# Does Food Insecurity at Home Affect Noncognitive Performance at School? A Longitudinal Analysis of Elementary Student Classroom Behavior

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**Abstract**

We use a panel of 4,730 elementary students in the U.S. enrolled in 1st, 3rd, and 5th grade (1999-2003) to examine whether household food insecurity changes an individual's noncognitive performance during school. A longitudinal analysis of classroom behaviors can afford insight into the underlying determinants of noncognitive ability and the efficiency of classroom education. We find that household food insecurity is negatively associated with individual noncognitive performance at school for skills classified as interpersonal relations, self-control, and approaches to learning. We do not find that food insecurity at home affects an individual's prevalence of violent disruptive behavior. One implication of this finding is that the potential benefits of "safety-net" programs aimed at reducing household food insecurity might be larger than previously thought.

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*Keywords*: classroom behavior; noncognitive ability; household food insecurity

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# Introduction

There is an immense literature on the relation between a child's household environment and their behavior outside of home. Quantifying the extent to which household food insecurity affects a child's noncognitive abilities observed by instructors at school is an important step towards fully understanding the possible mechanisms through which this condition at home can influence children. Much of the recent research has been concerned with identifying whether household food insecurity impacts resident's anthropometric measures and nutrient intake levels (Bhattacharya et al., 2004; Kirkpatrick and Tarasuk, 2008; Bhargava et al., 2008). While understanding the consequences of household food insecurity on nutritional outcomes is important, there is also concern that these measures might not be able to accurately assess the full range of potential effects resulting from household food insecurity (Kleinman et al., 1998). In contrast to direct nutritional effects of food insecurity, it is plausible that the behavior of children might change in response to economic adversity at home depending on the degree of severity (Weinreb et al., 2002; Ackerman et al., 2004). The use of classroom based education is highly prevalent and therefore a relevant context to study the observable determinants of children's behavior.

Theory and evidence indicate that quantifying these inter-relationships can help to explain differences in economic outcomes between individuals as well as communities. Heckman et al. (2006), for example, find a positive effect of individual noncognitive ability on long-run human capital accumulation and wealth. If household food insecurity imposes a cost on children through lower noncognitive performance in a classroom, there are potentially much larger long-run costs associated with this attribute of a child's home environment.[1] In contrast to focusing strictly on individual outcomes,

[1]Bowles et al. (2001) provide a thorough discussion of the determinants of individual earnings. The evidence suggests that schooling largely effects future earnings through mechanisms beyond improvements in cognitive functioning alone.

Lazear (2001), for example, emphasize the inherent "public good" aspect of education in a classroom environment whereby one student's behavior can potentially disrupt teaching and impede the learning of classmates.[2] From a community perspective, if household food insecurity results in children engaging in classroom behavior that is not conducive for learning then there could be welfare implications above and beyond individual costs. Borjas (2004), for example, find that public assistance programs in the U.S. reduce the probability of households experiencing food shortages due to financial constraints. If a lower incidence of household food insecurity contributes to improved classroom behavior then the potential benefits of "safety-net" programs might be larger than previously thought.

One impediment to investigating the determinants of noncognitive abilities is that the development of ability depends critically on the interaction between the immediate home environment and individual-specific aptitude, both of which are correlated and require detailed data to sufficiently identify causal relationships of interest (Zax and Rees, 2002). To partially circumvent this problem, we take advantage of a large, nationally representative panel of elementary students in the U.S. enrolled in 1st, 3rd, and 5th grade of the Early Childhood Longitudinal Study-Kindergarten.[3] This enables us to incorporate detailed information on a child's home environment into our model of noncognitive performance and utilize econometric techniques developed specifically for consistent estimation in the presence of unobserved individual-specific aptitude. We focus on four measures of noncognitive ability covering interpersonal relations, self-control, approaches to learning, and externalizing problem behaviors.[4] These are reported by a child's primary instructor in each grade and indicate the child's devel-

[2]Economists have long been concerned with quantifying "peer effects" in the context of academic achievement and behavior; see Figlio (2007), Ding and Lehrer (2007), and Argys and Rees (2008) for recent empirical evidence.

[3]Abbreviation: ECLS-K, Early Childhood Longitudinal Study-Kindergarten

[4]We interpret our classroom performance outcomes as measuring "noncognitive" abilities; other labels such as psychosocial outcomes, socioemotional abilities, or soft skills are interchangeable.

opment of each category of skill. We interpret above-average values as more desirable behavior from a community perspective due to the potential for externalities in a classroom setting.[5]

Our main findings indicate that household food insecurity is negatively associated with children's noncognitive performance of interpersonal relations, self-control, and approaches to learning. Of the households reporting food insecurity, 10% of the observations, the average degree of severity is 3.64 on a scale of 1 to 18. Our estimates imply that children from these households perform 0.87, 0.87, and 0.40 standard deviations lower, on average, for the noncognitive abilities of interpersonal relations, self-control, and approaches to learning, respectively. We do not find a statistically significant effect of household food insecurity on children's externalizing problems behaviors such as arguing or fighting in the classroom. Thus, while we uncover evidence that food insecurity at home can negatively impact classroom behavior, we do not find evidence that food insecurity contributes to violent disruptive behavior.

Findings from other studies investigating effects of household food insecurity are discussed in Section 1, and Section 2 describes the ECLS-K data utilized in our analysis. Section 3 outlines the empirical framework and estimation strategy. An important component of the estimation is the rigorous treatment of children-specific effects as well as the potential correlation of explanatory variables to these effects. Section 4 presents the results and explores the robustness of the findings to omitted school district characteristics. Section 5 concludes and briefly discusses the policy implications.

[5] A higher value for externalizing problem behaviors reflects a higher frequency of such problems and therefore we interpret below-average values as more desirable from a community perspective. See Masten et al. (2005) for longitudinal evidence that externalizing problem behaviors in childhood result in lower academic achievement in adolescence and young adulthood.

# 1 Effects of household food insecurity on children

Most of the literature investigating the influence of household food insecurity on children is concerned with assessing its impact on nutrition. A potential effect of a food shortage in a household is a reduction in the quality or quantity of meals; however, there is limited empirical evidence of food insecurity affecting school-age children's nutritional outcomes. In one of the most extensive cross-sectional studies to date, Bhattacharya et al. (2004) find that food security indicators do not predict nutritional measures of children age 6-11 years once the poverty level of their household is incorporated into the model. Similarly, Kirkpatrick and Tarasuk (2008) find no prevalence of nutrient inadequacy for children age 1-8 years according to their household food insecurity status, but do find small differences for children age 9-18 years for protein and certain micronutrients.[6] Moreover, in one of the most extensive longitudinal studies to date, Bhargava et al. (2008) find that household food insecurity does not predict children's anthropometric measures such as BMI Z-scores, height, or weight once the dependence of these outcomes on their respective previous levels is incorporated into the model.

The lack of evidence indicating household food insecurity is detrimental for children's nutrition does not preclude the possibility that it might influence children's outcomes through other mechanisms. Pollitt et al. (1998), for example, emphasize through rigorous experiments that metabolic changes, induced by morning and overnight fasting, interfere with attention and memory processes of children age 9-11 years. While Wyon et al. (1997) find that an increase in consumption at breakfast from 6-8% to 22-25% of recommended daily energy intake significantly increased the voluntary exertion of effort for children during school. Short-run metabolic changes instigated by a temporary low consumption of food are not likely to be accurately assessed using an-

[6]Kirkpatrick and Tarasuk (2008) find that children from households with food insecurity have lower dietary levels of protein, vitamin A, magnesium, phosphorous, and zinc.

thropometric or dietary intake measures; outcomes more likely to reflect food insecurity are behavioral measures relating to aggression, attention, depression, or hyperactivity (Kleinman et al., 1998). Furthermore, environmental stress created by economic adversity such as household food insecurity can change children's behavior by impacting their own mental well-being or that of their parents (MacFadyen et al., 1996; Weinreb et al., 2002; Ackerman et al., 2004).

In light of these possibilities, attention has turned to exploring the effect of household food insecurity on other non-nutrition outcomes of children. Using cross-sectional data on children age 6 to 11, Alaimo et al. (2001) find that household food insecurity is negatively associated with noncognitive outcomes such as the number of friends the child had, whether the child had difficulty getting along with other children or teenagers, and whether the child was shy and slow to make a new friend. Similarly, using cross-sectional data on children age 6 to 12, Dunifon and Kowaleski-Jones (2003) find that children from households with food insecurity are less likely to exhibit positive behaviors such as cooperating with others and sharing, but find no significant association between household food insecurity and externalizing problem behaviors.[7] Additionally, Jyoti et al. (2005) find that household food insecurity is negatively associated with a composite measure of noncognitive classroom behaviors using a panel of children in kindergarten and third grade to estimate first difference models.

In this paper we improve upon two important shortcomings of the earlier studies. First, we address the potential endogenous relationship between household food insecurity and noncognitive performance in the classroom. For example, parents concerned

[7]Dunifon and Kowaleski-Jones (2003) also explore the effect of participation in the National School Lunch Program (NSLP) on children's noncognitive outcomes and find it is postively associated with externalizing problem behaviors; however, the effect becomes insignificant once they account for selection bias in their original estimates. Other economists have studied the effect of NSLP participation on children's weights; see Schanzenbach (2005) and Millimet et al. (2008) for recent findings where selection bias is treated carefully. The potential endogeneity of children's weights is explicitly accounted for in our estimation.

with their children's performance at school may actively participate in developing their noncognitive ability at home while also exerting effort to mitigate the likelihood of experiencing food insecurity. Similarly, we consider the potential endogeneity of children's weights which are often utilized as a measure of current health and nutrition status. For example, parents that actively participate in developing their children's noncognitive ability may also be concerned with ensuring their children exercise and eat balanced meals to mitigate excessive weight gain. Unobserved parental behaviors leading to household food insecurity or a child's weight gain are likely to be correlated with the development of their children's noncognitive ability and their subsequent performance at school.[8] These estimation bias issues have not been addressed previously and can be tested with longitudinal data that are available.

Second, with the exception of the Dunifon and Kowaleski-Jones (2003) study, household food insecurity is often modeled as a dichotomous variable and based on one or more affirmative responses to the survey module questions. Modeling food insecurity as strictly affecting the intercept term of children's noncognitive performance might confound the effects of household food insecurity with a nonlinear function of household income.[9] By utilizing a continuous measure of household food insecurity we allow for the intensity of the condition to vary across households and over time.

[8]See Burton et al. (2002) for evidence on parenting style and child conduct; Powell and Chaloupka (2005) for evidence on parent and youth smoking; Escobar (1999) regarding parental influence on children's dietary practices.

[9]In our sample, the correlation coefficient between the continuous household food insecurity score and household income category is -0.28, -0.31, and -0.35 for the first, third, and fifth grades, respectively. If we define a dichotomous variable equal to one for households who answer affirmatively to 1 or more of the 18 questions in the survey module the correlation coefficient between this variable and household income category is slightly higher at -0.33, -0.35, -0.39 for each of the respective grades.

# 2 The data

The ECLS-K is an ongoing longitudinal study that began in the fall of 1998 by observing 19,864 children in kindergarten enrolled in 1,277 schools throughout the U.S.; however, attrition due to geographical relocation resulted in 11,479 children remaining in the study from kindergarten through 5th grade. The locatable students were followed for a random 50% of the schools (Tourangeau et al., 2006). Due to missing observations on instructor reported noncognitive performance, complete data were analyzed on 4,730 children at 2-year intervals in the 1st, 3rd and 5th grades; demographic characteristics of the sample in the analysis were similar to the full sample covering 11,479 children from kindergarten through the 5th grade.[10]

The noncognitive performance outcomes we analyze measure skills covering interpersonal relations, self-control, approaches to learning, and externalizing problem behaviors.[11] They are reported by the child's instructor in the spring of each grade and range 1-4 (never, sometimes, often, very often). The measures are adapted from the Social Skills Rating System of Gresham and Elliott (1990) and the reliability of the instructor ratings was high (Tourangeau et al., 2006). Because the instructors and specific questions in the questionnaires change across survey rounds, a static relationship between repeated observations is assumed in the empirical model and the possibility of serial correlation within repeated child observations is explicitly accounted for in the estimation.

Of our four noncognitive performance outcomes, interpersonal relations measure a child's skill in forming and maintaining friendships, getting along with people who are

[10] While sampling weights (inverse of probability of inclusion in the sample) based on children's age, gender, ethnicity, and geographical location were available in the ECLS-K data, they were not utilized in the modeling as they are formulated under the assumption of zero attrition. The children-specific effects in the model capture unobserved between-children differences and ignoring the possibility of unobserved group effects arising from the multi-stage sampling design mainly affects the estimate of the constant term (Wang et al., 1997).

[11] A higher value for externalizing problem behaviors reflects a higher frequency of such problems.

different, comforting or helping other children, expressing feelings, ideas, and opinions in positive ways, and showing sensitivity to the feelings of others. Self-control measures a child's ability to control behavior by respecting the property rights of others, controlling temper, accepting peer ideas for group activities, and responding appropriately to pressure from peers. Approaches to learning measure behaviors that affect the ease with which children can benefit in a learning environment such as attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization. Externalizing problem behaviors measure behaviors that may interfere with the learning process in the classroom such as arguing, fighting, getting angry, acting impulsively, and disturbing ongoing activities (Tourangeau et al., 2006).

Household food insecurity was assessed using an 18 question survey module developed by the United States Department of Agriculture (USDA). The questions aim to capture information about the household environment such as anxiety over insufficient food budget or supply, perceptions of inadequate food quality or quantity, and instances of reduced food intake by household members; each question specifies that the circumstance must have occurred in the past 12 months due to financial limitations. Affirmative answers indicate a degree of limited availability of nutritionally adequate food in a household (Bickel et al., 2000; Tourangeau et al., 2006). Given the degree of complexity involved with accurately measuring a household's full range of food insecurity and hunger, affirmative responses for the USDA survey module were scored as 1 and we utilize aggregate household scores as continuous variables in the empirical model to reflect intensity. We interpret a higher aggregate score as a greater degree of food insecurity in a home.

Additionally, information was collected on the attributes of children and their households. Children's heights and weights were measured in all survey rounds using a Shorr Board; duplicate measures were taken and we use the mean values. The highest

parental education level achieved was assessed as a categorical variable that ranges 1-9 (8th grade or below, 9th-12th grade, high school diploma/GED, vocational program, some college, bachelor's degree, graduate/professional school with no degree, master's degree, doctorate or professional degree). We use the only available time varying measure of annual household income and it was assessed as a categorical variable that ranges 1-13 in US $1000 (<5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-50, 50-75, 75-100, 100-200, >200). Lastly, we construct an indicator variable measuring whether a child was diagnosed with a developmental disability (attention deficit, autism, dyslexia, etc.) before the start of first grade.

# 3 Empirical framework

The model for children's noncognitive performance, incorporating both time-invariant and time-varying explanatory variables, is postulated in equation (1):

$$\begin{aligned} Performance_{it} = a_0 \;&+\; a_1(Age\ at\ 1st\ grade)_i + a_2(Age\ at\ 1st\ grade)_i^2 + a_3(Male)_i \\ &+\; a_4(Developmental\ disability)_i + a_5(Parent\ education)_i \\ &+\; a_6(Household\ income)_{it} + a_7(Number\ of\ siblings)_{it} \\ &+\; a_8(Height)_{it} + a_9(Weight)_{it} \\ &+\; a_{10}(Household\ food\ insecurity\ score)_{it} + u_{it} \end{aligned} \tag{1}$$

where $i$ indexes each child and $t$ indexes observations in 1st, 3rd, and 5th grade.

We incorporate nonlinearities with respect to children's ages into the model. Varying dates of birth and annual cutoff dates for school eligibility create relative age differences at the beginning of formal schooling which can affect individual skill development in the early grades due to variation in maturity (Bedard and Dhuey, 2006). We allow

for differences in mean noncognitive performance according to gender and whether the child was diagnosed with a developmental disability by the start of first grade. The highest parental education level achieved by first grade is included to capture environmental factors which can potentially affect the development of abilities before school begins.[12] We include the number of siblings in the household and a categorical measure of annual household income to capture differences over time in the availability of resources affecting development.[13] Children's heights and weights indicate long-run and short-run health and nutrition status, respectively (Cole, 1991; Thomas et al., 1991).

## 3.1 Estimation

In order to facilitate testing whether the variables measuring children's weight and household food insecurity score are endogenous we treat the longitudinal data on each child as a "system of T equations" in order to employ the simultaneous equation methods developed in Bhargava (1991) for applications where the number of children is large but the number of time periods is fixed. Letting coefficients $a_0 - a_{10}$ represent the explanatory variables in the model specified in equation (1), we can further organize these where $x_0 = [a_0 - a_5]$ are $m_1$ time-invariant and exogenous variables, $x_1 = [a_6 - a_8]$ are $n_1$ time-varying and exogenous variables, and $x_2 = [a_9 - a_{10}]$ are $n_2$ time-varying and (potentially) endogenous variables. We denote the complete system of simultaneous

[12]Household education was not assessed in the ECLS-K for the 3rd grade and is thus treated as time invariant here. Within child variation in household education between 1st and 5th grade was not large. See Heckman (2008) for an accessible discussion of gene-environment interactions in the context of ability formation from early ages onward.

[13]Finer measures of household income were not surveyed after the base round in 1998; thus, we utilize the only available information on annual household income.

equations as

$$
\begin{aligned}
-y_i + \sum_{t=1}^{T} A_{2t} x_{2it} + \sum_{t=1}^{T} A_{1t} x_{1it} + A_0 x_{0i} &= u_i \\
-x_{2it} + \sum_{j=1}^{T} R_{1tj} x_{1ij} + R_{0t} x_{0i} &= v_{it} \qquad (i = 1, ..., N; t = 1, ..., T) \qquad (2)
\end{aligned}
$$

where $y_i$ is a $T \times 1$ vector of the dependent variable measuring noncognitive performance, $A_{2t}$, $A_{1t}$, and $A_0$ are $T \times n_2$, $T \times n_1$, $T \times m_1$ coefficient matrices, respectively. Similarly, specifying an unrestricted reduced form equation for the endogenous variables $x_2$, $R_{1tj}$ $(t = 1, ..., T;\ j = 1, ..., T)$ and $R_{0t}$ $(t = 1, ..., T)$ are $n_2 \times n_1$ and $n_2 \times m_1$ reduced form coefficient matrices, respectively. Also, $u_i$ and $v_{it} (t = 1, ..., T)$ are, respectively, $T \times 1$ and $n_2 \times 1$ vectors of errors. Efficient estimates are obtained in this case by employing a standard Three Stage Least Squares estimator with equality restrictions on the coefficients in different time periods (Zellner and Theil, 1962). Realizations of the time-varying explanatory variables $x_1$ are assumed to be uncorrelated with the errors and used as "instrumental variables" in the estimation (Sargan, 1958).[14]

The estimation procedure outlined above does not impose any restrictions on the pattern of correlation between the time-varying explanatory variables and the errors. If we make the assumption that the individual errors can be decomposed into a time-varying error and a a time-invariant individual effect $\eta_i$ that is distributed independently across children such that

$$u_{it} = \eta_i + \varepsilon_{it} \qquad (3)$$

[14]Identification of the model requires sufficient correlation between the exogenous time-varying and time-invariant variables such that the matrix $(Z'Z)$ is of full rank where $Z = [X_0 : X_1]$ and $X_0$ and $X_1$ are $N \times m1$ and $N \times (n_1 T)$ data matrices, respectively (Bhargava and Sargan, 1983; Bhargava, 1991). We utilize the robust rk-statistic developed in Kleibergen and Paap (2006) to test the null hypothesis that the rank of the matrix $(Z'Z)$ is equal to $(m1 + n_1 T - 1)$; the rk-statistic equals 110.03 and is distributed as a Chi-square variable with 1 degree of freedom. We therefore reject the null hypothesis that the matrix is less than full rank with a p-value=(<0.0001).

then efficiency gains in estimation are possible by restricting the correlation of our endogenous variables to the individual "random effects" (Hausman and Taylor, 1981; Bhargava and Sargan, 1983). An additional $(T-1)n_2$ instrumental variables can be used to facilitate identification by noting that only the time means of $x_2$ are correlated with the time-invariant individual effects. Specifically, we exploit the following relation

$$x_{2it} = \delta\eta_i + \varepsilon^*_{it} \tag{4}$$

where $\eta_i$ are the time-invariant individual effects and $\varepsilon^*_{it}$ are uncorrelated with the errors, and utilize

$$z_{2it} = x_{2it} - \frac{\Sigma_{s=1}^{T} x_{2is}}{T} = x_{2it} - \overline{x}_{2i} \qquad (t = 2, ..., T) \tag{5}$$

as additional exogenous variables. In contrast to the more general model we first consider, in this model only the time means $\overline{x}_{2i}$ of the endogenous variables are predicted by the reduced form equation and the matrix of exogenous variables is redefined to include the time-mean deviations $z_{2it}$ of the (potentially) endogenous variables.

## 3.2 Testing the exogeneity assumptions

The advantage of applying the estimation methodology developed in Bhargava (1991) is that we are able to sequentially test our exogeneity assumptions. The matrix of exogenous variables is defined as $Z_{3SLS} = [x_0, x_1]$ for our most general case allowing for an unrestricted pattern of correlation between the endogenous variables and the errors. We then consider a random effects decomposition of the errors and impose the restriction that the endogenous variables are only correlated with the time-invariant individual effects. The restrictions on the correlation pattern allow us to redefine the

matrix of exogenous variables as $Z_{RE} = [x_0, x_1, z_2]$. To test the null hypothesis that the endogenous variables are not correlated with the time-varying errors we utilize the following statistic distributed as a Chi-square variable with $[T(T-1)n_2]$ degrees of freedom

$$trace[\widehat{\Omega}_{RE}^{-1}\{U'_{RE}[Z_{RE}(Z'_{RE}Z_{RE})^{-1}Z'_{RE}]U_{RE} - U'_{3SLS}[Z_{3SLS}(Z'_{3SLS}Z_{3SLS})^{-1}Z'_{3SLS}]U_{3SLS}\}] \tag{6}$$

where $U_{3SLS}$ and $U_{RE}$ are the residuals from each of the respective models and $\widehat{\Omega}$ is the estimated serial covariance matrix of the individual error terms from the model that is true under the null hypothesis (Sargan, 1973; Bhargava, 1987, 1991)

If we cannot reject the null hypothesis then we can further test whether the time means are correlated with the time-invariant individual effects $\eta_i$. If all explanatory variables are pre-determined then the the matrix of exogenous variables is defined as $Z_{SUR} = [x_0, x_1, x_2]$. In this case the Seemingly Unrelated Regression Equations estimator of Zellner (1962) with equality restrictions on the coefficients in different time periods is the most efficient . To test the null hypothesis that the time-means of the endogenous explanatory variables are not correlated with the time-invariant individual effects we utilize the following statistic distributed as a Chi-square variable with $[Tn_2]$ degrees of freedom

$$trace[\widehat{\Omega}_{SUR}^{-1}\{U'_{SUR}[Z_{SUR}(Z'_{SUR}Z_{SUR})^{-1}Z'_{SUR}]U_{SUR} - U'_{RE}[Z_{RE}(Z'_{RE}Z_{RE})^{-1}Z'_{RE}]U_{RE}\}] \tag{7}$$

where $U_{RE}$ and $U_{SUR}$ are the residuals from each of the respective models and $\widehat{\Omega}$ is the estimated serial covariance matrix of the individual error terms from the model that is true under the null hypothesis (Sargan, 1973; Bhargava, 1987, 1991)

# 4 Results

## 4.1 Descriptive statistics

The sample means of the noncognitive ability measures and the explanatory variables utilized in the model are reported in Table 1. Mean values of our noncognitive measures were fairly stable over the first, third, and fifth grades. A composite measure was constructed as a within child average of all four noncognitive ability measures and the internal consistency reliability was high at 0.88, 0.89, and 0.90 across each of the grades, respectively. The mean age of children in the 1st grade was 87 months, about 49% were male, and approximately 2% had been diagnosed with a developmental disability by this time. Sample means of parent education at the beginning of the 1st grade were between categories 5 and 6, i.e. some college to earned bachelor's degree. Sample means of household income were between categories 8 and 10, i.e. US$ 35,000-75,000, while the mean number of siblings was 1.5 over the time period.

## 4.2 Results for children's noncognitive performance

Table 2 presents the results from model for children's noncognitive performance at school specified in equation (1). All measures of noncognitive performance are standardized to have mean zero and variance one in order to facilitate the interpretation of regression coefficients. We reject the null hypothesis that children's weights and household food insecurity scores are not correlated with the time-varying errors based on the Chi-square test outlined in equation (6). Thus, we only report the Three Stage Least Squares estimates for the system defined in equation (2).

The main findings from the model are, first, children who entered first grade relatively older scored higher on measures of noncognitive performance; however, nonlinearities with respect to age are evident. Second, children whose parents are more

educated perform higher on all four measures of ability in addition to the composite. We do not find annual household income to significantly predict noncognitive performance of interpersonal relations, self-control, approaches to learning, or the composite, but do find a significant negative association with externalizing problem behaviors. This suggests that children from higher earning households are less likely to exhibit externalizing problem behaviors. Third, we find that a greater number of siblings in the household is associated with lower externalizing problem behaviors and higher measures of interpersonal relations and self-control.

Fourth, household food insecurity is negatively associated with children's noncognitive performance of interpersonal relations, self-control, and approaches to learning. Each affirmative response to the household food insecurity survey questions is associated with noncognitive ability being 0.24, 0.24, 0.11 standard deviations lower for each of the three measures, respectively. We do not, however, find a statistically significant effect of household food insecurity on children's externalizing problems behaviors. Furthermore, the estimated coefficient of household food insecurity scores on the composite measure of noncognitive performance is -0.17 and statistically different from zero.

## 4.3 Robustness of the findings to omitted variables measuring public school district expenditure on instruction

It is possible that unobserved measures of school district quality may bias our estimates in Table 2 if classroom instructors and children's households systematically differ according to school district finance characteristics.[15] If classroom instructors

[15]Empirical evidence on the relationship between instructor compensation and instructor quality is somewhat mixed. Hanushek et al. (2004) find that salaries impact the probability of an instructor switching from one school district to another. Figlio (2007) find that higher salaries increase the likelihood that a district is able to recruit higher-qualified instructors for nonunion districts, but not for unionized districts. Investigation of the slope of the supply curve for instructors in quality-salary space is beyond the scope of this study.

perception of student's noncognitive performance was correlated with financial characteristics of the school district they are employed by, for example, then our instrumental variables strategy would not provide consistent estimates in this context. To explore this possibility we retain the subset of children in the full sample who attend a public school for first, third, and fifth grade and are not missing school district identifiers. The restricted sample contains 3,151 students from 401 school districts in 36 U.S states. We construct two time-varying school district variables measuring the total number of instructors employed and the ratio of expenditure on instruction to the total number of instructors employed.[16] The model in equation 1 is modified to include $Ln(Number\ of\ instructors\ employed)$ and $Ln(Average\ expenditure\ per\ instructor)$ as additional explanatory variables in order to capture the potential effects of school district expenditure on instruction at the extensive and intensive margin, respectively.[17]

The sample means of the explanatory variables utilized in the model for the subset of children attending public schools for the first, third, and fifth grades are reported in Table 3. Demographic characteristics of the restricted sample are similar to the full sample of children. A slightly higher fraction of the restricted sample was diagnosed with a developmental disability by the first grade. Additionally, parent education at the beginning of the 1st grade and annual households incomes were slightly lower relative

[16]We match data from the National Center for Education Statistics Common Core of Data to each child based on the school district identifier. We utilize the Local Education Agency Universe Survey for school years 1999-2000, 2001-2002, and 2003-2004 to construct a variable measuring the sum of full-time equivalent teachers and instructional aides in each child's school district (Thomas et al., 2006). We also utilize the School District Finance Survey for fiscal years 1999, 2001, 2003 to incorporate data on the total school district expenditure on elementary and secondary instruction. This total only includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction during the regular school year and summer school (Berry and Cohen, 2006).

[17]Missing data constrained our exploration of variables measuring teacher salaries and benefits directly. Ultimately, we chose to include these two variables in the specification because the children's noncognitive performance is observed directly by their primary instructor in each grade. The total number of instructors employed in a school district is highly correlated with the number of students in the district with a correlation coefficient of 0.993 in our sample; thus, we are unable to investigate other interesting aspects such as whether average school district class size is also relevant in this context due to concerns of multicollinearity in the model.

to the full sample. The average household food insecurity score increased from 0.38 in the full sample to 0.49 in the restricted sample of children attending public schools.

Table 4-7 present the results for public school district children's noncognitive performance of interpersonal relations, self-control, approaches to learning, and externalizing problem behaviors, respectively. Model 1 shows the estimates of the original specification in equation (1) while Model 2 shows the estimates of the expanded model incorporating school district finance characteristics.[18] We reject the null hypothesis that children's weights and household food insecurity scores are not correlated with the time-varying errors based on the Chi-square test outlined in equation (6) for interpersonal relations, self-control, and approaches to learning. We fail to reject the null hypothesis for externalizing problem behaviors. Furthermore, we fail to reject the null hypothesis that the time-means of children's weights and household food insecurity scores are not correlated with the time-invariant individual effects based on the Chi-square test outlined in equation (7). Thus, we only report the results for externalizing problem behaviors that employ the Seemingly Unrelated Regression Equations estimator of Zellner (1962) with equality restrictions on the coefficients in different time periods.

The main findings from the models are, first, household food insecurity is negatively associated with children's noncognitive performance of interpersonal relations and self-control, but not for approaches to learning once omitted school district expenditure on instruction is accounted for. The magnitude of the estimated coefficient of household food insecurity scores is similar between the full sample and the restricted sample. Once we include the omitted school district finance variables the magnitude

[18]It is possible that the parents with a higher demand for quality schools will select districts that spend more on instruction while also actively participating in developing their children's noncognitive ability. This type of endogeneity would bias our estimates upward. We do not explore the potential endogeneity of our school district finance variables here. See Loeb and Page (2000) for evidence that the bias is minimal from ignoring the potential endogeneity and that it might even go in the opposite direction once compensating differentials are accounted for.

of the estimated coefficient of household food insecurity scores is slightly smaller for interpersonal relations, self-control, and approaches to learning and slightly larger for externalizing problem behaviors. The omitted variable bias is in the downward direction. One implication is that households whose children attend schools in districts that spend more on instruction are less likely to experience food insecurity.

Second, school district expenditure at the extensive margin is positively associated with children's noncognitive performance of interpersonal relations, self-control, and approaches to learning and negatively associated with externalizing problem behaviors. The magnitude of the effect, however, is rather small. For example, a 100% increase in the number of instructors employed by a district is associated with a 0.04, 0.03, 0.02, -0.02 standard deviation change in each of the measures of noncognitive ability, respectively. Furthermore, we find that school district expenditure on the intensive margin is only significantly related to children's noncognitive performance of externalizing problem behaviors. A 100% increase in the average expenditure for instruction per instructor results in a 0.15 standard deviation decrease in externalizing problem behaviors. Thus, while we find that school district expenditure on instruction is related to the noncognitive performance of children we do not find that it explains a large portion of the variation in observed ability.

# 5 Discussion

The detailed models of children's noncognitive performance at school presented here provide several insights into factors affecting children's development during the elementary school period of their lives. First, on average, household food insecurity has significant deleterious consequences for certain measures of noncognitive ability. The measures include interpersonal relations (forming and maintaining friendships, ex-

pressing feelings, ideas, and opinions in positive ways, etc.), self-control (respecting the property rights of others, controlling temper, accepting peer ideas for group activities, etc.), and approaches to learning (attentiveness, task persistence, eagerness to learn, etc.). In contrast, food insecurity does not contribute to the frequency with which children exhibit externalizing problem behaviors such as arguing, fighting, getting angry, acting impulsively, or disturbing ongoing activities. Thus, while we uncover evidence that food insecurity at home can negatively impact classroom behavior, it does not appear to be a contributing factor to violent disruptive behavior in school classrooms. This finding suggests that public policies aimed at reducing food insecurity are not likely to affect the prevalence of disruptive behavior in classrooms. Further research is necessary to explain what determines this kind of classroom behavior.

Second, the potential benefits of "safety-net" programs might be larger than previously thought. Borjas (2004), for example, find that a 10% increase in the fraction of the population that receives public assistance such as cash assistance, food stamps, or Medicaid results in a 5% decrease in the fraction of households experiencing food insecurity. If our estimates of the effect of household food insecurity are applied more generally, an expansion in the "take up" of public assistance is likely to result in an improvement of noncognitive performance for children from these households. Our findings suggest these children would have a 0.87, 0.87, and 0.40 standard deviation increase in their noncognitive ability of interpersonal relations, self-control, and approaches to learning, respectively. The extent to which these improvements in individual behavior translate into an improvement in classroom efficiency or long-run individual economic prosperity remains an open question.

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Table 1: Sample means of noncognitive performance outcomes and selected explanatory variables in the ECLS-K for the first, third, and fifth grade[a,b]

| | First grade | | Third grade | | Fifth grade | |
|---|---|---|---|---|---|---|
| Variables | Mean | SD | Mean | SD | Mean | SD |
| Interpersonal relations[c] (1-4) | 3.19 | 0.61 | 3.17 | 0.62 | 3.14 | 0.62 |
| Self-control[d] (1-4) | 3.26 | 0.57 | 3.27 | 0.58 | 3.28 | 0.58 |
| Approaches to learning[e] (1-4) | 3.18 | 0.64 | 3.16 | 0.64 | 3.16 | 0.65 |
| Externalizing problem behaviors[f] (1-4) | 1.57 | 0.58 | 1.63 | 0.56 | 1.60 | 0.54 |
| Composite measure[g] | 2.01 | 0.52 | 1.99 | 0.52 | 1.99 | 0.52 |
| Internal consistency reliability[h] | 0.88 | – | 0.89 | – | 0.90 | – |
| Age at first grade (months) | 87.2 | – | – | – | – | – |
| Male (%) | 0.49 | – | – | – | – | – |
| Developmental disability[i] (%) | 0.02 | – | – | – | – | – |
| Parent education category (1-9) | 5.26 | 1.84 | – | – | – | – |
| Household income category[j] (1-13) | 8.88 | 2.80 | 9.14 | 2.72 | 9.26 | 2.76 |
| Number of siblings (0-12) | 1.46 | 1.04 | 1.49 | 1.04 | 1.48 | 1.04 |
| Height (in) | 48.6 | 2.29 | 53.2 | 2.58 | 57.8 | 2.97 |
| Weight (lb) | 56.9 | 12.6 | 75.2 | 19.7 | 97.2 | 27.4 |
| Household food insecurity score (n) | 0.38 | 1.44 | 0.30 | 1.28 | 0.42 | 1.59 |
| Number of children | 4730 | | 4730 | | 4730 | |

Note: Sample means and standard deviations are reported.

Source: Early Childhood Longitudinal Study-Kindergarten (ECLS-K); data on 4730 children in 3 time periods(1999-2003).

[a]Noncognitive performance outcomes are rated by the classroom instructor of each student on a scale of one (Never) to four (Very often).

[b]Noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[c]Noncognitive skills such as forming and maintaining friendships, expressing feelings, ideas, and opinions in positive ways, etc.

[d]Noncognitive skills such as respecting the property rights of others, controlling temper, accepting peer ideas for group activities, etc.

[e]Noncognitive skills such as attentiveness, task persistence, eagerness to learn, etc.

[f]Noncognitive skills such as arguing, fighting, getting angry, acting impulsively, etc.

[g]Composite measure is the within child average of all four noncognitive performance outcomes.

[h]Cronbach (1951) alpha statistic estimating the reliability of the composite psychometric instrument.

[i]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[j]Finer measures of household income were not surveyed after the base round in 1998; thus, the only available information on annual household income is 13 categories in US $1000 (<5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-50, 50-75, 75-100, 100-200, >200)

Table 2: Three-stage least squares estimates of static models for the noncognitive performance of elementary school students in the classroom treating children's weights and household food insecurity scores as endogenous[a,b]

| | Noncognitive performance outcomes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Composite[c] | | Skill 1[d] | | Skill 2[e] | | Skill 3[f] | | Skill 4[g] | |
| Explanatory variables | Coeff | SE | Coeff | SE | Coeff | SE | Coeff | SE | Coeff | SE |
| Constant | −13.489** | 3.448 | −9.943** | 3.339 | −10.163** | 3.386 | −17.194** | 3.361 | 8.872** | 3.443 |
| Age at first grade | 0.290** | 0.078 | 0.216** | 0.076 | 0.226** | 0.077 | 0.363** | 0.077 | −0.185** | 0.078 |
| Age at first grade-squared | −0.002** | 0.0004 | −0.001** | 0.0004 | −0.001** | 0.0004 | −0.002** | 0.0004 | 0.001** | 0.0004 |
| Male | −0.480** | 0.023 | −0.424** | 0.022 | −0.344** | 0.022 | −0.481** | 0.022 | 0.416** | 0.023 |
| Developmental disability[h] | −0.738** | 0.076 | −0.579** | 0.074 | −0.506** | 0.075 | −0.837** | 0.075 | 0.623** | 0.076 |
| Parent education category | 0.049** | 0.007 | 0.036** | 0.007 | 0.037** | 0.007 | 0.061** | 0.007 | −0.030** | 0.007 |
| Household income category | 0.003 | 0.009 | −0.006 | 0.010 | −0.009 | 0.010 | 0.010 | 0.009 | −0.019** | 0.009 |
| Number of siblings | 0.039** | 0.012 | 0.038** | 0.013 | 0.056** | 0.013 | 0.011 | 0.012 | −0.040** | 0.012 |
| Height | 0.010 | 0.008 | 0.009 | 0.009 | 0.002 | 0.009 | 0.015* | 0.008 | −0.011 | 0.008 |
| Weight | −0.002 | 0.002 | −0.002 | 0.002 | −0.001 | 0.002 | −0.003* | 0.002 | 0.003 | 0.002 |
| Household food insecurity score | −0.166** | 0.058 | −0.237** | 0.065 | −0.236** | 0.065 | −0.112** | 0.057 | 0.015 | 0.056 |
| $\chi^2$ test for the exogeneity of Weight and Household food insecurity score[i] (12 d.f.) | 49.32** [< 0.0001] | | 38.94** [0.0001] | | 46.59** [< 0.0001] | | 43.39** [< 0.0001] | | 32.77** [0.0011] | |

Note: Slope coefficients and robust standard errors are reported and p-values are in brackets; ** Significant at 5-percent level; * Significant at 10-percent level.

[a]Data on 4730 children in 3 time periods (1999-2003) from the ECLS-K were used in the estimation; noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[b]Instrumental variables are all realizations of the variables measuring household income category, number of siblings, and children's heights.

[c]Composite measure is the within child average of all four noncognitive performance outcomes.

[d]Interpersonal relations: measuring noncognitive skills such as forming and maintaining friendships, expressing feelings, ideas, and opinions in positive ways, etc.

[e]Self-control: measuring noncognitive skills such as respecting the property rights of others, controlling temper, accepting peer ideas for group activities, etc.

[f]Approaches to learning: measuring noncognitive skills such as attentiveness, task persistence, eagerness to learn, etc.

[g]Externalizing problem behaviors: measuring noncognitive skills such as arguing, fighting, getting angry, acting impulsively, etc; higher values are interpreted as a worse outcome.

[h]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[i]Tests the null hypothesis that Weight and Household food insecurity score are not correlated with the time-varying errors; see Section 3.2 for the details on the calculation.

Table 3: Sample means of selected explanatory variables and public school district finance variables for children attending public schools in the ECLS-K for the first, third, and fifth grade

| | First grade | | Third grade | | Fifth grade | |
|---|---|---|---|---|---|---|
| Variables | Mean | SD | Mean | SD | Mean | SD |
| Age at first grade (months) | 87.1 | – | – | – | – | – |
| Male (%) | 0.48 | – | – | – | – | – |
| Developmental disability[a] (%) | 0.03 | – | – | – | – | – |
| Parent education category (1-9) | 4.97 | 1.79 | – | – | – | – |
| Household income category[b] (1-13) | 8.39 | 2.92 | 8.68 | 2.84 | 8.81 | 2.88 |
| Number of siblings (0-9) | 1.49 | 1.05 | 1.50 | 1.05 | 1.49 | 1.04 |
| Height (in) | 48.5 | 2.27 | 53.2 | 2.58 | 57.8 | 2.97 |
| Weight (lb) | 56.8 | 12.7 | 75.3 | 19.9 | 97.9 | 28.1 |
| Household food insecurity score (n) | 0.49 | 1.66 | 0.37 | 1.42 | 0.52 | 1.79 |
| Number of instructors employed[c] | 2079 | 5590 | 2234 | 6310 | 2318 | 6835 |
| Average expenditure per instructor[d] | 51915 | 11924 | 56241 | 13063 | 63275 | 20252 |
| Number of children | 3151 | | 3151 | | 3151 | |

Note: Sample means and standard deviations are reported.

Sources: Early Childhood Longitudinal Study-Kindergarten (ECLS-K) data on 3151 children enrolled in public schools for all 3 time periods(1999-2003); National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04; National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003

[a]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[b]Finer measures of household income were not surveyed after the base round in 1998; thus, the only available information on annual household income is 13 categories in US $1000 (<5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-50, 50-75, 75-100, 100-200, >200)

[c]Sum of full-time equivalent teachers and instructional aides for each child's school district; data are from the National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04.

[d]Includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction; expenditure data are from the National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003.

Table 4: Three-stage least squares estimates of static models for the noncognitive performance of interpersonal relations of public elementary school students in the classroom treating children's weights and household food insecurity scores as endogenous[a,b]

| | Noncognitive skill: Interpersonal relations[c] | | | |
|---|---|---|---|---|
| | Model 1 | | Model 2 | |
| Explanatory variables | Coeff | SE | Coeff | SE |
| Constant | −2.355 | 4.138 | −3.694 | 4.162 |
| Age at first grade | 0.038 | 0.095 | 0.047 | 0.094 |
| Age at first grade-squared | −0.0002 | 0.0005 | −0.0002 | 0.0005 |
| Male | −0.430** | 0.026 | −0.432** | 0.026 |
| Developmental disability[d] | −0.599** | 0.082 | −0.604** | 0.080 |
| Parent education category | 0.040** | 0.009 | 0.040** | 0.009 |
| Household income category | 0.001 | 0.010 | 0.003 | 0.009 |
| Number of siblings | 0.024 | 0.015 | 0.021 | 0.014 |
| Height | 0.011 | 0.011 | 0.011 | 0.011 |
| Weight | −0.003 | 0.002 | −0.003 | 0.002 |
| Household food insecurity score | −0.177** | 0.060 | −0.164** | 0.053 |
| Ln(Number of instructors employed[e]) | – | | 0.036** | 0.008 |
| Ln(Average expenditure per instructor[f]) | – | | 0.054 | 0.054 |
| $\chi^2$ test for the exogeneity of Weight and Household food insecurity score[g] (12 d.f.) | 25.19** [0.0139] | | 26.67** [0.0086] | |

Note: Slope coefficients and robust standard errors are reported and p-values are in brackets; ** Significant at 5-percent level; * Significant at 10-percent level.

[a]Data on 3151 children in public schools for all 3 time periods (1999-2003) from the ECLS-K were used in the estimation; noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[b]Instrumental variables are all realizations of the variables measuring household income category, number of siblings, and children's heights.

[c]Noncognitive skills such as forming and maintaining friendships, expressing feelings, ideas, and opinions in positive ways, etc.

[d]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[e]Sum of full-time equivalent teachers and instructional aides for each child's school district; data are from the National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04.

[f]Includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction; expenditure data are from the National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003.

[g]Tests the null hypothesis that Weight and Household food insecurity score are not correlated with the time-varying errors; see Section 3.2 for the details on the calculation.

Table 5: Three-stage least squares estimates of static models for the noncognitive performance of self-control of public elementary school students in the classroom treating children's weights and household food insecurity scores as endogenous[a,b]

| | Noncognitive skill: Self-control[c] | | | |
|---|---|---|---|---|
| | Model 1 | | Model 2 | |
| Explanatory variables | Coeff | SE | Coeff | SE |
| Constant | −3.200 | 4.216 | −4.743 | 4.275 |
| Age at first grade | 0.058 | 0.096 | 0.070 | 0.096 |
| Age at first grade-squared | −0.0003 | 0.0005 | −0.0003 | 0.0005 |
| Male | −0.352** | 0.027 | −0.353** | 0.027 |
| Developmental disability[d] | −0.547** | 0.083 | −0.548** | 0.083 |
| Parent education category | 0.047** | 0.009 | 0.046** | 0.009 |
| Household income category | −0.00003 | 0.010 | 0.001 | 0.009 |
| Number of siblings | 0.044** | 0.015 | 0.042** | 0.014 |
| Height | 0.007 | 0.011 | 0.005 | 0.011 |
| Weight | −0.002 | 0.002 | −0.002 | 0.002 |
| Household food insecurity score | −0.167** | 0.059 | −0.159** | 0.053 |
| Ln(Number of instructors employed[e]) | – | | 0.032** | 0.009 |
| Ln(Average expenditure per instructor[f]) | – | | 0.072 | 0.055 |
| $\chi^2$ test for the exogeneity of Weight and Household food insecurity score[g] (12 d.f.) | 26.04** [0.0106] | | 26.70** [0.0085] | |

Note: Slope coefficients and robust standard errors are reported and p-values are in brackets; ** Significant at 5-percent level; * Significant at 10-percent level.

[a]Data on 3151 children in public schools for all 3 time periods (1999-2003) from the ECLS-K were used in the estimation; noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[b]Instrumental variables are all realizations of the variables measuring household income category, number of siblings, and children's heights.

[c]Noncognitive skills such as respecting the property rights of others, controlling temper, accepting peer ideas for group activities, etc.

[d]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[e]Sum of full-time equivalent teachers and instructional aides for each child's school district; data are from the National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04.

[f]Includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction; expenditure data are from the National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003.

[g]Tests the null hypothesis that Weight and Household food insecurity score are not correlated with the time-varying errors; see Section 3.2 for the details on the calculation.

Table 6: Three-stage least squares estimates of static models for the noncognitive performance of approaches to learning of public elementary school students in the classroom treating children's weights and household food insecurity scores as endogenous[a,b]

| | Noncognitive skill: Approaches to learning[c] | | | |
|---|---|---|---|---|
| | Model 1 | | Model 2 | |
| Explanatory variables | Coeff | SE | Coeff | SE |
| Constant | −9.442** | 4.255 | −9.426** | 4.308 |
| Age at first grade | 0.182* | 0.097 | 0.181* | 0.097 |
| Age at first grade-squared | −0.0009* | 0.0006 | −0.0009* | 0.0006 |
| Male | −0.495** | 0.027 | −0.496** | 0.027 |
| Developmental disability[d] | −0.820** | 0.084 | −0.826** | 0.083 |
| Parent education category | 0.065** | 0.009 | 0.065** | 0.009 |
| Household income category | 0.011 | 0.009 | 0.015* | 0.008 |
| Number of siblings | 0.006 | 0.014 | 0.003 | 0.014 |
| Height | 0.015 | 0.010 | 0.016* | 0.009 |
| Weight | −0.004* | 0.002 | −0.004* | 0.002 |
| Household food insecurity score | −0.086* | 0.052 | −0.063 | 0.047 |
| Ln(Number of instructors employed[e]) | – | | 0.020** | 0.009 |
| Ln(Average expenditure per instructor[f]) | – | | −0.021 | 0.054 |
| $\chi^2$ test for the exogeneity of Weight and Household food insecurity score[g] (12 d.f.) | 24.80** [0.0158] | | 23.96** [0.0206] | |

Note: Slope coefficients and robust standard errors are reported and p-values are in brackets;
** Significant at 5-percent level; * Significant at 10-percent level.

[a]Data on 3151 children in public schools for all 3 time periods (1999-2003) from the ECLS-K were used in the estimation; noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[b]Instrumental variables are all realizations of the variables measuring household income category, number of siblings, and children's heights.

[c]Noncognitive skills such as attentiveness, task persistence, eagerness to learn, etc.

[d]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[e]Sum of full-time equivalent teachers and instructional aides for each child's school district; data are from the National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04.

[f]Includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction; expenditure data are from the National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003.

[g]Tests the null hypothesis that Weight and Household food insecurity score are not correlated with the time-varying errors; see Section 3.2 for the details on the calculation.

Table 7: Seemingly unrelated regression estimates of static models for the noncognitive performance of externalizing problem behaviors of public elementary school students in the classroom[a]

| | Noncognitive skill: Externalizing problem behaviors[b] | | | |
|---|---|---|---|---|
| | Model 1 | | Model 2 | |
| Explanatory variables | Coeff | SE | Coeff | SE |
| Constant | 3.044 | 4.380 | 5.616 | 4.443 |
| Age at first grade | −0.053 | 0.100 | −0.072 | 0.010 |
| Age at first grade-squared | 0.0003 | 0.0006 | 0.0003 | 0.0006 |
| Male | 0.418** | 0.028 | 0.419** | 0.028 |
| Developmental disability[c] | 0.605** | 0.085 | 0.604** | 0.085 |
| Parent education category | −0.041** | 0.009 | −0.040** | 0.009 |
| Household income category | −0.018** | 0.005 | −0.017** | 0.005 |
| Number of siblings | −0.027** | 0.012 | −0.026** | 0.012 |
| Height | −0.008** | 0.004 | −0.005 | 0.004 |
| Weight | 0.002** | 0.001 | 0.002** | 0.001 |
| Household food insecurity score | 0.004 | 0.006 | 0.005 | 0.006 |
| Ln(Number of instructors employed[d]) | – | | −0.024** | 0.009 |
| Ln(Average expenditure per instructor[e]) | – | | −0.147** | 0.054 |
| $\chi^2$ test for the exogeneity of Weight and Household food insecurity score[f] (12 d.f.) | 16.78 [0.1581] | | 16.66 [0.1628] | |
| $\chi^2$ test for the exogeneity of the time means of Weight and Household food insecurity score[g] (6 d.f.) | 9.69 [0.1383] | | 10.39 [0.1092] | |

Note: Slope coefficients and robust standard errors are reported and p-values are in brackets;
** Significant at 5-percent level; * Significant at 10-percent level.

[a]Data on 3151 children in public schools for all 3 time periods (1999-2003) from the ECLS-K were used in the estimation; noncognitive performance outcomes are standardized to mean 0 and variance 1 in the estimation.

[b]Noncognitive skills such as arguing, fighting, getting angry, acting impulsively, etc.

[c]Child diagnosed with developmental disability(attention deficit, autism, dyslexia, etc.) by first grade.

[d]Sum of full-time equivalent teachers and instructional aides for each child's school district; data are from the National Center for Education Statistics Common Core of Data, Local Education Agency Universe Survey for school years 1999-00, 2001-02, and 2003-04.

[e]Includes expenditure from all funds for salaries, employee benefits, supplies, materials, and contractual services for elementary/secondary instruction; expenditure data are from the National Center for Education Statistics Common Core of Data, School District Finance Survey for fiscal years 1999, 2001, and 2003.

[f]Tests the null hypothesis that Weight and Household food insecurity score are not correlated with the time-varying errors; see Section 3.2 for the details on the calculation.

[g]Tests the null hypothesis that the time means of Weight and Household food insecurity score are not correlated with the time-invariant individual effects; see Section 3.2 for the details on the calculation.