houtenville and Conway 2001). These studies emphasize the importance of household resources and behaviors, such as parental effort and child care time, in the production of student achievement, and many also recognize that these behaviors are a matter of choice. Furthermore, these choices may be influenced by policy and, in particular, school inputs. At the same time, concerns have been raised by the American Association of University Women and others (e.g., AAUW 1998) that girls and boys are not enjoying equal learning experiences at school. If such concerns are correct and parents know about the disparity, they may allocate their resources differently between their sons and daughters. Such differences could also be the result of parent tastes. These issues have been explored with regard to nutrients and health care in developing countries (e.g., Behrman 1988 and Chen and McElroy 1999). Our purpose is to explore whether there are gender differences in the amount of effort expended by parents and, ultimately, student achievement, and whether such differences are due to different school experiences (or technology), parental tastes or other factors.

This paper investigates whether parents devote different amounts of effort to the education of their sons versus their daughters within a theoretical model of parental time allocation and household production of student achievement. Using data from the National Educational Longitudinal Survey (NELS), we estimate parental effort supply equations and student achievement equations, paying close attention to gender differences. Our preliminary results suggest that girls receive higher levels of parental effort and that this effort, to a limited extent, has a more significant effect on their ultimate achievement. It also appears that parents are compensating for the different achievement production technology facing their daughters; however, school resources do not appear to be the culprit. Rather, it may be that girls' achievement is more affected by parental effort directed at them and their studies, whereas boys' achievement is more affected by the household environment more generally.

Theoretical Framework

Houtenville (1997) and Houtenville and Conway (2001) find that parents appear to devote more parental effort to their daughters.[1] Does this mean that parents desire greater achievement for their daughters than their sons? Or could there be a production technology explanation? For example, if girls are overlooked in the classroom, as some argue, then gender could be proxying for school input and parents could simply be compensating for the relatively poorer school quality experienced by their daughters. Parental effort could also have a greater impact on the student achievement of girls versus boys. And, regardless of the reason for the difference in effort, what is the resulting impact on student achievement?

To help disentangle some of the issues, we employ a standard household production model of student achievement. Our framework blends the model of Houtenville (1997) and Houtenville and Conway (2001), who consider parental effort as a choice input into the production of achievement, with that of Chen and McElroy (1999), who consider differences in the household's allocation of medical expenditures between boys and girls and also differences in the production of health by gender. To simplify we begin with a representative household in which one child is present. This household is allowed to have a different utility function, depending upon whether the child is a girl or a boy,

$$U^i(A, C, L; X), \tag{1}$$

in which $i = b, g$ indexes whether the child is a boy or a girl. The vector X contains variables that affect the tastes and preferences of the parents. Parents are assumed to derive utility from their child's achievement (A). The usual basis for this assumption is that an increase in human capital (or achievement) results in higher incomes. Parents indirectly benefit from their children's higher incomes because of their altruism or the possibility of intergenerational income transfers. In addition, altruistic preferences suggest that parents benefit from their child's achievement as long as that achievement increases the child's lifetime *utility* (and not necessarily income), through a more enriching life for example. It is certainly

possible that the marginal returns to academic achievement, in terms of higher incomes, differ between boys and girls.[2] Also, girls may themselves value achievement differently from boys so that parental altruism, equally applied to boys and girls, could still lead to different valuations of their child's achievement by gender. Parents' utility is also a function of a composite good (C), leisure (L), and these too may potentially affect utility differently depending upon the child's gender.

To produce achievement, parents mix their effort (E) with the available school inputs (S^o) according to a production function, $f(\bullet)$,

$$A = f^i(E,\ S^o, Z) \quad \text{(household production function)}, \tag{2}$$

where $i = b, g$, such that the production function may also differ by gender. (Z is a vector of other characteristics that may affect the production of achievement such as parental education.) If, for example, girls are receiving a lesser learning experience at school, then school inputs (as typically measured) will be less productive. Parents may increase their effort to compensate, which could be one explanation for Houtenville (1997) and Houtenville and Conway's (2001) result. Another explanation, however, is that parental effort is more productive for girls.

To close out the model, parents maximize the utility function written in (1) subject to the production function written in (2), and budget and time constraints,

$$p^S S^o + p^C C = wH + Y \quad \text{(budget constraint), and} \tag{3}$$

$$T = H + L + E \quad \text{(time constraint)}, \tag{4}$$

where p^S is the price of S^o[3]; p^C is the price of C; w is the market wage; H is labor market time; Y is non-labor income; and T is the maximum Time available to the parents. Note that we assume that the budget

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[1] Specifically, they include a gender dummy variable in their parental effort equations, which is consistently positive.
[2] One could argue that boys receive higher returns because males tend to have steeper earnings profiles due to fewer work interruptions. However, what matters here is the *relative* wages received, and it is possible that girls actually receive a higher relative benefit to achievement if they face a more limited choice set of low skilled jobs.
[3] This is a simplifying assumption. The amount the family pays for schooling is likely a function of its' property holdings, as well as the property values of the community. In addition, diminishing returns in the production of school inputs suggests that the cost of increasing school inputs may be nonconstant. Specifying a more complicated 'price' of schooling and allowing for Tiebout sorting are worthwhile extensions to this model, but beyond the scope

and time constraints for the household are not affected by the child's gender. It is further assumed that $U(\bullet)$ is separable, twice differentiable, and strictly quasi-concave, and $f(\bullet)$ is twice differentiable and strictly concave.[4] The sign of $\frac{\partial^2 f^i}{\partial S^o \partial E}$ depends upon whether the inputs are substitutes or complements in production. Presumably, they could be either. A small class size may facilitate greater teacher attention so that parental tutoring is not as productive (substitutes). Or, more resources may mean more challenging homework and other activities for parental involvement (complements).

By normalizing p^C to 1.0 and substituting the constraints and the production function into the utility function, the parents' problem is

$$\max_{E,L} U^i(f^i(E, S^o, Z), wT + Y - wE - wL - p^S S^o, L; X). \tag{5}$$

The parents maximize their utility by choosing effort and leisure,

$$E^i = E(w, T, Y, p^S, S^o, Z; X) \text{ and} \tag{6}$$

$$L^i = L^i(w, T, Y, p^S, S^o, Z; X). \tag{7}$$

The production function for desired achievement is residually found as

$$A^i = f^i(E^i(w, T, Y, p^S, S^o, Z; X), S^o, Z), \tag{8}$$

where, again, Z is a vector of other inputs (e.g., parent's education, household study aids) that may affect achievement. Most achievement studies either include an extensive list of household variables to proxy for E and Z, or have eliminated them using panel data or natural experiments.

Several implications may be drawn from this simple framework. First, this model implies that parents have an effort supply equation and an achievement demand equation, both of which may differ between boys and girls. For this reason, we estimate these equations separately for boys and girls and, for comparison, we also pool boys and girls together, allowing some key parameters to differ. It also

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of this paper.

[4] Removing the separability assumption does not substantively change the results, but is assumed in order to simplify the discussion. In addition, assuming a single wage rate for the family greatly simplifies matters.

suggests that effort is an endogenous variable that must be treated as such in the estimation procedure. Furthermore, it suggests that girls may have different levels of achievement, holding other inputs such as school inputs constant, both because the production technology is different and because their parents choose a different level of effort.

What are the factors that might lead parents to devote different levels of effort to their sons versus their daughters? Looking at the first order conditions for effort,

$$\frac{\partial U^i}{\partial A} = w\frac{\partial U^i}{\partial C}\left(\frac{\partial f^i}{\partial E}\right)^{-1}$$

for $i = b, g$. This condition is very similar to that of Chen and McElroy (1999) and is the standard marginal benefit = marginal cost calculation. It highlights, however, why parents may devote different amounts of effort according to their child's gender. On the benefit side, parents will devote more effort if achievement is valued more highly in the utility function. For instance, if parents value achievement more highly for girls for the reasons given earlier, then they may devote more effort to their daughters. Or perhaps their marginal utility is higher because the overall level of achievement is lower for girls at the current level of school resources, due to production technology differences. On the cost side, they may devote more effort either if effort is more productive $\left(\frac{\partial f^g}{\partial E} > \frac{\partial f^b}{\partial E}\right)$ or if having a daughter for some reason leads to a lower level marginal utility of income.

Our estimated effort and achievement equations can shed light on these influences. First, we can verify whether parents do indeed devote more effort to their daughters. If so, we can look at how effort is affected by school inputs and infer whether it may be due to the production relationship. For example, finding that effort is less affected by school resources for girls than boys is consistent with school inputs having less effect on girls' achievement (a lower A, *ceteris paribus*) or, conversely, being more complementary to effort in production (a greater $\frac{\partial^2 f^i}{\partial S^o \partial E}$ which should lead to a higher $\frac{\partial f^g}{\partial E}$, again, *ceteris paribus*). Our estimates of the achievement production relationship can then help reveal whether

school inputs are indeed less productive for girls' achievement than boys'; likewise, we can see whether parental effort is *more* productive for girls. Finally, by predicting values of parental effort and student achievement, holding household characteristics and, at times, parental effort across boys and girls, we can further decompose any differences in achievement by gender into productive effects and resource allocation effects.

Empirical Strategy

In the theoretical model presented above, there are several reasons why parents may devote different levels of effort to their sons versus their daughters. Likewise, there are several reasons why student achievement may differ by gender. To explore these issues, we first estimate a parental effort equation (equation 6) and then a student achievement equation (equation 8) that includes endogenous parental effort as well as school inputs, as in Houtenville (1997) and Houtenville and Conway (2001). We build on the work of Rosenzweig and Schultz (1983), who estimate the demand for health related inputs and the infant health production function, and Hanushek (1986), who provides insight into estimating an achievement production function.

Our simultaneous model therefore consists of a parental effort supply equation corresponding to equation (6) above,

$$E_i = \gamma' X_i + \theta' Z_i + u_i, \tag{10}$$

and an achievement production function

$$A_i = \delta' E_i + \phi' S_i^o + \alpha' Z_i + v_i, \tag{11}$$

which corresponds to equation (8) above. S^o denotes school input and the vectors X and Z contain family characteristics like parent wages, other resources and family structure. The coefficients in equation (11) shed light on any production differences between boys and girls, which can be used in combination with the effort equation estimates to help understand if and why parents devote levels of effort. Finally, by also estimating an achievement equation in the "usual" way (i.e., omitting parental effort) helps us to understand both whether parental effort is acting to compensate for poorer school inputs and the impact of

ignoring gender differences and parental effort, as most studies do.

***Data Description*:** In order to estimate the model above, a comprehensive data set that reports a child's achievement, his or her parents' effort, his or her schooling and other characteristics is needed. The United States Department of Education's Restricted Use National Education Longitudinal Study (NELS) is such a data set. The NELS is a comprehensive national panel survey of 24,599 students and their parents, teachers, and school administrators. The students (from 815 public schools and 237 private schools) were in the eighth grade in 1988. Along with the survey, each student took standardized tests in reading, mathematics, science, and social studies. The NELS follows and re-tests the same students from 8^{th} grade to 10^{th} grade to 12^{th} grade.[5]

Using the 8^{th} graders is perhaps preferable if parental effort is more relevant in 8^{th} grade than in 10^{th} grade. However, in order to control for prior achievement, which is stressed throughout the achievement production function literature, we must use the 10^{th} grade surveys (1990) because the 8^{th} grade surveys do not contain a measure of prior achievement. In preparing the NELS data set for estimation, four basic exclusions are made to the sample. First, 7,952 observations (31 percent of the 25,851 base year eligible sample) are excluded because they are unavailable in the first follow-up sample. Second, 3,212 observations (18 percent of the remaining 17,889 observations) are excluded due to incomplete student, parent and school administrator surveys, or student examinations.[6] Third, 8,683 observations (59 percent of the remaining 14,686 observations) are excluded because of missing responses to pertinent questions. Lastly, 21 observations with extreme outlying information are excluded leaving a total of 5,982 observations—5,053 public school students and 929 private schools students.[7]

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[5]The use is restricted due to confidentiality issues. The Public Release NELS does not contain continuous measures of schooling, for fear that someone will be able to identify a specific school and thus a specific school administrator.
[6]One of the major shortcomings of NELS is that it does not contain parents surveys for 1990, therefore some of the family information (wages and income) are 1988 figures.
[7]When information is available, we tested the differences between our current sample and the omitted observations for all of the variables, both with and without the sample panel weights. Using the weights lessens the differences in means. Only one of the six effort dummy variables has a statistically significant difference in means. With respect to the other variables, however, the results are as one would expect with the omitted students being less advantaged. Although statistically different, the magnitude of the differences is usually small, typically less than 15 percent.

Econometric Techniques and Issues*:* The NELS provides several measures of parental effort. However, these measures are all categorical data such that ordered probit is used for the effort equation (10). Since there is more than one student per school, the data suffers from clustering at the school level. One would expect students who attend the same school to share some unobserved characteristics, which suggests that the errors may be correlated across observations. We therefore adjust all standard errors for clustering.

Most prior student achievement studies focus only on public school students and we want to provide comparable results. In addition, the assumption of exogenous school input is more tenuous for private school students. We therefore limit our sample to public school children in our main specifications. To adjust for potential sample selection bias, we estimate a probit equation for whether the child attends private schools and use the estimated inverse Mills ratio that results in the effort and achievement equations.[8] Whenever we stratify the samples by gender, we also estimate separate public/private equations, which yield different inverse Mills ratios by gender.

A final complication is the estimation of the achievement equation. Because parental effort is endogenous, we must come up with an instrumental variable from equation (10). Two possibilities are to use the predicted latent variable or to use the predicted probabilities of being in each category. Because past work (Houtenville and Conway 2001) find little difference, we opt for the latter measure. The predicted probabilities also imply a less restrictive production relationship (e.g., diminishing returns to effort) and they are more reflective of the categorical variables provided in the NELS. The use of these instrumental variables in addition to the clustering and heteroskedasticity in the errors leads us to use bootstrapped standard errors in the achievement equation.[9]

Discussion of the Variables: Variables definitions and descriptive statistics are provided in Table

[8]Results for the private school equation are provided in the Appendix (Table A1). The standard errors in the effort and achievement equations are adjusted for the heteroskedasticity introduced by the sample selection correction.
[9]Following Efron and Gong (1983), this bootstrap procedure treats the data set (5,053 observations) like the universal population. One thousand random samples of 5,053 observations are drawn *with replacement* from the data set. These 500 samples are used to estimate 500 achievement equations. For each variable, the standard

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

Actual parental effort (E) is not observed. Instead, two variables are used to represent *actual* parental effort—the responses of a child to two questions about how frequently parents discuss education issues with their child on the 10th grade survey. The way children categorize their parents is assumed to reflect the underlying *actual* parental effort (E).[10] The NELS captures the discussion of course or program selection by asking the children how frequently parents discuss selecting courses or programs at school: never, sometimes, or often. The other measure is how frequently parents discuss things the child studied in class: never, sometimes, or often. These specific measures have been used in the education literature as measures of home-based parent involvement in the education process (e.g., Muller and Kerbow 1993).

There are other measures of parental effort in the NELS, including two questions regarding how often parents get involved with school activities. The children are asked how often parents attend school meetings, and how often parents act as a volunteer at the child's school: never, once or twice, or more than twice. However, these measures of parental effort are problematic. Whether parents volunteer and go to events and meetings is relative to the number of activities in the school. They may therefore suffer from reverse causality, whereby poor school systems actively recruit parent volunteers and wealthy systems put on more events and have more meetings. For this reason, we focus on the discussion measures, believing they most closely match our definition of parental effort.

Our measure of student achievement (A) is the student's score on part of the 10th grade standardized math and reading test. Because past research has discovered possible gender differences in reading versus mathematics, we estimate separate achievement equations for the reading score and the

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deviation of the 500 estimated coefficients is an estimate of the coefficient's standard error.

[10]Of course, a child's perception may differ from his or her parents' and may depend on the child's gender. We discuss this issue further shortly. We also recognize that these responses do not map perfectly with the amount of time a parent actually spends. Still, we argue they are indicative of the overall level of parental involvement in their child's education.

math score. For consistency, we include the past values of both of these scores in the effort and achievement equations. These scores are defined by the creators of NELS and are described as being "consistent" across the 1988 (8^{th} grade) examination and 1990 (10^{th} grade) examination. We can therefore use the 8^{th} grade scores to capture lagged achievement (and past investments in parental effort).

The school inputs (S^o) is represented by a set of school characteristics. Three measures are employed to capture the quality of the school's teachers: the student-teacher ratio, lowest salary received by a teacher, and the percentage of teachers with a Master's or a doctoral degree. Lowering the student-teacher ratio, raising teachers' salaries, and increasing teachers' credentials are often cited as ways to improve school inputs and the performance of students. A child's school experience is also greatly influenced by the students with which he or she associates. Two measures of the child's peers are the percentage of the student body *not* in the school's subsidized lunch program and the percentage of *non*-minority students in the student body. These two measures capture the extent to which a child's peers come from income constrained families (who in turn may provide fewer educational opportunities). Attending school with the children of such constrained families may diminish the schooling of other children. Note that with the exception of the student-teacher ratio, an increase in these school characteristics reflects an increase in school input.

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. We include the child's prior achievement to capture previous effort and school inputs. Other child characteristics include race and whether they are a problem child. Our set of family characteristics captures opportunity costs, preferences and resources: mother and father's wage, education and age, the number of siblings, family income, single parenthood, and whether there is limited household physical capital.[11] Parents' wage, education and age are interacted with single parenthood; e.g., a single parent's education may have a differential effect on the provision of effort (due

to the different time constraint).

As shown above, the wage is an important determinant of parental effort because it is part of the marginal cost of effort. However, it has an ambiguous effect due to the usual income and substitution effects (Houtenville 1997 and Houtenville and Conway 2001). We therefore include both the mother and father's hourly wages in the parental effort equation with no expectations regarding their influence.[12] Wages may influence achievement indirectly through parental effort, but should not directly influence coordination and production abilities of parents, especially since parents' education is included to capture these abilities. They also should not proxy ability to pay for other inputs because family income is included.

Likewise, we exclude the interactions of single parenthood and wage, education and age from the achievement equation because they are not expected to influence the production of achievement once being a single parent and the level of effort have been controlled. Whether there is limited household physical capital is also excluded. This measure is likely to influence achievement through its constraint on parental time and not directly affect the production of achievement. These restrictions help to identify the achievement equation.

Finally, to control for other exogenous influences, we include an urban dummy variable because schools in urban areas are more likely to face a whole host of problems, such as aging infrastructure, inadequate educational material and under-funding. Regional dummy variables are also included.

Empirical Results

Recall that our empirical strategy requires estimating three equations – a public/private school

[11]"Mother" and "father" represent a parent, step-parent or individuals similar to a step-parent.
[12]The wage measures were created by using a NELS occupation question and the Bureau of Labor Statistics median weekly earnings by occupation, by gender. Home-makers received the wage for his or her gender's overall market wage as a measure of their foregone market wage. This may overstate a home-maker's wage if he or she is staying home because of a low earning potential.

probit equation to control for self-selection, a parental effort equation and, finally, a student achievement equation that includes predicted parental effort as an input. Therefore, a thorough look at gender differences in household decision making includes the private/public school equation. These results are available upon request. Here it is interesting to note that the decision to send a child to private school is only affected by past achievement (and then only reading scores) for boys. In addition, there appears to be a smaller penalty for being nonwhite or a problem child if one is a boy. Perhaps this is evidence that parents are more likely to seek out private schools for their problem boys as opposed to their problem girls. On the other hand, having a single parent brings a bigger penalty for boys than girls.

Parental Effort Estimates

Turning to our main equations of interest, Table 2 reports the ordered probit estimates from our two measures of parental effort – how often they discuss "things studied" and course selection. We report four sets of estimates for each effort measure. The first two pools boys and girls together: of these, the first one includes child's gender as a shifter only and is most comparable to Houtenville (1997) and Houtenville and Conway (2001). The second allows the school inputs to also have different coefficients between boys and girls. The last two sets of estimates come from estimating separate equations for girls and boys, respectively. Recall that all standard errors are adjusted for clustering and heteroskedasticity.

Immediately apparent from the first column for each measure is the result found by Houtenville (1997) and Houtenville and Conway (2001) that girls receive more parental effort than boys. Indeed this is the most statistically significant coefficient in that specification. Having confirmed their results, we now turn to asking why this is true. The second column in both tables reveals that production technology differences could be part of the story, as there are statistically significant differences in the effects that the school inputs measures have on parental effort. We consider first the "things studied" measure, which is our preferred measure because we believe it reflects a broader measure of parental effort than discussing only course selection. Here it is clear that parental effort devoted to girls is much less affected by school inputs; not a single coefficient is statistically significant for girls. For boys, however, parents appear to

devote less effort the higher teachers' salaries are, the higher the percentage of nonminority students, and the *lower* the percentage of teachers with masters' degrees. School inputs therefore have significant, but mixed, effect on parental effort, which are entirely consistent with the theoretical model of Houtenville (1997) and Houtenville and Conway (2001) that shows that school inputs have ambiguous effects on effort. However, the fact that school inputs are more important for the effort received by boys is consistent with there being differences in production technology, not just in parental tastes. We return to this issue when we discuss the achievement results.

For the other measure of parental effort, the results for school inputs are more balanced, although they still reveal differences between boys and girls. The effort devoted to girls is increased by a high student/teacher ratio (which means poorer quality) and a high percentage of nonminority students (higher quality), whereas effort to boys is increased in much the same way as before – by lower teacher salaries and a higher percentage of teachers with masters' degrees.

Further evidence that differences in school resource productivity are part of the explanation comes from the fact that the other variables show much smaller differences across the genders. Additional constraints on household resources tend to reduce parental effort, as revealed by the negative effect of number of siblings and limited household capital. Income has a consistently positive effect, but its significance varies. Study aids are associated with higher parental effort for girls but not for boys. One place where some gender differences are found, interestingly, is in the education of the parents. Effort to girls, measured as "discuss things," is more positively affected by their mother's education, whereas effort to boys is more affected by their father's. However, this result does not carry over to the "discuss course selection" measure of effort.

In sum, it is clear that the parental effort equations are different between boys and girls; this conclusion is confirmed by likelihood ratio tests that find them statistically significantly different. Are girls still predicted to receive more parental effort, holding all else constant, even when we estimate separate equations? Our simulations, which we discuss shortly and are reported in Table 4, suggest they

do. Boys have a higher probability of receiving the two lower levels of effort, and girls have a higher probability of receiving the highest. What effect does this have on student achievement?

Student Achievement Results

In the spirit of our theoretical framework and equation (11), we include the predicted probabilities of receiving different levels of parental effort as inputs in an achievement equation. Here again, we report four sets of estimates – one with gender as a shifter, one that allows *effort and school inputs* coefficients to differ by gender, and then one for each gender estimated separately. Also for comparison, we estimate a 'typical' achievement equation that pools boys and girls together, has a gender shifter, and omits parental effort. We have two measures of achievement – reading score and math score – and two measures of parental effort. Table 3a reports the reading score estimates using the two different measures of effort, and Table3b does the same for the math score estimates.

Beginning with the reading score estimates, the results from the 'typical specification' (first column) supports the common belief that girls do better than boys. However, this advantage disappears as soon as parental effort is included. This suggests that girls may be scoring higher in reading because they are receiving greater parental effort. A similar result appears for the math scores except that the starting point is different – boys do better than girls. This gap between boys' and girls' math scores then grows once parental effort is included. These two results suggest that parents may be compensating for the different production technology faced by their daughters. In other words, girls would lose their edge in reading and fall further behind in math were it not for increased parental effort.[13]

However, it is also possible that parental effort is less productive for girls so that when they are pooled together, as in columns 2 and 6, girls appear to do worse. More generally, we need to look at differences in the school inputs and parental effort coefficients before concluding there are differences in production technology. Across both reading and math scores, and both measures of parental effort, parental effort appears more productive, if anything, for girls than for boys. The "discuss things" effort

measure consistently has a positive and statistically significant effect for girls, yet it is never significant for boys. The magnitude of its effect is also usually larger for girls. For the other measure of parental effort, "course selection," the results are less conclusive as it is rarely significant for either gender. This supports our argument that the "discuss things" variable is a superior measure of parental effort because it is broader in scope; the data also suggest that it is the measure that matters to achievement, at least for girls.

Do school resources likewise have different productivities for boys versus girls? Again, the estimates presented in Tables 3a and 3b suggest so. In all four cases (reading and math, two measures of effort), there are statistically significant differences in the school input coefficients when the two genders are pooled. Considering the separate equation estimates, we find interesting differences across subjects and genders. Recall that high teacher salaries decrease the parental effort devoted to sons but did not affect daughters. For both math and reading, teacher salaries emerge as an input that affects the achievement of girls and boys differently, too. In all four cases, high teacher salaries have a more positive impact on the achievement of boys than it does for girls. This is further evidence that parents' decisions are driven, at least in part, by technology differences. High teacher salaries increase boys' achievement and make it more likely that parents will substitute away their effort in response; no such effect is found for girls.

The other school inputs tell less of a consistent story and tend to vary more by subject. Girls' achievement, in general, is affected more by school inputs although the effect is not always positive. A low student-teacher ratio (higher quality) leads to higher girls' math achievement, as does a higher proportion of non income-constrained students (non-lunch). These are the expected signs. A high percentage of non-minority students (typically consider a measure of less constrained peers) leads to a lower level of math achievement. Girls' reading achievement is *negatively* affected by teacher salaries, but positively affected by the percentage of teachers with masters' degrees. In contrast, none of the

[13] Recall that we are controlling for past achievement, which should capture differences in endowments.

school inputs significantly affect the reading scores of boys and only high teacher salaries increase their math achievement. In general, girls' achievement appears to be more much more affected by both parental effort and school resources, with the important exception of teacher salaries.

Boys, on the other hand, consistently appear to be affected more by other household inputs, whereas girls are almost completely unaffected. In particular, being nonwhite, having a single mother or an older father all are associated with lesser achievement for boys, across both subjects. Having a single father appears to increase boys' achievement. High family income appears to lower reading scores, whereas study aids increase math scores. None of these effects are significant for girls. One interesting result that is constant over girls and boys is the 'problem child' dummy variable. Being a problem child significantly reduces math scores (although less so for boys), but has no significant impact on reading scores.

One might ask how much these results are due to our inclusion of parental effort. We also estimate 'typical' reading and math achievement equations (i.e., no parental effort included) separately for boys and girls. We find that including parental effort actually has little impact on the effects of the other variables, with the notable exception that mother's education has a statistically significant, positive effect for girls' math and reading achievement, a common result, when parental effort is left out. Recall that mother's education had a strong positive effect on the amount of effort devoted to daughters so that this difference makes sense. Otherwise, there are few differences in the results except that some of the boys' coefficients on household variables are marginally more statistically significant.

Further Discussion

What do the results say about differences in parental tastes versus differences in production technologies as alternative explanations for differences in parental effort? To address this issue and tie back to the spirit of our theoretical framework, we perform a few simulations. Specifically, we begin with the empirically "representative household" – that is, a household or observation that has all of the overall sample's means for all variables except for parental effort and student achievement. We then use

these characteristics to predict parental effort if the child in this household happens to be a girl (using the girls' coefficients – columns 3 and 7 in Table 2) versus a boy (columns 4 and 8). We then perform a similar exercise for reading and math achievement, treating parental effort in several ways. First, we use the estimates from 'typical' achievement equations, in which parental effort is left out, but stratified by the child's gender. We next allow for parental effort, under a few different scenarios. To isolate production differences, we predict achievement for boys versus girls assuming that the "representative" household (1) "never" discussed,[14] (2) "sometimes" discussed, or (3) "often" discussed, alternately. Finally, to estimate the "representative" household's desired achievement, we also predict achievement using the predicted effort for that household (which will depend upon whether the child is a boy or a girl).

The results from these simulations are reported in Table 4. We see again the result that parents devote more effort to their daughters; boys have a higher probability of receiving the middle or lowest levels of effort, while girls have a much higher probability of receiving the highest level of effort. We also see the common result that girls score slightly better on reading but slightly worse in math using the 'typical' achievement equation estimates. Allowing for parental effort yields more insights. When both boys and girls receive the same level of effort, we see these gaps grow, especially at the extreme levels of effort, but not uniformly. When both receive the lowest amount of effort, especially the "things studied" measure, girls are hurt much more than boys. Boys in this category are actually predicted to score 13 points higher in reading than girls! On the other hand, boys appear to be helped more than girls by the highest level of effort. In fact, using the 'things studied' measure, girls only do better than boys when both receive the "middle" level of effort.

These production estimates suggests that girls have a much steeper relationship between A and E at low levels of effort, but that diminishing returns set in much sooner. Boys have a flatter relationship with closer to constant returns. This is evidenced by the estimated effort coefficients as well. The effort

[14] Note that this is equivalent to using the estimates that include parental effort but assuming that it is not, in fact, productive.

coefficients for girls is frequently smaller for the second category than for the first, whereas for boys they are more likely to steadily increase with the level of effort, even though they are statistically insignificant. These differing relationships are illustrated in Figure 1.

Finally, we look at household desired achievement by using the predicted effort for the "representative" household. Not surprisingly, because this household is predicted to devote more effort to their child if she is girl, desired achievement has a smaller gap. In terms of reading this gap is nearly zero; girls lose most of their small advantage over boys. For math, however, the gap is larger than that yielded by the "typical" model. We caution, however, that these differences are fairly small.

Households therefore devote more effort to their daughters, especially in the highest category, and yet girls appear to face diminishing returns more than boys. Households also appear to be compensating for production technology differences between boys and girls, although it is not at all clear that school inputs are less productive for girls, as some have argued. Could there be alternative explanations? Perhaps girls are more likely to over-report parental effort; that might explain why the gender gap in achievement grows (or diminishes when girls have the edge) when we control for parental effort. However, then one would also expect parental effort to appear less effective for girls, when we actually find the opposite in most cases. To further explore this issue, we use the 8th grade data in which both parent and child responses are available for similar variables; however, the reported categories do line up very well.[15] Nonetheless, we report these frequencies in Table 5. While there are major differences between the parent and child responses, they are loosely correlated and, more importantly, there does not appear to be a major difference between boys and girls. If anything, boys appear more likely to over-report parental effort, especially when their parents reported "seldom or never." As the parents report higher levels of effort, the girls appear to report higher levels than boys; however, these still fall short of what the parents reported and so is not evidence of over-reporting. In sum, we conclude

[15] For instance, the child's questions ask how many times since the beginning of the school year (and the survey was taken in the spring), whereas the parent's questions ask whether they "discuss" with their child "seldom or never," "once or twice a month," "once or twice a week," and "almost everyday."

that over-reporting parental effort on the part of girls is not a convincing explanation for our results.

Other explanations include econometric ones. Perhaps there is simply less variability in school and parental effort inputs such that it is more difficult to estimate these coefficients with precision. Boys are slightly more likely to report the middle category of parental effort, but the differences are not large. Another possible explanation is that the latent variable, parental effort, is reported differently between boys and girls. However, one would hope that by estimating separate ordered probit effort equations and separate achievement equations, we have captured that fact as well.

Concluding Remarks

This research investigates differences in household allocations of parental effort between boys and girls and also differences in the achievement production technologies that face them. Our simple theoretical framework reveals how differences in parental tastes as well as production technologies can lead parents to choose different amounts of effort for boys as opposed to girls. Our empirical results, obtained from the NELS, suggest that parents do indeed allocate more effort to girls than boys. Furthermore, this does not appear to be a case of daughters simply over-reporting parental effort. Parents may be allocating more effort to girls because it appears to be more effective in increasing their achievement, at least at moderate levels of effort. In other words, effort is a more productive input for girls and therefore parents allocate more. There is also evidence that parents may be compensating for a lack of productive inputs elsewhere. Specifically, when parental effort is controlled for, girls' slight edge in reading disappears and their small deficit in math grows. And yet, our results do not suggest that school inputs are to blame. Although parents respond to school resources more when deciding how much effort to give boys, school resources seem to have little impact on boys' achievement, with the possible exception of teacher salaries. In fact, school inputs appear to matter more to girls' achievement than boys'. Contrary to what some may argue, girls therefore do not appear to be suffering from a lessened school experience. Perhaps what our study shows is that girls' achievement is more affected by resources allocated more specifically towards education (parental effort, school resources), whereas boys

are more affected by the general home environment (family structure, parental characteristics). In any case, our results strongly suggest that girls and boys differ both in how their achievement is produced and in the resource allocation decisions their parents make.

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Figure 1: Gender Differences in the Relationship between Effort and

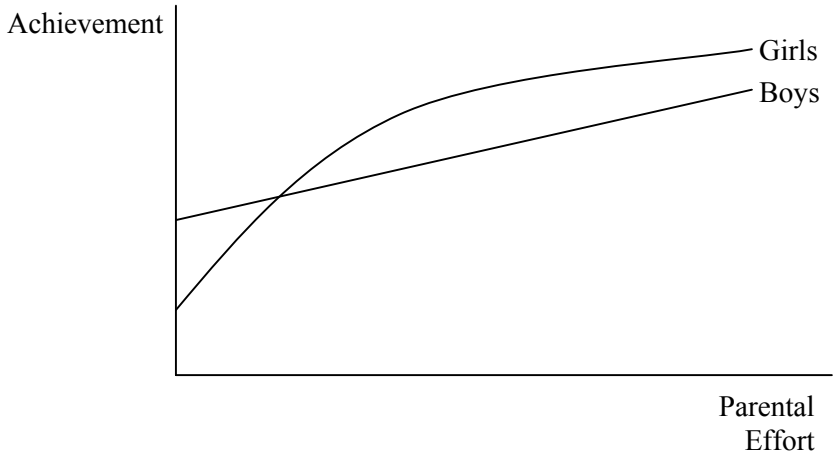

Table 1 Variable Definitions and Descriptive Statistics

Variable	Description		Mean or Percentage	St.Dev.
Parental Effort Measures				
Discuss Course Selection	In the first half of this school year, how often have you discussed the following with either or both of your parents or guardians? Selecting courses or programs at school? Never, sometimes, or often?	Never	16.7%	37.3
		Sometimes	63.9%	48.1
		Often	19.4%	39.6
Discuss Things Studied	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? Things you've studied in class? Never, sometimes, or often?	Never	19.9%	39.9
		Sometimes	60.3%	48.9
		Often	19.9%	39.9
School Inputs Measures				
Student-Teacher Ratio	ratio of students to full-time regular teachers in the school		15.5	3.7
Lowest Teacher Salary	lowest salary paid to a teacher at the school		20,036	2,967
Pct. Advance Degrees	percentage of teachers with a Masters or Ph.D. degrees		52.2	22.1
Pct. Non-Minority	percentage of students in the school that are non-minorities		78.0	26.9
Pct. Non-Free Lunch	percentage of students not in the school's free or reduced price lunch program		81.8	18.0
Child Characteristics				
Achievement	child's scores on standardized reading and mathematics examinations in 1990 (10^{th} grade)		103.9	17.8
Prior Achievement	child's scores on standardized reading and mathematics examinations taken in 1988 (8^{th} grade)		94.3	15.2
Problem Child	most involved parent/guardian reports that child has behavior problems		5.8%	23.4
Female Child	child is female		51.7%	50.0
Non-White Child	child is non-white		18.0%	38.4
Parent(s) Characteristics				
Single Mother	child lives in a single mother household		13.3%	34.0
Single Father	child lives in a single father household		2.0%	14.0
Mother's Education	number of years the mother/female guardian spent in school		13.0	3.0
Father's Education	number of years the father/male guardian spent in school		12.0	5.6
Single Mother's Education[a]	an interaction term of the variables single mother and mother's education		13.0	7.1
Single Father's Education[b]	an interaction term of the variables single father and father's education		12.2	40.9
Mother's Age	age of the mother/female guardian		39.1	8.3
Father's Age	age of the father/male guardian		36.4	16.2
Single Mother's Age[a]	an interaction term of the variables single mother and mother's age		39.1	20.3
Single Father's Age[b]	an interaction term of the variables single father and father's age		38.2	118.6

(Continued)

Table 1 Continued

Variable	Description	Mean or Percentage	St.Dev.
Parent(s) Characteristics—Continued			
Mother's Wage	hourly wage of the mother/female guardian, the opportunity cost of effort	8.0	3.3
Father's Wage	hourly wage of the father/male guardian, the opportunity cost of effort	10.1	5.6
Single Mother's Wage[a]	an interaction term of the variables single mother and mother's hourly wage	8.0	8.5
Single Father's Wage[b]	an interaction term of the variables single father and father's hourly wage	9.7	40.0
Family Characteristics			
Number of Siblings	number of siblings, including step-brothers and step-sisters	2.3	1.6
Family Income	total family income from all sources in 1987	40,860	32,777
Study Aids	home has encyclopedias, a computer, or study room	62.6%	48.4
Limited Household Capital	home does not have a dryer, washer, and dishwasher	39.4%	48.8
Geographic Locations			
Non-Urban School	child's school is not in a central city	83.1%	37.5
North Central Region	child's school is in a north central state	31.5%	46.5
South Region	child's school is in a southern state	31.6%	46.5
West Region	child's school is in a western state	16.1%	36.8
Variables Pertaining to Private School Participation Estimates			
Inverse Mills Ratio	selection adjustment	-0.13	0.2
Catholic Parent	responding parent is Catholic	27.1%	44.4
Private-Public Ratio	ratio of private schools to public schools in the state	28.2	13.9
Religious Enrollment	percentage of private enrollment in the state that attend religious schools	84.1	13.2
Choice Allowable	state allows children to switch districts without changing residency	13.2%	33.8
Local Funding	percentage of state and local school district revenue in the state from local sources	50.4	13.6
Urbanicity	absolute value of the difference between 50 percent and percentage of the state's population in urban areas	26.8	13.1

Source: Authors' calculations using the National Education Longitudinal Survey, 1988 and 1990.
[a]Descriptive statistics are based single mothers only (n=672).
[b]Descriptive statistics are based single fathers only (n=99).

Table 2 Parental Effort: Coefficient Estimates for Parental Effort using Alternative Measures of Parental Effort and Gender Specifications [a]

	Discussion of Things Studied				Discussion of Course Selection			
			Split Samples				Split Samples	
Variables	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Student-Teacher Ratio	0.004608	-0.003895	0.008782	-0.002247	0.013084 *	0.006207	0.019484 **	0.002820
	0.68	-0.41	0.98	-0.19	1.88	0.57	2.14	0.23
Lowest Teacher Salary	-0.000020 **	-0.000039 ***	-0.000001	-0.000045 ***	-0.000013	-0.000030 ***	0.000005	-0.000035 ***
	-2.24	-3.06	-0.11	-3.30	-1.53	-2.89	0.40	-3.14
Pct. Advance Degrees	0.001366	0.003700 **	-0.000624	0.003886 **	0.001109	0.003162 *	-0.001014	0.003692 **
	1.30	2.32	-0.52	2.33	0.95	1.89	-0.76	2.10
Pct. Non-Minority	-0.000349	-0.002375 *	0.001347	-0.002552 *	0.000896	-0.001026	0.002515 *	-0.001215
	-0.33	-1.88	1.03	-1.74	0.90	-0.84	1.91	-0.88
Pct. Non-Free Lunch	-0.000621	0.001691	-0.002616	0.001972	0.001511	0.001873	0.001246	0.002240
	-0.45	0.82	-1.60	0.90	1.01	0.88	0.72	0.97
Girl*Student-Teacher Ratio	---	0.014804	---	---	---	0.012228	---	---
	---	1.23	---	---	---	0.88	---	---
Girl*Lowest Teacher Salary	---	0.000036 **	---	---	---	0.000034 **	---	---
	---	2.38	---	---	---	2.35	---	---
Girl*Pct. Advance Degrees	---	-0.004639 **	---	---	---	-0.004106 **	---	---
	---	-2.34	---	---	---	-1.96	---	---
Girl*Pct. Non-Minority	---	0.003922 **	---	---	---	0.003637 **	---	---
	---	2.43	---	---	---	2.18	---	---
Girl*Pct. Non-Free Lunch	---	-0.004296	---	---	---	-0.000635	---	---
	---	-1.62	---	---	---	-0.25	---	---
Prior Achievement, Reading	0.009374 ***	0.009131 ***	0.007267 *	0.011186 **	0.007298 **	0.007052 **	0.007194	0.007217
	2.89	2.82	1.66	2.32	2.03	1.97	1.47	1.46
Prior Achievement, Math	-0.006428 *	-0.006037 *	-0.004382	-0.007863	-0.001988	-0.001662	-0.004344	0.001108
	-1.81	-1.75	-0.99	-1.52	-0.62	-0.51	-0.95	0.23
Problem Child	-0.059526	-0.069038	-0.114722	-0.042146	-0.107537	-0.118214	0.126276	-0.223544 *
	-0.74	-0.85	-0.86	-0.45	-1.09	-1.22	0.78	-1.87
Girl	0.221279 ***	-0.447024	---	---	0.276125 ***	-0.607487	---	---
	5.64	-1.28	---	---	6.25	-1.52	---	---

Continued

Table 2 Parental Effort: Continued

	Discussion of Things Studied				Discussion of Course Selection			
			Split Samples				Split Samples	
Variables	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Non-White Child	-0.011018	0.000183	-0.048155	0.082777	0.063392	0.073306	0.099743	0.036171
	-0.19	0.00	-0.64	0.96	0.94	1.09	1.14	0.37
Single Mother	0.150311	0.136990	-0.223990	0.697309	-0.338056	-0.355793	-0.790377 *	0.394876
	0.38	0.35	-0.43	1.29	-0.87	-0.91	-1.65	0.58
Single Father	0.960949 ***	0.943988 ***	1.313013 *	0.995789 **	0.661069 *	0.633281 *	0.543535	0.772049 *
	2.85	2.80	1.68	2.52	1.93	1.86	1.04	1.70
Mother's Education	0.026795 **	0.025204 **	0.034710 **	0.014183	0.014841	0.013094	0.023431	0.003767
	2.30	2.20	2.10	0.88	1.14	1.03	1.34	0.21
Father's Education	0.030471 ***	0.030926 ***	0.020721	0.043668 ***	0.017384 *	0.018081 *	0.018710	0.020279
	2.96	3.02	1.39	3.07	1.66	1.77	1.33	1.46
Single Mother's Education	-0.009707	-0.006506	-0.041096	0.029743	0.049519	0.053591	0.056323	0.037862
	-0.30	-0.20	-0.85	0.67	1.51	1.63	1.16	0.81
Single Father's Education	-0.031562	-0.037754	0.013095	-0.090561 *	-0.037492	-0.043545	-0.069024	-0.020037
	-0.81	-0.98	0.21	-1.91	-1.04	-1.23	-1.27	-0.43
Mother's Age	0.001664	0.001876	-0.001636	0.007644	-0.000713	-0.000613	-0.001367	0.000514
	0.40	0.46	-0.30	1.28	-0.16	-0.14	-0.22	0.09
Father's Age	-0.003677	-0.003929	-0.004973	-0.003947	-0.004837	-0.005024	-0.010702 **	0.001017
	-1.12	-1.20	-1.07	-0.87	-1.28	-1.35	-2.08	0.20
Single Mother's Age	0.006821	0.006708	0.018213	-0.009488	0.002707	0.002523	0.006001	-0.004049
	0.65	0.63	1.18	-0.78	0.24	0.23	0.37	-0.27
Single Father's Age	-0.002426	0.000191	-0.029274	0.016516	0.006200	0.008747	0.020815	-0.004832
	-0.19	0.01	-1.22	1.30	0.62	0.90	1.28	-0.37
Mother's Wage	0.010054	0.010671	0.013033	0.005609	0.012392	0.013126	0.009770	0.017555
	1.12	1.23	1.19	0.39	1.44	1.53	0.92	1.32
Father's Wage	0.009791	0.009761	0.009250	0.010687	0.015042 **	0.014774 **	0.012550	0.015004
	1.42	1.42	1.18	1.05	2.15	2.16	1.48	1.51

Continued

Table 2 Parental Effort: Continued

	Discussion of Things Studied				Discussion of Course Selection			
			Split Samples				Split Samples	
Variables	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Single Mother's Wage	-0.000660	-0.004323	0.009316	-0.017993	-0.041181 *	-0.045081 **	-0.049166	-0.036322
	-0.03	-0.18	0.26	-0.57	-1.81	-1.97	-1.60	-1.08
Single Father's Wage	0.001773	0.001155	0.013248	0.003911	-0.038407	-0.038736	-0.052220	-0.015442
	0.07	0.05	0.24	0.11	-1.32	-1.35	-0.87	-0.42
Number of Siblings	-0.037012 ***	-0.036219 ***	-0.029817 *	-0.042855 **	-0.045717 ***	-0.045426 ***	-0.056232 ***	-0.030375
	-2.86	-2.80	-1.72	-2.24	-3.31	-3.31	-3.00	-1.60
Family Income	1.8E-06 **	1.9E-06 **	1.2E-06	2.7E-06 **	6.6E-07	7.1E-07	3.9E-07	1.0E-06
	2.31	2.39	1.06	2.47	0.85	0.92	0.41	0.80
Study Aids	0.069114	0.063639	0.172331 ***	-0.093368	0.128863 ***	0.124413 ***	0.202917 ***	0.015825
	1.56	1.45	3.28	-1.39	2.97	2.87	3.63	0.24
Limited Household Capital	-0.110389 **	-0.111964 **	-0.097183 *	-0.138315 *	-0.111521 **	-0.111952 **	-0.150121 **	-0.061880
	-2.28	-2.33	-1.71	-1.95	-2.40	-2.40	-2.32	-0.90
Non-Urban School	0.026471	0.027510	0.022611	0.105948	0.181759 *	0.187943 *	0.192107	0.231672
	0.25	0.26	0.18	0.73	1.66	1.76	1.58	1.58
North Central Region	-0.011641	-0.004803	0.026810	-0.036105	-0.128020 **	-0.125857 **	-0.112225	-0.139607
	-0.18	-0.07	0.33	-0.35	-2.14	-2.09	-1.39	-1.53
South Region	0.073702	0.079315	0.117064	0.035761	0.036569	0.037911	0.064911	0.016770
	1.16	1.24	1.29	0.38	0.54	0.55	0.68	0.17
West Region	0.129835 *	0.135923 *	0.191579 *	0.081883	-0.045793	-0.045997	-0.111569	0.063889
	1.65	1.71	1.92	0.63	-0.53	-0.53	-1.06	0.43
Inverse Mills Ratio	0.183209	0.171551	0.225386	-0.024163	0.018605	0.004061	0.071508	-0.157351
	0.94	0.89	0.92	-0.09	0.09	0.02	0.30	-0.58
μ(1)	-0.051611	-0.415042	-0.075167	-0.316674	0.119780	-0.361690	0.015422	-0.092415
μ(2)	1.713136	1.354837	1.619835	1.552256	2.044304	1.567799	1.862790	1.947404

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

[a]Statistical significant coefficients at the 1, 5, and 10 percent levels are indicated with ***, **, and *, respectively. t-statistics are under the coefficients. The underlying standard errors are adjusted for clustering at the school/classroom level, and Huber/White/sandwich standard errors are estimated.

[b]Ordered probit coefficients.

Table 3a Reading: Coefficient Estimates for Achievement using Alternative Measures of Parental Effort and Gender Specifications [a]

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Discuss Sometimes	---	6.86713	-1.57156	19.28348 ***	0.71896	3.50885	-4.53162	1.86793	1.58929
	---	1.49	-0.24	2.62	0.13	0.91	-0.78	0.29	0.24
Discuss Often	---	8.87354	9.16094	15.93420 ***	4.35200	4.46297	5.34129	2.57462	6.80027
	---	1.44	1.50	2.61	0.67	0.95	1.09	0.46	0.89
Girl*Discuss Sometimes	---	---	19.373 **	---	---	---	11.123	---	---
	---	---	2.13	---	---	---	1.25	---	---
Girl*Discuss Often	---	---	1.12659	---	---	---	-0.36909	---	---
	---	---	0.30	---	---	---	-0.09	---	---
Student-Teacher Ratio	0.03098	0.01835	0.05692	-0.01412	0.04120	0.01623	0.04372	0.01110	0.03502
	0.79	0.46	1.04	-0.26	0.71	0.38	0.80	0.17	0.60
Lowest Teacher Salary	-0.00003	0.00002	0.00013	-0.00010 *	0.00010	-0.00002	0.00008	-0.00010 *	0.00010
	-0.61	0.30	1.42	-1.66	0.92	-0.30	1.02	-1.72	1.07
Pct. Advance Degrees	0.00826	0.00488	-0.00701	0.01804 **	-0.00357	0.00697	-0.00279	0.01607 **	-0.00549
	1.28	0.71	-0.65	2.34	-0.33	1.06	-0.29	2.05	-0.50
Pct. Non-Minority	-0.00187	-0.00098	0.01216	-0.01449	0.00998	-0.00281	0.00784	-0.00978	0.00938
	-0.23	-0.12	1.27	-1.20	1.03	-0.35	0.92	-0.79	1.08
Pct. Non-Free Lunch	-0.00138	-0.00135	-0.00328	0.00523	-0.00151	-0.00380	0.00002	-0.00383	-0.00288
	-0.17	-0.16	-0.28	0.52	-0.13	-0.43	0.00	-0.34	-0.24
Girl*Student-Teacher Ratio	---	---	-0.06463	---	---	---	-0.04196	---	---
	---	---	-0.88	---	---	---	-0.59	---	---
Girl*Lowest Teacher Salary	---	---	-0.00022 **	---	---	---	-0.00018 *	---	---
	---	---	-2.23	---	---	---	-1.92	---	---
Girl*Pct. Advance Degrees	---	---	0.02518 *	---	---	---	0.01961	---	---
	---	---	1.85	---	---	---	1.61	---	---
Girl*Pct. Non-Minority	---	---	-0.02545 *	---	---	---	-0.01978	---	---
	---	---	-1.86	---	---	---	-1.56	---	---
Girl*Pct. Non-Free Lunch	---	---	0.00411	---	---	---	-0.00557	---	---
	---	---	0.28	---	---	---	-0.40	---	---

Continued

Table 3a Reading: Continued

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Prior Achievement, Reading	0.72271 ***	0.70024 ***	0.70439 ***	0.68616 ***	0.71516 ***	0.71493 ***	0.71738 ***	0.71242 ***	0.71568 ***
	31.38	25.96	26.58	17.78	24.80	29.12	29.53	18.92	27.27
Prior Achievement, Math	0.28058 ***	0.29508 ***	0.29161 ***	0.29055 ***	0.29760 ***	0.28240 ***	0.28037 ***	0.27556 ***	0.28734 ***
	14.86	14.18	14.48	10.32	11.79	14.97	15.21	9.87	12.00
Problem Child	-0.34832	-0.20381	-0.13608	-0.38751	0.08839	-0.21770	-0.19068	-1.02578	0.36801
	-0.87	-0.48	-0.33	-0.51	0.19	-0.50	-0.45	-1.44	0.58
Girl	0.51950 **	0.00442	-6.10630	---	---	0.22725	-1.65504	---	---
	2.17	0.01	-0.95	---	---	0.52	-0.24	---	---
Non-White Child	-0.58044	-0.46711	-0.53923	-0.18653	-0.88888 **	-0.59684 *	-0.66181 *	-0.54651	-0.85248 *
	-1.63	-1.27	-1.48	-0.33	-2.01	-1.73	-1.90	-1.07	-1.94
Single Mother	-0.83754	-1.31959	-1.30912	1.05836	-2.57280 *	-0.77938	-0.86111	0.88869	-2.53412 **
	-1.09	-1.64	-1.64	1.02	-1.86	-1.03	-1.11	0.73	-2.13
Single Father	2.67331 **	1.27482	1.44976	-1.20015	3.76426 **	2.47765 **	2.44125 **	0.78392	3.95313 **
	2.20	0.97	1.11	-0.69	2.05	2.12	2.09	0.49	2.40
Mother's Education	0.05007	-0.02898	-0.01939	-0.12524	0.07114	0.01652	0.02186	-0.01203	0.06750
	0.96	-0.38	-0.26	-1.37	0.76	0.25	0.33	-0.12	0.77
Father's Education	0.10557 **	0.01968	0.02526	0.04562	0.01238	0.08214	0.07842	0.15327 **	0.01920
	2.29	0.27	0.35	0.58	0.13	1.60	1.54	2.23	0.26
Mother's Age	0.03711 **	0.02793	0.02976	0.00786	0.04686	0.03687 **	0.03662 **	0.02275	0.05159 *
	2.05	1.53	1.64	0.35	1.63	2.05	2.04	1.02	1.83
Father's Age	-0.03407 **	-0.02260	-0.02419	0.02385	-0.05405 **	-0.02830	-0.02900	-0.00290	-0.05722 ***
	-1.99	-1.22	-1.32	0.86	-2.45	-1.60	-1.64	-0.09	-2.57
Number of Siblings	-0.13162	-0.03264	-0.04407	0.02591	-0.08142	-0.07656	-0.08816	-0.08248	-0.07720
	-1.49	-0.35	-0.49	0.21	-0.65	-0.83	-0.97	-0.68	-0.65
Family Income	-6.5E-06 *	-1.1E-05 **	-1.0E-05 **	-8.1E-06	-1.6E-05 **	-7.6E-06 **	-7.7E-06 **	-4.0E-06	-1.5E-05 **
	-1.78	-2.19	-2.02	-1.56	-1.98	-1.97	-1.98	-0.84	-2.34
Study Aids	-0.03711	-0.24194	-0.18401	-1.00190 **	0.33607	-0.20297	-0.14734	-0.41681	0.22182
	-0.14	-0.84	-0.66	-2.09	0.94	-0.64	-0.48	-0.82	0.65

Continued

Table 3a Reading: Continued

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Non-Urban School	-0.42899	-0.53752	-0.61552	-1.01274	-0.31522	-0.65885	-0.67935	-0.99306	-0.57346
	-0.77	-0.94	-1.10	-1.41	-0.44	-1.10	-1.15	-1.29	-0.66
North Central Region	-0.51779	-0.48058	-0.50072	-0.68395	-0.35824	-0.37304	-0.40199	-0.48485	-0.17709
	-1.35	-1.26	-1.33	-1.43	-0.67	-0.90	-0.98	-0.98	-0.29
South Region	-0.23155	-0.42607	-0.41432	-0.66486	-0.21098	-0.28487	-0.29170	-0.22868	-0.20385
	-0.60	-1.02	-0.99	-1.16	-0.40	-0.73	-0.75	-0.42	-0.39
West Region	0.57644	0.25084	0.29112	-0.19288	0.65797	0.61100	0.60536	0.62221	0.64091
	1.35	0.51	0.60	-0.28	1.08	1.43	1.41	1.01	1.05
Inverse Mills Ratio	0.12461	-0.22547	-0.08691	1.25038	-1.79931	0.13939	0.19921	1.98916	-1.53129
	0.10	-0.17	-0.07	0.81	-1.21	0.11	0.16	1.31	-0.97
Constant	2.90028	-0.66903	1.01102	-5.33463	-0.65283	1.19257	3.32099	4.76997	-0.86428
	1.49	-0.21	0.23	-1.03	-0.16	0.37	0.77	0.79	-0.19

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

[a]Statistical significant coefficients at the 1, 5, and 10 percent levels are indicated with ***, **, and *, respectively. t-statistics are under the coefficients. The underlying standard errors are adjusted for clustering at the school/classroom level, and Huber/White/sandwich standard errors are estimated. Ordered probit coefficients are reported.

Table 3b Math Achievement: Coefficient Estimates for Achievement using Alternative Measures of Parental Effort and Gender Specifications [a]

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Discuss Sometimes	---	7.71634 **	4.36449	9.40419 *	4.84285	4.83164	1.42577	3.95542	4.76652
	---	2.38	1.06	1.76	1.36	1.38	0.29	0.89	1.00
Discuss Often	---	8.53556 **	8.74648 **	7.01234 *	7.58797	8.29911 ***	8.26525 **	6.88234 *	7.73090
	---	2.20	2.15	1.88	1.64	2.62	2.49	1.79	1.51
Girl*Discuss Sometimes	---	---	7.24917	---	---	---	6.85313	---	---
	---	---	1.10	---	---	---	1.04	---	---
Girl*Discuss Often	---	---	0.50871	---	---	---	0.94670	---	---
	---	---	0.21	---	---	---	0.33	---	---
Student-Teacher Ratio	-0.03969	-0.05203 **	-0.00511	-0.07521 **	-0.01539	-0.06796 **	-0.02508	-0.09377 **	-0.02388
	-1.57	-2.04	-0.15	-2.15	-0.43	-2.54	-0.71	-2.42	-0.67
Lowest Teacher Salary	0.00003	0.00007 *	0.00016 **	0.00000	0.00015	0.00005	0.00013 **	-0.00001	0.00013
	0.77	1.73	2.39	0.07	1.94	1.46	2.26	-0.22	1.81
Pct. Advance Degrees	0.00236	-0.00089	-0.00327	0.00036	-0.00261	-0.00008	-0.00064	0.00062	-0.00197
	0.50	-0.18	-0.40	0.07	-0.31	-0.02	-0.08	0.11	-0.23
Pct. Non-Minority	-0.01148 **	-0.01064 **	-0.00312	-0.01885 ***	-0.00028	-0.01321 ***	-0.00670	-0.02022 ***	-0.00288
	-2.51	-2.32	-0.47	-3.19	-0.04	-2.87	-1.09	-3.35	-0.46
Pct. Non-Free Lunch	0.01520 **	0.01515 **	0.01113	0.02031 ***	0.00956	0.01096	0.01290	0.01363 *	0.00949
	2.26	2.26	1.13	2.76	0.99	1.61	1.34	1.82	1.00
Girl*Student-Teacher Ratio	---	---	-0.08272 *	---	---	---	-0.07465 *	---	---
	---	---	-1.85	---	---	---	-1.74	---	---
Girl*Lowest Teacher Salary	---	---	-0.00016 **	---	---	---	-0.00014 **	---	---
	---	---	-2.38	---	---	---	-2.28	---	---
Girl*Pct. Advance Degrees	---	---	0.00411	---	---	---	0.00104	---	---
	---	---	0.43	---	---	---	0.12	---	---
Girl*Pct. Non-Minority	---	---	-0.01441 *	---	---	---	-0.01255 *	---	---
	---	---	-1.74	---	---	---	-1.67	---	---
Girl*Pct. Non-Free Lunch	---	---	0.00760	---	---	---	-0.00285	---	---
	---	---	0.69	---	---	---	-0.27	---	---

Continued

Table 3b Math Achievement: Continued

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Prior Achievement, Reading	0.14133 ***	0.11964 ***	0.12150 ***	0.16618 ***	0.09024 ***	0.12659 ***	0.12858 ***	0.16720 ***	0.09911 ***
	10.05	7.51	7.74	8.43	4.29	8.60	8.84	8.48	5.14
Prior Achievement, Math	0.84737 ***	0.86148 ***	0.86014 ***	0.82239 ***	0.89174 ***	0.85060 ***	0.84967 ***	0.82163 ***	0.87352 ***
	60.88	59.38	59.67	42.36	47.43	61.71	61.71	42.01	45.37
Problem Child	-1.12725 ***	-0.98293 ***	-0.94775 ***	-1.61543 ***	-0.68330	-0.89571 ***	-0.87514 **	-2.10166 ***	-0.33558
	-3.42	-2.87	-2.76	-2.61	-1.76 *	-2.61	-2.54	-3.43	-0.70
Girl	-0.57573 ***	-1.07287 ***	-0.83116	---	---	-1.12837 ***	-0.65010	---	---
	-3.63	-3.71	-0.18	---	---	-4.04	-0.14	---	---
Non-White Child	-0.38214 *	-0.26429	-0.29993	-0.20383	-0.50788	-0.42619 *	-0.45070 **	-0.45272	-0.43821
	-1.67	-1.15	-1.32	-0.59	-1.47	-1.89	-1.98	-1.42	-1.30
Single Mother	-0.91338 *	-1.37782 ***	-1.38077 ***	-0.43715	-2.41023 ***	-0.83509 *	-0.85992 *	-0.03704	-2.01508 **
	-1.86	-2.67	-2.71	-0.66	-2.72	-1.73	-1.79	-0.05	-2.53
Single Father	2.08669 **	0.73579	0.80549	0.40217	1.67249	1.67437 **	1.71364 **	1.11388	2.45753 **
	2.55	0.73	0.80	0.31	1.20	2.05	2.09	1.00	1.99
Mother's Education	0.11129 ***	0.03525	0.04005	0.00484	0.10915 *	0.04800	0.05247	-0.00659	0.12639
	3.01	0.68	0.79	0.08	1.66	1.07	1.19	-0.11	2.03 **
Father's Education	0.10315 ***	0.02107	0.01863	0.05689	-0.01230	0.05657	0.05417	0.06814	0.02944
	3.20	0.42	0.37	0.98	-0.19	1.53	1.45	1.20	0.57
Mother's Age	0.00189	-0.00687	-0.00717	-0.02387	0.00489	0.00095	0.00068	-0.01867	0.01634
	0.14	-0.48	-0.50	-1.29	0.22	0.07	0.05	-1.04	0.79
Father's Age	-0.04559 ***	-0.03473 ***	-0.03400 **	-0.02622	-0.04087 **	-0.03454 ***	-0.03437 ***	-0.02111	-0.04771 ***
	-3.80	-2.59	-2.53	-1.33	-2.51	-2.71	-2.70	-0.97	-2.96
Number of Siblings	-0.08166	0.01608	0.01299	-0.02030	-0.01261	0.01874	0.01625	0.02123	-0.04225
	-1.62	0.25	0.20	-0.26	-0.15	0.30	0.26	0.24	-0.53
Family Income	-7.5E-07	-5.1E-06	-4.9E-06	-3.9E-06	-3.0E-06	-3.0E-06	-2.8E-06	-3.5E-06	9.6E-07
	-0.28	-1.40	-1.32	-1.05	-0.49	-1.08	-0.97	-1.04	0.19
Study Aids	0.35136 **	0.15049	0.16956	-0.12626	0.69338 **	0.04232	0.06581	-0.20212	0.50254 *
	2.07	0.77	0.88	-0.43	2.52	0.20	0.32	-0.64	1.90

Continued

Table 3b Math Achievement: Continued

	No Parental Effort	Discussion of Things Studied				Discussion of Course Selection			
				Split Samples				Split Samples	
Variables	Girl Indicator	Girl Indicator	Interaction	Girls	Boys	Girl Indicator	Interaction	Girls	Boys
Non-Urban School	-0.17584	-0.27786	-0.31952	0.31702	-1.32300 **	-0.59229	-0.62423	0.02569	-1.59179 **
	-0.41	-0.65	-0.75	0.66	-2.12	-1.34	-1.42	0.05	-2.30
North Central Region	-0.00679	0.02797	0.02098	-0.02156	0.07690	0.26421	0.25563	0.21939	0.28265
	-0.03	0.10	0.08	-0.06	0.21	0.89	0.87	0.60	0.68
South Region	-0.02032	-0.21013	-0.21550	-0.12787	-0.18568	-0.11953	-0.11982	-0.05636	-0.12843
	-0.07	-0.66	-0.68	-0.29	-0.48	-0.39	-0.39	-0.14	-0.33
West Region	0.31966	0.00751	-0.00231	-0.12647	0.25676	0.39140	0.37396	0.36982	0.32373
	0.95	0.02	-0.01	-0.25	0.61	1.17	1.12	0.82	0.75
Inverse Mills Ratio	0.28114	-0.06148	0.01647	-0.49891	1.65042	0.28295	0.35847	-0.31800	1.99684 *
	0.34	-0.07	0.02	-0.47	1.62	0.34	0.43	-0.31	1.87
Constant	5.10584 ***	0.99433	0.36390	0.67648	0.34950	3.11046	2.49202	4.50951	0.62314
	4.29	0.46	0.13	0.18	0.13	1.29	0.76	1.31	0.19

Source: Authors' calculations using the National Education Longitudinal Survey, 1988 and 1990.
[a]Statistical significant coefficients at the 1, 5, and 10 percent levels are indicated with ***, **, and *, respectively. t-statistics are under the coefficients. The underlying standard errors are adjusted for clustering at the school/classroom level, and Huber/White/sandwich standard errors are estimated.

Table 4 Simulations: Predicted Probabilities/Test Scores using Estimates from Split Sample for the Representative Observation as Represented by the Mean Characteristics of Combined Sample

	Parental Effort Specification					
	No Parental Effort		Discuss Things Studied		Discuss Course Selection	
Measure	Using the Coefficients of Girls	Using the Coefficients of Boys	Using the Coefficients of Girls	Using the Coefficients of Boys	Using the Coefficients of Girls	Using the Coefficients of Boys
Parental Effort						
- "Never"	---	---	0.167	0.197	0.131	0.168
- "Sometimes"	---	---	0.600	0.648	0.635	0.691
- "Often"	---	---	0.233	0.155	0.234	0.140
Achievement - Reading Test Scores						
- No Parental Effort in Equation	52.2	51.6	---	---	---	---
- "Never" Assumed	---	---	37.4	50.5	50.4	49.5
- "Sometimes" Assumed	---	---	56.1	51.1	52.2	51.0
- "Often" Assumed	---	---	53.6	54.7	53.1	56.5
- Mean Predicted Values Assumed	---	---	51.9	51.7	52.1	51.8
Achievement - Math Test Scores						
- No Parental Effort in Equation	52.1	52.8	---	---	---	---
- "Never" Assumed	---	---	45.2	48.4	48.0	49.0
- "Sometimes" Assumed	---	---	54.3	53.4	52.0	53.1
- "Often" Assumed	---	---	52.1	56.0	55.0	55.9
- Mean Predicted Values Assumed	---	---	52.0	52.9	51.9	53.0

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

Table 5 Cross Frequencies (percentages) Base Year Parent Responses v. Base Year Child Responses to Discussion Questions[a]

		Base Year: Discuss things you've studies in class[b]							
		Girls				Boys			
Parent Question	Response	Not at all	Once or twice	Three or more	Total	Not at all	Once or twice	Three or more	Total
Talk to child about school experience	Seldom or never	0.33	0.08	0.07	0.49	0.00	0.16	0.03	0.20
	Once or twice a month	0.37	0.81	0.52	1.70	0.66	0.60	0.72	1.98
	Once or twice a week	1.95	6.72	7.95	16.62	2.85	6.93	7.28	17.06
	Almost everyday	4.84	24.24	52.10	81.19	8.87	27.91	43.99	80.77
	Total	7.50	31.86	60.64	100.00	12.38	35.60	52.02	100.00

		Base Year: Discuss selecting courses or programs at school[b]							
		Girls				Boys			
Parent Question	Response	Not at all	Once or twice	Three or more	Total	Not at all	Once or twice	Three or more	Total
Talk to child about school experience	Seldom or never	0.27	0.16	0.05	0.49	0.07	0.10	0.03	0.20
	Once or twice a month	0.17	1.13	0.40	1.70	0.78	0.98	0.22	1.98
	Once or twice a week	1.75	9.46	5.40	16.62	3.77	8.58	4.70	17.06
	Almost everyday	5.03	33.87	42.28	81.19	10.16	39.08	31.53	80.77
	Total	7.23	44.63	48.14	100.00	14.78	48.74	36.48	100.00

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

[a] Although these results only use base year responses, these results are based on the same sample used in the previous tables, which requires participation in both the Base Year and First Follow-up surveys.

[b] Base Year responses use the following framing question: "[s]ince the beginning of the school year, how often have you discussed the following with either or both of your parents/or guardians?" In contrast, First Follow-up responses use the following framing question: "[i]n the first half of this school year, how often have you discussed the following with either or both of your parents or guardians?" In addition the First Follow-up responses are "never, sometimes, or often." See Table 1 for First Follow-up frequencies.