

Is Full Better than Half?

Examining the Longitudinal Effects of Full-day Kindergarten Attendance

by

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Abstract

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Abstract

Kindergarten policy varies widely both across and within states. As high-stakes testing become more important, more attention is being paid to the delivery of early education, and more states and districts are considering moving to full-day kindergarten to increase the educational attainment of students. This paper uses the Early Child Longitudinal Study-Kindergarten Cohort to evaluate the efficacy of this policy. In ordinary least squares, probit, county-fixed effects, and instrumental variable models, we find that there are initial benefits for students and the mothers of students that attend full-day kindergarten, but that these differences largely evaporate by third grade. The only effect of full-day kindergarten attendance on boys is to increase the prevalence of severe external behavioral problems, whereas there is some evidence that girls who attend full-day kindergarten have increases in math scores that persist through third grade. Finally, attending full-day kindergarten is found to have no additional effect on students in families with income below the poverty threshold, despite claims by some advocates that full-day programs are beneficial for the most disadvantaged students.

Keywords: Elementary education policy, achievement tests, and maternal employment

1. INTRODUCTION

As high-stakes testing becomes more important and is occurring at earlier junctures in a student's educational experience, the importance of the early educational experience of students in kindergarten also increases. A notable policy by the federal government, the No Child Left Behind Act, puts special emphasis on "scientifically-based" information to guide education efforts. In large part, the government is calling for research that will show "what works" in education and the Act includes an accountability provision (e.g., test scores) for schools to prove that children are learning. For elementary school, this policy is based on the belief that student achievement is cumulative (Entwisle & Alexander, 1998); therefore, early school success can lead to an increased likelihood of staying in school through high school graduation. A large body of research shows that higher educational attainment leads to better adult outcomes in a variety of ways. The question then becomes determining which educational policies foster school success.

Kindergarten, as the transitional year into formal schooling, can have an important role in laying the groundwork for future school success (Entwisle & Alexander, 1998; Morrow et al., 1998). Many state and local school district decisionmakers are interested in policies that expand kindergarten from half-day to full-day because of perceived benefits for learning. This has led to a marked increase in the number of children enrolled in full-day programs over the past three decades. The U.S. Census shows that 60 percent of kindergartners were in full-day classes in 2000 (Education Commission of the States, 2004), compared with about 13 percent in 1970 (Elicker & Mathur, 1997). The decade of the 1990s, in particular, saw an increase in the requirement of full day offerings in states (Chart 1). At the same time, there remains great variation in the full-day program offerings across the country (Table 1). State policies vary from

requiring school districts to offer a full-day program (10 states) to states with no formal policy (10 states), with half-day and combinations of half-day and full-day policies in between (Council of Chief State School Officers, 1998).

Many parents are also enthused by the full-day option for both educational reasons and because it lessens the need for child care arrangements during the workday (Elicker & Mathur, 1997; Gullo, 1990). However, even if the students and parents receive benefits from full-day kindergarten programs, it remains a significant expense for school districts to expand their kindergarten programs. Therefore, more research is needed to evaluate the efficacy of full-day kindergarten programs when education dollars could instead be spent on numerous other programs designed for improving student achievement.

This analysis will examine the education, social, and maternal employment effects of full-day kindergarten compared to half-day kindergarten.¹ While research to date has provided some evidence of the benefits of full-day kindergarten programs, most of the studies have methodological limitations such as small sample sizes, selection biases, and/or have only examined outcomes through first grade. Using nationally-representative data from the Early Childhood Longitudinal Study – Kindergarten Class of 1998-1999 (ECLS-K), this research will overcome many of the methodological limitations of previous research first by examining student and parental outcomes through the third grade. Second, due to sufficient sample size this study is able to test for differential effects of full-day programs by gender and by poverty status as research suggest possible difference for these different groups. Finally, this analysis attempts to control for the role parents have in choosing the type of kindergarten program their children attend by both county fixed effects and instrumental variables models. In the latter, we use state

¹ Full-day is also referred to as “whole-day” or “extended-day” in the literature. Half-day is often referred to as “part-day.”

variation in kindergarten full-day policies as an instrument for the likelihood that a student will attend a full-day program.

2. THEORY AND BACKGROUND

Teachers, parents, and child development experts cite academic and social reasons why a longer kindergarten day may be beneficial for children. One major reason mentioned is the belief that a longer kindergarten day will help children to be better prepared for first grade (Clark & Kirk, 2000). More classroom time will provide a less rushed schedule and more opportunity for the teacher to work individually with children and spend less time proportionately on large-group or teacher-directed activities (Clark & Kirk, 2000; Elicker & Mathur, 1997; Morrow et al., 1998).

In addition, a longer day is hypothesized to allow more time for the types of child-initiated and process-oriented activities that encourage social and cognitive development. Children learn through play and child-initiated activities, as well as teacher-directed instruction, thus a balance between the two, which a longer day facilitates, is important for development (Bredekamp & Copple, 1997). Morrow et al. (1998) suggest that a longer class would provide better literacy outcomes because of the larger blocks of time for literacy instruction available in a full-day program, as well as more time proportionately than half-day programs. Early childhood theorists such as Piaget and Vygotsky posit that larger blocks of time are necessary for young children to engage in process learning (Morrow et al., 1998). However, child development experts argue that a longer day in itself does not necessarily mean that the additional time is used in a developmentally appropriate manner (Gullo, 1990; Olsen & Zigler, 1988), and therefore could potentially have negative effects as well.

In addition to a focus on child outcomes, there is reason to expect that maternal employment would also be affected by the enrollment of a child in a full-day rather than half-day program. Child care literature suggests that availability and price of child care, especially subsidized child care, significantly affects maternal employment (Blau & Robins, 1988; Gelbach, 2002; Karoly et al., 1998; Ribar, 1992). Gelbach (2002) extends this literature by studying the impact of kindergarten enrollment for 5 year olds because the free kindergarten program substitutes for parental child care expenses. Gelbach (2002) found that kindergarten enrollment significantly affected maternal labor market outcomes, increasing labor supply measures by six to 24 percent.

While the effect of full-day kindergarten on maternal employment outcomes has not been empirically tested, extant research on the issue of full-day kindergarten compared to half-day kindergarten has shown several positive student outcomes from the longer school day. Beneficial outcomes cited in previous studies include improved readiness for first grade, improved reading and mathematics achievement in early elementary school, and improved social skills and behavior (Clark & Kirk, 2000). While findings indicate some positive outcomes, studies with no significant differences or mixed results also exist. Further, overall confidence in the early literature is weak, at least in part due to methodological limitations of previous studies.²

More recently research has begun to utilize larger sample sizes in their study of the efficacy of full-day vs. half-day programs. Cryan et al. (1992) studied 8,290 children retrospectively in 27 school districts and 2,899 longitudinally in the state of Ohio to help inform

² A review of early research from the 1970s and 1980s found a few positive effects for the full-day program, such as short-term gains in basic academic skills and fewer grade retentions (Puelo, 1988; see Fusaro (1997) for another review). No differences were found for social and emotional development. However, Puelo (1988) notes that methodological weaknesses in these studies as a whole suggests that most of the early research findings are tenuous. Cryan et al. (1992) note that exhaustive literature reviews on kindergarten schedules found that studies “(a) tend to be with small samples or unique populations, (b) generally fail to use rigorous research standards, (c) give almost exclusive priority to academic outcomes, and most important, (d) offer little or no convincing evidence favoring one type of schedule over another” (p. 188).

statewide decisionmaking. They found generally positive academic and behavioral outcomes through first grade of full-day kindergarten on average. Children performed better on standardized tests and had fewer grade retentions through first grade, and kindergarten teachers rated full-day children higher on the majority of the fourteen classroom behavior dimensions. Another study in the Philadelphia schools (Weiss & Offenber, 2002, as cited in Brewster & Railsback, 2002) followed 17,600 Philadelphia students into fourth grade and also found positive effects of full-day kindergarten. Full-day students were 26 percent more likely than half-day students to avoid repeating a grade by third grade. They also experienced higher academic achievement scores and better attendance.

A recent study using a nationally-representative sample of kindergarten children (Walston & West, 2004) examined cognitive gains of public school children in the kindergarten year using ECLS-K data. This study found evidence of positive effects of full-day attendance on math and reading score gains from fall to spring of the kindergarten year, but the analysis did not extend beyond the kindergarten year.

An additional limitation with these larger-sample studies (as well as with the other studies) is that they fail to account for potential selection bias. Existing studies have not modeled family or school choice of full-day versus half-day kindergarten. Ignoring this element of choice may have led to biased findings in earlier studies. For instance, if parents with high motivation and expectations for their children tend to choose full-day programs, then findings from the study may be recording the fact that these children have different circumstances at home that might account for their achievement, not the full-day program per se.

Finally, several studies have suggested that at-risk children may benefit the most from full-day programs (Clark & Kirk, 2000; Morrow et al., 1998; Olsen & Zigler, 1989), perhaps

because the extra time is especially needed because of poor learning environments at home or in other child care arrangements. According to Rothenberg (1995), two-thirds of full-day kindergarten teachers in 1993 taught in high-poverty areas. Walston and West (2004) note that in the ECLS-K sample of public school children, “63 percent of kindergarten children living below the poverty threshold are enrolled in a full-day program compared with 55 percent that come from households at or above the poverty line” (p. 21). Morrow et al. (1998, p. 8) suggest two reasons to help explain this: state and federal funding flows to districts with low-income and minority students, which they use for full-day programs, and rural districts use full-day programs to prevent the need for bussing in the middle of the day.

3. DATA

The primary data source is the Early Childhood Longitudinal Study-Kindergarten Class of 1998-1999. Information on state kindergarten policies is primarily from the *Key State Education Policies on K-12 Education* (Council of Chief State School Officers, 1998). Data on job market characteristics at the county and state level are from the Bureau of Labor Statistics’ (BLS) Quarterly Census of Employment and Wages program, BLS Local Area Unemployment Statistics program, and Robert Moffitt’s Welfare Benefits Database at Johns Hopkins University.³

ECLS-K

The ECLS-K is a longitudinal data set collected by the National Center of Education Statistics (NCES). The original sample of approximately 22,000 children from about 1,000 kindergarten programs was designed to be nationally representative of kindergartners during the 1998-1999 academic year with over samples of Asians and children in private schools. The

³ Web sites for these sources are <ftp://ftp.bls.gov/pub/special.requests/cew/>, <http://www.bls.gov/lau/home.htm>, and www.econ.jhu.edu/People/Moffitt/DataSets.html, respectively.

sample is designed to support separate estimates by type of school child attends (i.e., public or private), race/ethnicity, and socio-economic status. To date, information has been collected from children, parents, teachers, and school administrators during the fall and spring of the kindergarten year, the fall and spring of first grade, and the spring of third grade.⁴

The ECLS-K was designed to support research on a range of topics regarding the kindergarten experience; hence, these data are quite rich. Data are available about the child, the household the child resides in, and the classroom and school the child attends. Pertinent to this paper, information on what type of kindergarten program the child attended was collected from teachers in the fall and spring of kindergarten. Teachers could respond that they taught a full-day kindergarten class, a half-day morning kindergarten class, or half-day afternoon kindergarten class.

The ECLS-K also contains information on a rich set of outcomes that may be influenced by the type of kindergarten program a child participated in. Test scores for reading, mathematics, and general studies are administered during each wave of the survey.⁵ In addition, information on whether a child was retained at any grade is available. Data are collected from parents and teachers to measure the behavior of the child. Finally, mothers are asked about their employment status.

Analysis Sample

The baseline analysis sample is comprised of 8,481 children meeting the following criteria for inclusion. First, only children who were first-time kindergarteners were included in the sample. Second, only those children in the same type of kindergarten program throughout the year were included. Third, only students in a regular-type of kindergarten class were

⁴ For additional information, user guides are available from NCES at <http://nces.ed.gov/ecls/KinderDataInformation.asp>.

⁵ The general studies examination is not administered in the third grade wave of data collection.

included. Fourth, only those with values for state identifiers were included.⁶ Fifth, those with positive values for survey weights in all four of the waves of interest (the fall and spring kindergarten, spring first grade, and spring third grade waves) were included.⁷ Finally, observations were only included if they had non-missing values for all of the independent variables included in the respective models with the exception of maternal and paternal education, household income, and religiosity. For the first three variables we imputed values and for religiosity we included a dummy variable indicating a missing value.

While only children with positive weights in all four waves were included in the baseline analysis sample, this does not ensure that children have non-missing values for each of the outcome variables in each wave of the survey. Hence, an analysis sample is generated for each of the six outcomes examined: math achievement scores, reading achievement scores, internal behavior problems, external behavior problems, grade retention, and maternal full-time employment status. The samples sizes for the six outcome samples are the following: math achievement scores (7,835), reading achievement scores (7,463), internal behavior problems (5,964), external behavior problems (6,124), grade retention (8,353) and maternal full-time employment status (7,677).

From Table 2, several key points emerge that are relevant to the analyses. First, variation exists among children who are attending different types of kindergarten programs. Fifty-two percent of children in the sample attend full-day kindergarten programs. Second, almost half of the children in the sample are females. Finally, 15.7 percent of the children are in households below the poverty threshold.

⁶ Observations without county identifiers are included; hence the sample sizes for fixed effects models are slightly lower than other models.

⁷ We do not use data from the fall of first grade because information was only collected on a sub-sample of the sample.

4. EMPIRICAL STRATEGY

OLS and Probit Regression Models

To test the effect of attending a full-day kindergarten program relative to a half-day kindergarten program on five of the six outcomes of interest, we estimate ordinary least squares (OLS) and probit regression models as shown in Equation 1.

$$Y_i = \alpha_0 + \alpha_1 FD_i + \alpha_2 CH_i + \alpha_3 HH_i + \alpha_4 SC_i + \varepsilon_i \quad [1]$$

In Equation 1, Y represents the dependent variables; FD is whether the child attended full-day kindergarten; CH is a vector of child-level characteristics, HH is a vector of household characteristics, and SC is a vector of school characteristics. The unit of analysis, i , is the child. OLS regression models are estimated when examining the math and reading test scores. Probit models are estimated for the two behavioral outcomes and grade retention.

Dependent Variables

This paper estimates the effect of attending a full-day kindergarten program on five child outcome variables (math test scores, reading test scores, internal behavior problems, external behavior problems, and grade retention) at three points in time as well as over time. Specifically, we estimate the effect of full-day kindergarten on all outcomes, in the spring of kindergarten, the spring of first grade, and the spring of third grade. The one exception is grade retention, which is measured once in third grade.

For the math and reading test scores, gain scores are constructed to examine the effects of full-day kindergarten on gains in math and reading achievement. These gain scores are calculated by subtracting the fall kindergarten test score from a more recent score of interest. Gain scores are generated for math and reading between the fall kindergarten and spring

kindergarten, fall kindergarten and spring first grade, and fall kindergarten and spring third grade.

The first two outcome variables represent academic achievement. They are math and reading scaled-test scores.⁸ Because achievement tests used a two-stage assessment approach, all children did not take the same exam. Hence, the ECLS-K computed scaled-test scores based on the full-set of test items using Item Response Theory (IRT). For easier interpretation of results, these math and reading scaled-test scores are standardized based on a mean of zero and a standard deviation of one.

The second two outcome variables capture children's behavioral problems. The first variable is a binary variable indicating whether the child exhibits internal behavior problems often or very often as reported by teachers on an internalizing behavior scale.⁹ The second variable is binary variable indicating whether a child exhibits external behavior problems often or very often as reported by teachers on an externalizing behavior scale.¹⁰ The final academic outcome variable is grade retention. It is a binary variable indicating whether the child was retained at any grade between kindergarten and third grade.

Full-day Kindergarten

The primary independent variable in the analysis is whether the child is attending a full-day kindergarten program versus half-day one. We categorize those who attended either

⁸ In kindergarten and first grade, math examinations test children's abilities on the following subjects: numbers and shapes, relative size, ordinality and sequence, addition and subtraction, and multiplication and division. In third grade, students are also asked about place values and rates and measurements. The reading examinations test kindergartners and first-graders on letter recognition, beginning sounds, ending sounds, sight words, and words in context. In third grade, literal reference, extrapolation, and evaluation skills are also tested.

⁹ The internalizing behavior scale asks the teacher a series of questions about the frequency of the following four behaviors: presence of anxiety, loneliness, low self-esteem, and sadness. To each of the questions the teacher could report the frequency of the behavior as: never, sometimes, often, or very often.

¹⁰ The externalizing behavior scale asks the teacher to rate students on the frequency of the following five behaviors: arguing, fighting, getting angry, acting impulsively, and disturbing ongoing activities. To each of the questions the teacher could report the frequency of the behavior as: never, sometimes, often, or very often.

morning or afternoon half-day classes as half-day because there is little reason to believe there is any difference between attending either type of half-day program (empirical tests confirm this assumption). Students who attended full-day programs are classified as full-day, and those students who changed schools or the type of program within schools were omitted.

Additional Independent Variables

Many variables affect a child's school achievement and behavior, including home environment and school-related factors. To rule out other factors as causes of the child outcomes of interest, this analysis controls for three groups of variables measured during the child's kindergarten year: child characteristics, household characteristics, and school characteristics.¹¹ All of these variables are listed in Table 2 along with their weighted means.

Child characteristics included are: female, age in months at kindergarten entry, race (dummy variables for non-Hispanic Black, Hispanic, and Other), home language is non-English, and presence of a disability in kindergarten. The household characteristics included in the regression models are the following: number of children in the household, single-parent family, log of household income, maternal education (dummy variables for high school graduate, some college, college graduate), paternal education (dummy variables for high school graduate, some college, college graduate), parents' attendance at religious services (dummy variables for several times a month or more, several times a year, and missing response), participation in non-parental care the year before kindergarten, and participation in non-parental care during the kindergarten year. As part of these household characteristics, we also include some variables that capture parents' expectations for their children's scholarly accomplishments. Variables include number of books in the child's home, frequency that the parents read books to child, how often parents play games with child, and the highest educational degree parent expects for child. The final

¹¹ Parents' religious attendance and status as a child in non-parental care in K were asked in first grade.

group of explanatory variables is the school characteristics which include: public school, percentage of children receiving free and reduced-price lunch, school size, kindergarten class size, location (dummy variables for urban and rural), and the number of years the classroom teacher has taught kindergarten.

While almost all of the aforementioned explanatory variables are measured in the kindergarten year, we also include three variables that capture change in a child's household and school environment that may influence one of the outcome variables. These variables are changes in household structure status between waves, moves to different schools between waves, and changes in income between waves. Household structure changes represent a change in the number of parents living in the household. The change in income is measured as a percentage change in income between survey waves. Upon examining first grade outcomes or gains between kindergarten and first grade, we include changes between kindergarten and first grade. Similarly upon investigating third grade outcomes or gains between first and third grades, we include variables that indicate changes in these three areas. Weighted means for these variables can be found in Table A.1.

Controlling for Potential Selection Bias

As discussed earlier, the estimation described above does not account for potential selection bias. For instance, parents with high motivation and expectations for their children may choose to send their children to full-day programs (i.e., positive selection). Because theoretical direction of selection is ambiguous, another plausible scenario is that parents who do not have time to spend with their kids or resources to spend on tutors tend to enroll their children in full-day kindergarten programs (i.e., negative selection). For both cases of selection, OLS and probit regressions estimates of full-day kindergarten may be capturing the fact that these children

have different unobservable circumstances at home that might account for their achievement or behavioral problems. Table 2 demonstrates statistically significant differences among observable characteristics between those children attending full-day and half-day kindergarten programs, suggesting that selection may occur. For example, children who attend full-day kindergarten programs are more likely to be non-Hispanic Black, speak English as a home language, be in single-parent household, have fewer books at home, have parents who attend religious services several times a month or more, attend a school with a higher percentage of free and reduced-price lunch recipients, attend a private school, and attend a school in an urban or rural area.

We first explore this potential selection by dividing the sample into poor and non-poor. To the extent that poor children are more likely to be offered full day programs, or are more likely to utilize full day programs, then we may observe differential effects by poverty status. In addition, the rhetoric of the move to increase full day offerings is sometimes driven by concerns for the at-risk population, often characterized by poverty status. Next, we also divide the sample into boys and girls because they may mature at different rates, and because parents may respond differently by gender in selecting the type of kindergarten program.

We then estimate models with county fixed effects and models with instrumental variables to address selection on unobservables that may be present. Including fixed effects controls for the role of county level policies that may influence parental choice of type of program or the actual choices available to the parent. The fixed effects also control for other unobservables that may influence student educational or social outcomes.¹²

¹² Alternatively, we could have used school district level fixed effects to control for unobservable characteristics about the school district that affect achievement and full day participation. However, we believe that the county level more fully captures the choices that parents have available for kindergarten.

Next, we estimate instrumental variable models to address this selection. Using state variation in policies on full-day kindergarten programs as an instrument for the likelihood that a student will attend a full-day program, this analysis is able to address the fact that parents play a role in choosing the type of kindergarten program their children attend. Specifically, a variable representing state policy on the availability of full-day kindergarten at the school district-level, hereafter called state full-day policy, is used as an instrument. From the five state policies on the provision of kindergarten listed in Table 1, the state full-day policy variable is generated.¹³ States that have the policy that the district must offer full-day kindergarten or full- and half-day kindergarten are coded as one. The remainder of the states with either no policy or policies that the district must offer half-day kindergarten or full- or half-day kindergarten is assigned the value of zero for the instrument. Table A.2 lists each state's policy, the value for the instrument, and the percent of children in the state attending a full-day kindergarten program.

Equation 2 illustrates the full-day participation equation that is part of the two-stage least squares (2SLS) models estimated with the state full-day policy instrument.

$$FD_i = \alpha_0 + \alpha_1 SP_i + \alpha_2 CH_i + \alpha_3 HH_i + \alpha_4 SC_i + \varepsilon_i \quad [2]$$

In Equation 2, FD is whether the child attended full-day kindergarten; SP is the state full-day policy instrument, CH is a vector of child-level characteristics, HH is a vector of household characteristics, and SC is a vector of school characteristics. Similar to the OLS and probit equations, the unit of analysis, i , is the child.

¹³ The information on relevant state kindergarten policies for the 1998-1999 academic year are extracted from a survey conducted of states by the Council of Chief State School Officers, *Key State Education Policies on K-12 Education* (Council of Chief State School Officers, 1998). Through searches of state kindergarten laws and policies, the information on these policies in the CCSSO publication was verified. If clear discrepancies between CCSSO and other sources were found, the CCSSO data were changed to match the state laws and policies. Discrepancies were found in North Dakota, Rhode Island, South Carolina, South Dakota, Texas, and Washington.

The validity of this approach rests upon whether the instrument, state full-day policy, meets the following criteria. First, the instrument, state full-day policy, must be highly correlated with participation in a full-day kindergarten program. This is shown to be true in Appendix Table A.3. Second, the instrument must not be correlated with unobservable factors that affect the outcome variables of interest. Unless it is the case that parents choose the state they live in based on the state's kindergarten policy, then this second condition is not violated. For the second condition to hold, the state policy also must be exogenous to the selection mechanism (Besley & Case, 2000). Because there has been an increase in the number of states requiring full-day kindergarten, it may be the case that the policy instrument is endogenous. Even though only a few states have switched policy, it is a concern, and the instrumental variables results should be viewed with caution.

Maternal Labor Force Participation

The final outcome analyzed in this paper is the likelihood that a mother will work. As mentioned previously, research has established a connection between maternal labor force participation and a child's enrollment in kindergarten (Gelbach, 2002). To our knowledge, no one has investigated the impact of a full-day kindergarten program on maternal labor force participation when compared to a half-day program. Consistent with the literature on child care availability, we would expect that the mothers of children who attend full-day kindergarten to have higher labor force participation than those with children in half-day programs. In addition, we are interested in finding out whether any advantage that mothers of students in full-day programs may have had persist over time.¹⁴

¹⁴ In this analysis, the labor force participation variable is dichotomous for self-reported maternal full-time employment status. Full-time status is reported as working 35 or more hours per week. Questions on maternal employment status were only administered during the fall of the kindergarten year and not the spring, thus we use the fall value for the kindergarten year.

To estimate the effect of full-day kindergarten participation on maternal employment, we estimate a recursive bivariate probit model. The motivation behind estimating such a model is the following. First, it is likely that full-day kindergarten participation is endogenous to maternal employment decisions. Therefore, estimating a single-equation probit model with full-day kindergarten participation included as an explanatory variable is not appropriate. Estimating a recursive bivariate probit model allows full-day kindergarten participation to be instrumented for and included as an explanatory variable. Second, both full-day kindergarten and maternal employment are binary. Lastly, the recursive bivariate probit model tests the correlation between the error terms in the two equations after controlling for the included variables; thus, providing information on whether the unobservable factors affecting full-day kindergarten participation and maternal employment decisions are related.¹⁵

Finally, all regression analyses are weighted using weights accompanying the ECLS-K. In addition, standard errors are clustered at the teacher level because multiple children located within the same classroom are included in the analysis sample and are likely to be correlated.

5. RESULTS

Baseline Model

The main results for the paper are presented in Table 3 in summary form, with an exemplar of the results for all control variables (kindergarten year) in Table A.4. The first column presents the results estimated by OLS and probit for the continuous and dichotomous variables, respectively, for the set of academic and behavioral outcome variables described above. As shown in Table A.4, the control variables have the signs consistent with past literature

¹⁵ Additional independent variables are included in the estimation of mother's decision to work full-time beyond those that are used in the estimation of academic and social outcomes to capture characteristics of the job market that the mother resides in and to capture the opportunity cost of leisure. These variables include the unemployment rate, average wage, and the size of the TANF guarantee.

on educational attainment. Higher socioeconomic status, living in a two parent home, possessing a better educational environment in the home, and status as a non-minority lead to better achievement at the end of kindergarten.¹⁶

The first set of outcome variables concerns the academic performance of the student at the end of kindergarten. For both reading and math achievement, attending a full-day kindergarten predicts significantly higher test scores. Specifically, the results imply that reading scores increase by .207 standard deviations, and math scores increase by .144 standard deviations. On the other hand, attending a full-day program does not impact the likelihood of exhibiting frequent internal behavior problems, and significantly predicts more frequent external behavioral problems (2 percentage points).

By the end of first grade, the estimated effect of attending a full-day kindergarten had been cut by two thirds for reading scores and in half for math scores. Further, the estimated effects on reading scores become insignificant by third grade, but remain significant for math scores with a further reduced effect (.058 standard deviations). The relationship between full-day attendance in kindergarten and external behavioral problems, while insignificant in first grade, is significant in third grade. Also observed in third grade is no impact of full day kindergarten attendance on the likelihood that a student is retained by third grade. Finally, we observe that attending a full-day kindergarten is significantly related to greater gain scores during kindergarten for both reading and math scores, is significantly related to greater math gain scores from kindergarten to first grade, but unrelated to increases in gain scores for reading or math by third grade.

¹⁶ The same basic pattern of results for the control variables is replicated in both 1st and 3rd grade.

Differences by Poverty Status

We next compare estimates of the impact of full-day attendance on the set of outcomes stratified by poverty status because part of the rationale for offering full-day kindergarten is to benefit those who were considered “at-risk” (Clark & Kirk, 2000; Karweit, 1992).¹⁷ The evidence in Table 4 suggests that there is no clear benefit for poor students over non-poor students when attending full-day kindergarten programs. In all cases, the effect sizes for poor students were smaller or equal to the effect sizes for the non-poor students. At the same time, the impact of attending a full day kindergarten program has adverse impacts on external behavioral problems and on the likelihood of being retained by the third grade. Thus, it is fair to conclude that poor children do not receive a greater benefit from full-kindergarten programs.

Gender Differences

Because boys and girls may mature at different rates, we next compare the impact of full-day attendance on the full set of outcomes for boys and girls separately (Table 5).¹⁸ As indicated in the table, there are differences in the importance of full-day attendance by gender. In kindergarten, both girls and boys benefited academically from full-day programs, with girls having higher estimated effects than boys. While boys benefited academically, they also had a significantly higher likelihood of external behavioral problems (2 percentage points), and the girls did not.

Comparing estimates in first and third grade, the results suggest that the impact of attending full-day kindergarten on math scores for girls persists through third grade. The impact

¹⁷ In addition, stratification of the sample by poverty status and gender allows for test for the role that selection bias may play in increasing the odds that particular groups are placed in full day programs.

¹⁸ Some have found in the school readiness literature that boys may benefit from being older upon entering kindergarten (Crosser, 1991), suggesting different rates of maturity between boys and girls. Therefore, it is plausible that girls may be more ready to learn in a full day setting, and thereby receive a higher benefit from a full day program.

of attending full-day kindergarten diminishes for reading scores, and becomes insignificant by third grade. The estimate on full-day attendance for girls is not significant for the other outcome variables in this study. By third grade, all of the academic benefits for boys go away, while the positive relationship between the presence of external behavioral problems and full day attendance in kindergarten remains marginally significant at a reduced level. The impact of full-day attendance on gain scores demonstrates a positive effect on math scores for girls in kindergarten and marginally for third grade, and a positive impact on reading scores in only kindergarten. Full day attendance in kindergarten predicts higher gain scores in math and reading for boys in kindergarten, and marginally significant increases in gains scores for first grade math scores.

Fixed Effects

As noted above in the methods discussion, there may be reason to be concerned about the role of selection on unobservables characteristics into full-day programs. At the same time, the theoretical direction of selection on the estimates is ambiguous as those whose parents have the highest motivation for education may be placed into full-day programs or those who have the worst home environments may be placed into full-day programs. We first attempt to control for this type of selection by introducing county level fixed effects. We only display results for the math and reading scores because the inclusion of the fixed effects in the probit model required the exclusion of large portions of the sample. As is evidenced in Table 6, the inclusion of the fixed effects in the whole sample eliminates the significance of the coefficient on third grade math scores, and suggests that students who attend a full day kindergarten have lower gain scores in math and reading in third grade than their half-day peers. Also in contrast to the results for girls shown in Table 5, models with fixed effects in a sample of girls yield an insignificant

coefficient on third grade math scores and negative coefficients on the gains in third grade math and reading scores (results not shown). This suggests that some unobservable policy or other variable at the county level may be influencing the measurement of higher math scores for girls who attend full day kindergarten.

Instrumental Variables

Next, we estimate a model of instrumental variables using state policy requiring districts to offer full-day programs as an instrument (Table 7 presents the second stage estimates of the models).¹⁹ Comparing the estimates from Table 3 with the IV estimates in kindergarten, there is little change. The coefficients on reading scores and external behavioral problems are not statistically different from each other. The one significant change is that there is no positive effect on math scores in the 2SLS models.

The basic pattern of results remains similar for the students at the end of first grade. The coefficient on reading test scores decline by about two thirds, and both the coefficients on reading and math scores are insignificant. As with the OLS estimates, the coefficient on external behavioral problems gets smaller and becomes insignificant as students move from kindergarten to first grade. Unlike the OLS estimates, the estimate of the impact of attending full-day kindergarten on retention is positive and significant. The coefficient on math scores is also significant after not being significant in the previous years. While the IV estimates and the OLS estimates are not significantly different from each other in each year, the pattern of results for math scores is curious.

¹⁹ In the first stage regressions, the coefficient on the instrument was a strong positive predictor of full-day attendance and was always significant at the 1 percent level (see Table A.3 for first-stage results for the kindergarten math outcome). Other positive influences on full-day attendance were age at school entry, non-Hispanic Black, and whether the school was in an urban or rural school district. Speaking other languages in the home or attending a public school lowered the probability that someone attended a full-day program. Finally, most household characteristics were not related to full-day attendance, perhaps suggesting that parental choice may not be a large issue.

Finally, the estimates comparing the instrumental variables estimates in Table 7 and Table 3 for the gain scores are similar. There are significant gains during kindergarten for both math and reading scores. By first grade, the impact of full-day attendance on gain scores is insignificant. By third grade, the estimates of full-day attendance on gain scores for reading are negative and insignificant, and the estimate on gain scores for math are positive. The latter results for third grade gains in math scores is the lone difference from the OLS results.

Mother's Labor Force Participation

As mentioned by Elicker & Mathur (1997) and Gull (1990), many parents are in favor of full day kindergarten because it lessens the need for child care. Thus one would expect higher labor force attachment among mothers whose children attend full day kindergarten. Using a recursive bivariate probit model to estimate the likelihood that a mother will work full-time if the child attends full-day kindergarten in combination with the likelihood that the parent will send her child to a full-day program, we find consistent support that mothers are more likely to work full-time in the kindergarten year if their students attend full-day kindergarten (see Table 8).²⁰ These effect sizes are not statistically significant in first and third grade, suggesting that there may not be any longer term impact on early labor force attachment for these mothers.

The results for the population as a whole are replicated for the subpopulations investigated in this research. As might be expected due to child care cost issues, there is a larger positive impact on the labor force participation rates for the poor than the non-poor. Again, this effect disappears after kindergarten. Also as expected there is no difference by gender, but the positive effect of full-day attendance in kindergarten is eliminated by first grade.

Additional Analyses

²⁰ As expected, the unemployment rate is negatively related to the probability that a mother would work. The coefficient on the welfare benefit is not statistically significant, and the coefficient on the average wage, although significant, is quite small (-0.00002)

A number of additional analyses were conducted to test the robustness of results discussed above. First, we re-estimated the models in kindergarten and first grade with additional observations that were available in those years, but were not available in third grade. Results were unchanged. We also re-estimated the models including first and third grade school level variables such as class size and the percentage of the school population receiving free and reduced price lunch. While this lowered the sample size, it did not change the results.

Next, we restricted the sample to students who attended public schools only because they would be most likely affected by state policies. In these models, we found that the results in Tables 3 through 5 are driven by the students in public schools, and that there was very little effect of full day attendance for private school students.

Finally, we stratified the sample by whether the mother worked full time while the child was in kindergarten. It may be the case that those mothers who do not work are able to supplement the education of the students, and that full day attendance may be less important for this sample. Paradoxically, the impact of full day attendance on test scores is strongest in the sample of non-working mothers.²¹ This suggests that while full day attendance may help mothers work while a child is in kindergarten, there is not likely to be an academic advantage for those children.

CONCLUSIONS AND DISCUSSION

As school districts consider implementing full-day kindergarten programs more broadly, little empirical research exists to determine whether full-day programs enhance the educational outcomes of students and the labor market outcomes of their parents. What research does exist has typically been limited methodologically by focusing on single sites or has not followed students much beyond their kindergarten year. This paper is able to overcome these past

²¹ This is true in the OLS models, but not in the fixed effects models.

limitations by using the ECLS-K data and investigating outcomes through a student's third grade year. In addition, this study deals with the possible selection bias of parents choosing full-day programs for their students using fixed effects models, models of instrumental variables, and bivariate probit models for labor force participation.

The results of the analysis suggest that attending a full-day kindergarten program increases the academic performance of students in both math (.14 standard deviations) and reading (.21 standard deviations) by the spring of the kindergarten year. These effects partially disappear by first grade, and are largely eliminated by third grade. The analysis also finds no effect of full-day attendance on the likelihood that a student will exhibit internal behavioral problems, and a positive probability of exhibiting external behavioral problems in kindergarten and the third grade. Finally, the results suggest that mothers who have students in full-day programs are more likely to work than mothers with children in a half-day program, but that this effect is likely confined to kindergarten.

Further analyses were conducted using fixed effects and instrumental variables. In the fixed effects' models, the results confirm that all the advantage that a student attending full-day kindergarten may have is gone by 3rd grade, and the students who attend full day may have lower gains in test scores between kindergarten and third grade. The results from the IV models do not differ much from the OLS results. This suggests one of two things, but, at present, we cannot distinguish between the two hypotheses. Either the theoretical ambiguity surrounding the direction of selection is such that the two effects cancel each other out, or there is little selection in the choice of kindergarten programs by parents.

The overall results may obscure an interesting set of results that exist when examining the effects of full-day attendance by gender. There is evidence that the positive impact on math test

scores for girls persists through third grade, but this effect is erased in the fixed effects models. On the other hand, boys are more likely to exhibit external behavioral problems in full-day programs, and receive none of the long-term educational benefits. Finally, we find no additional benefit for children or mothers of children whose household income is below the poverty line when they attend full-day kindergarten compared to the non-poor.

In sum, there is little evidence that the positive impact of attending a full-day kindergarten program persists beyond first grade. Given the cost of these programs, it calls into question the practice of requiring school districts to offer such programs. There are two potentially important caveats that may temper the above conclusion. The first is that mothers experience a higher likelihood of working full-time while their children attend full-day programs. To the extent that these environments are better than alternative child care arrangements that may be funded by the public sector, then it could be the case that full-day programs are cost-beneficial. Second, it could be the case that full day programs are beneficial, but that these benefits erode for the students that are disadvantaged. In a study of black-white test scores gaps, Fryer and Levitt (2004) find that the gaps widen over time, which they hypothesize may be due to worse out of school environments for minorities. It could be the case that a similar mechanism exists in our sample, but more research is needed to reach this conclusion or the alternative conclusion.

REFERENCES

- Besley, T. and A. Case (2000). Unnatural Experiments? Estimating the Incidence of Endogenous Policies, *The Economic Journal*, 110(467), 672-694.
- Bredekamp, S., & Copple, C. (Eds.). (1997). *Developmentally Appropriate Practice in Early Childhood Programs* (Revised ed.). Washington, DC: National Association for the Education of Young Children.
- Blau, David M., and Robins, Philip K. (1988). "Childcare Costs and Family Labor Supply," *Research in Economics and Statistics*, 70(3), 374-381.
- Brewster, C., & Railsback, J. (2002). *Full-Day Kindergarten: Exploring an Option for Extended Learning*. Portland, OR: Northwest Regional Educational Laboratory.
- Clark, P., & Kirk, E. (2000). All-Day Kindergarten. *Childhood Education*, 228-231.
- Council of Chief State School Officers (1998). *Key State Education Policies on K-12 Education: Standards, Graduation, Assessment, Teacher Licensure, Time and Attendance*. Retrieved June 30, 2004, from <http://www.ccsso.org/Publications/Download.cfm?Filename=keystate98.pdf>
- Crosser, S.L. (1991). "Summer Birth Date Children: Kindergarten Entrance Age and Academic Achievement," *Journal of Educational Research*, 84(3), 140-146.
- Cryan, J. R., Sheehan, R., Wiechel, J., & Bandy-Hedden, I. G. (1992). Success Outcomes of Full-Day Kindergarten: More Positive Behavior and Increased Achievement in the Years After. *Early Childhood Research Quarterly*, 7(2), 187-203.
- Education Commission of the States. (2004). Kindergarten: Quick Facts. Retrieved March 31, 2004, from

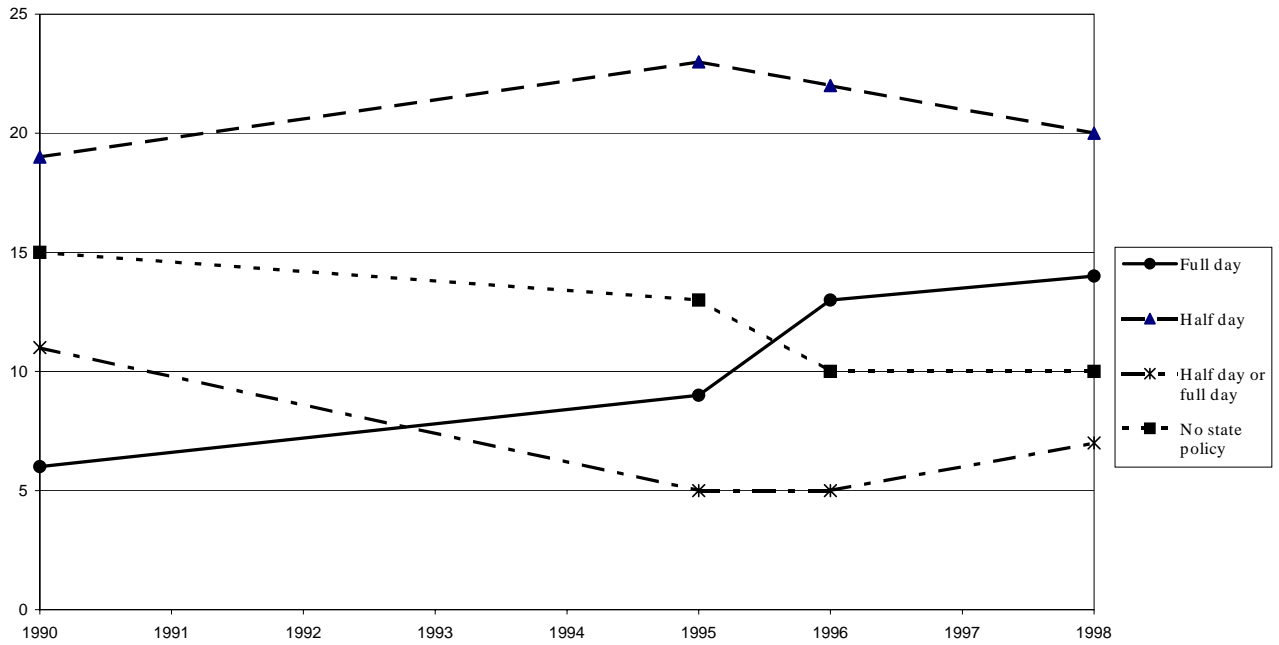
<http://www.ecs.org/html/issueSection.asp?print=true&issueID=77&subIssueID=0&s=Quick+Facts>

- Elicker, J., & Mathur, S. (1997). What Do They Do All Day? Comprehensive Evaluation of a Full-Day Kindergarten. *Early Childhood Research Quarterly*, 12(4), 459-480.
- Entwisle, D. R., & Alexander, K. L. (1998). Facilitating the Transition to First Grade: The Nature of Transition and Research on Factors Affecting It. *The Elementary School Journal*, 98(4), 351-364.
- Fryer Jr., Roland G. and Steven Levitt (2004). Understanding the Black-White Test Score Gap in the First Two Years of School. *Review of Economics and Statistics*, 86(2), 447-464.
- Fusaro, J. A. (1997). The Effect of Full-Day Kindergarten on Student Achievement: A Meta-Analysis. *Child Study Journal*, 27(4), 77.
- Gelbach, J. B. (2002). Public Schooling for Young Children and Maternal Labor Supply. *American Economic Review*, 92(1), 307-322.
- Gullo, D. F. (1990). The Changing Family Context: Implications for the Development of All-Day Kindergarten. *Young Children*, 45(4), 35-39.
- Karoly, L. et al. (1998). *Investing in our Children: What we Know and Don't Know About the Costs and Benefits of Early Childhood Interventions*. Santa Monica, CA: RAND Corporation.
- Karweit, N. (1992). The Kindergarten Experience. *Educational Leadership*, (March 1992), 82-86.
- Morrow, L. M., Strickland, D. S., & Woo, D. G. (1998). *Literacy Instruction in Half- and Whole-Day Kindergarten: Research to Practice*. Newark, DE: International Reading Association.

- Olsen, D., & Zigler, E. (1989). An Assessment of the All-Day Kindergarten Movement. *Early Childhood Research Quarterly*, 4(2), 167-182.
- Puelo, V. (1988). A Review and Critique of Research on Full-Day Kindergarten. *Elementary School Journal*, 88(4), 427-439.
- Rothenberg, D. (1995). Full-day Kindergarten Programs: ERIC Digest. Retrieved March 31, 2004, from http://www.ericfacility.net/databases/ERIC_Digests/ed382410.html
- Ribar, D. (1992). "Childcare and the Labor Supply of Married Women: Reduced Form Evidence," *Journal of Human Resources*, 27(1), 134-165.
- Walston, J., & West, J. (2004). *Full-day and Half-day Kindergarten in the United States*. Washington, DC: NCES.

CHARTS

Chart 1: State Kindergarten Policy Trends 1990-1998



Note: States with a full-day or a full-day and half-day policy are combined into full day.

Source: Council of Chief State School Officers

Table 2: Baseline Sample Descriptive Characteristics

	All Children		Full-Day Only		Half-Day Only	
	Mean	Std Err	Mean	Std Err	Mean	Std Err
Sample size	8,481		4,474		4,007	
Attended full-day kindergarten	0.522	(0.006)				
Child Characteristics						
Female	0.498	(0.006)	0.501	(0.008)	0.495	(0.009)
Age at kindergarten entry (months)	65.934	(0.047)	66.212*	(0.064)	65.631	(0.070)
Race - Non-Hispanic Black (omitted is White)	0.125	(0.004)	0.191*	(0.007)	0.053	(0.004)
Race - Hispanic	0.168	(0.005)	0.146*	(0.006)	0.192	(0.007)
Race - Other	0.064	(0.003)	0.066	(0.004)	0.061	(0.004)
Home language is non-English	0.102	(0.004)	0.085*	(0.004)	0.120	(0.005)
Disability in kindergarten	0.134	(0.004)	0.137	(0.006)	0.130	(0.006)
Household Characteristics						
Number of children in household	2.447	(0.013)	2.437	(0.019)	2.457	(0.018)
Single-parent family	0.180	(0.005)	0.210*	(0.007)	0.148	(0.006)
Household income (in log dollars)	10.626	(0.010)	10.555*	(0.015)	10.704	(0.014)
Mother graduated from high school	0.284	(0.005)	0.297	(0.008)	0.270	(0.008)
Mother attended some college	0.343	(0.006)	0.334	(0.008)	0.353	(0.008)
Mother graduated from college	0.260	(0.005)	0.251	(0.007)	0.270	(0.008)
Father graduated from high school	0.257	(0.005)	0.255	(0.007)	0.259	(0.007)
Father attended some college	0.336	(0.006)	0.343	(0.008)	0.328	(0.008)
Father graduated from college	0.262	(0.005)	0.238*	(0.007)	0.287	(0.008)
Number of books in child's home	78.882	(0.706)	73.905*	(0.955)	84.327	(1.036)
How often parent reads books to child (Four categories from 1=not at all to 4=every day)	3.280	(0.009)	3.242*	(0.013)	3.321	(0.013)
How often parent plays games with child (Four categories from 1=not at all to 4=every day)	2.785	(0.010)	2.779	(0.014)	2.793	(0.013)
Highest degree parent expects for child (Six categories from 1=less than high school diploma to 6=Ph.D., M.D. or other higher degree)	4.099	(0.013)	4.118	(0.018)	4.077	(0.018)
Parents attend religious services several times a month or more (omitted is no religious attendance)	0.590	(0.006)	0.614*	(0.008)	0.563	(0.008)
Parents attend religious services several times a year	0.216	(0.005)	0.215	(0.007)	0.218	(0.007)
Parents' religious attendance is missing	0.003	(0.001)	0.003	(0.001)	0.002	(0.001)
Child in non-parental care year before kindergarten	0.829	(0.005)	0.838	(0.006)	0.820	(0.007)
Child in non-parental care in kindergarten year	0.502	(0.006)	0.489	(0.008)	0.517	(0.009)
School Characteristics						
Public school	0.850	(0.004)	0.809*	(0.006)	0.893	(0.004)
Free and reduced-price lunch (percentage)	59.036	(0.453)	62.040*	(0.603)	55.752	(0.675)
School size (Five categories from 1=0-149 students to 5=750 students and above)	3.410	(0.013)	3.389	(0.019)	3.433	(0.018)
Kindergarten class size	20.834	(0.059)	21.551*	(0.086)	20.051	(0.079)
Location - Urban (Omitted is suburban)	0.358	(0.006)	0.404*	(0.008)	0.307	(0.008)
Location - Rural	0.218	(0.005)	0.258*	(0.007)	0.175	(0.006)
Years teacher has taught kindergarten	9.311	(0.094)	8.782*	(0.126)	9.889	(0.140)

Note: All means are weighted.

* significant at 5%

**Table 3: Effects of Full-Day Kindergarten Attendance
OLS and Probit Results for All Students**

	Marginal Effect ¹ Std Err	
Spring Kindergarten		
Math Scores - standardized (n=7,835)	0.144**	(0.026)
Reading Scores - standardized (n=7,463)	0.207**	(0.029)
Internal Problem Behaviors ² (n=5,964)	0.000	(0.003)
External Problem Behaviors ³ (n=6,124)	0.017**	(0.005)
Spring First Grade		
Math Scores - standardized (n=7,835)	0.080**	(0.028)
Reading Scores - standardized (n=7,463)	0.072*	(0.031)
Internal Problem Behaviors (n=5,964)	-0.002	(0.004)
External Problem Behaviors (n=6,124)	0.010	(0.006)
Spring Third Grade		
Math Scores - standardized (n=7,835)	0.058*	(0.029)
Reading Scores - standardized (n=7,463)	0.014	(0.030)
Internal Problem Behaviors (n=5,964)	0.002	(0.005)
External Problem Behaviors (n=6,124)	0.014*	(0.006)
Retained by third grade (n=8,353)	0.011	(0.008)
Gain Scores		
Math Fall K to Spring K (n=7,835)	0.189**	(0.033)
Math Fall K to Spring First (n=7,835)	0.072*	(0.032)
Math Fall K to Spring Third (n=7,835)	0.037	(0.032)
Reading Fall K to Spring K (n=7,463)	0.253**	(0.033)
Reading Fall K to Spring First (n=7,463)	0.033	(0.033)
Reading Fall K to Spring Third (n=7,463)	-0.052	(0.033)

¹OLS coefficients are reported for math and reading outcomes. Probit marginal effects are reported for behavior and retention outcomes.

²Child exhibits internal behavior problems often or very often. The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

³Child exhibits external behavior problems often or very often. The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1 unless otherwise noted.

+ significant at 10%

* significant at 5%

** significant at 1%

**Table 4: Effects of Full-Day Kindergarten Attendance
OLS and Probit Results By Poverty Status**

	Poor		Non-Poor	
	<u>Marginal Eff.¹</u>	<u>Std Err</u>	<u>Marginal Eff.¹</u>	<u>Std Err</u>
Spring Kindergarten				
Math Scores - standardized (n=1,121 and 6,714)	0.060	(0.057)	0.157**	(0.028)
Reading Scores - standardized (n=929 and 6,534)	0.213**	(0.061)	0.207**	(0.031)
Internal Problem Behaviors ² (n=760 and 5,204)	0.006	(0.005)	-0.002	(0.003)
External Problem Behaviors ³ (n=794 and 5,330)	0.083**	(0.024)	0.011*	(0.005)
Spring First Grade				
Math Scores - standardized (n=1,121 and 6,714)	0.047	(0.070)	0.083**	(0.030)
Reading Scores - standardized (n=929 and 6,534)	0.070	(0.080)	0.071*	(0.033)
Internal Problem Behaviors ² (n=760 and 5,204)	0.015*	(0.008)	-0.006	(0.004)
External Problem Behaviors ³ (n=794 and 5,330)	0.004	(0.023)	0.011+	(0.006)
Spring Third Grade				
Math Scores - standardized (n=1,121 and 6,714)	0.087	(0.077)	0.053+	(0.030)
Reading Scores - standardized (n=929 and 6,534)	0.067	(0.094)	0.010	(0.031)
Internal Problem Behaviors ² (n=760 and 5,204)	0.016	(0.011)	-0.002	(0.005)
External Problem Behaviors ³ (n=794 and 5,330)	0.043**	(0.014)	0.007	(0.005)
Retained by third grade ⁴ (n=1,238 and 7,115)	0.054*	(0.024)	0.005	(0.007)
Gain Scores				
Math Fall K to Spring K (n=1,121 and 6,714)	0.104	(0.071)	0.204**	(0.035)
Math Fall K to Spring First (n=1,121 and 6,714)	0.056	(0.079)	0.072*	(0.034)
Math Fall K to Spring Third (n=1,121 and 6,714)	0.092	(0.087)	0.026	(0.033)
Reading Fall K to Spring K (n=929 and 6,534)	0.272**	(0.070)	0.252**	(0.035)
Reading Fall K to Spring First (n=929 and 6,534)	0.021	(0.084)	0.034	(0.034)
Reading Fall K to Spring Third (n=929 and 6,534)	0.003	(0.102)	-0.054+	(0.033)

¹OLS coefficients are reported for math and reading outcomes. Probit marginal effects are reported for behavior and retention outcomes.

²Child exhibits internal behavior problems often or very often. The categorical variables for home language and missing observations for parents' religious attendance were dropped from this regression because they perfectly predicted failure.

³Child exhibits external behavior problems often or very often. The categorical variables for home language and missing observations for parents' religious attendance were dropped from this regression because they perfectly predicted failure.

⁴The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1 unless otherwise noted.

+ significant at 10%

* significant at 5%

** significant at 1%

**Table 5: Effects of Full-Day Kindergarten Attendance
OLS and Probit Results By Gender**

	Female		Male	
	<u>Marginal Eff.¹</u>	<u>Std Err</u>	<u>Marginal Eff.¹</u>	<u>Std Err</u>
Spring Kindergarten				
Math Scores - standardized (n=3,959 and 3,876)	0.151**	(0.031)	0.135**	(0.038)
Reading Scores - standardized (n=3,781 and 3,682)	0.243**	(0.036)	0.170**	(0.039)
Internal Problem Behaviors ² (n=3,053 and 2,911)	0.004	(0.004)	-0.005	(0.004)
External Problem Behaviors ³ (n=3,124 and 3,000)	0.005	(0.005)	0.033**	(0.009)
Spring First Grade				
Math Scores - standardized (n=3,959 and 3,876)	0.069*	(0.035)	0.086*	(0.041)
Reading Scores - standardized (n=3,781 and 3,682)	0.104**	(0.039)	0.039	(0.043)
Internal Problem Behaviors ² (n=3,053 and 2,911)	0.003	(0.004)	-0.008+	(0.004)
External Problem Behaviors ³ (n=3,124 and 3,000)	0.009+	(0.005)	0.008	(0.011)
Spring Third Grade				
Math Scores - standardized (n=3,959 and 3,876)	0.085*	(0.039)	0.020	(0.041)
Reading Scores - standardized (n=3,781 and 3,682)	0.008	(0.041)	0.023	(0.041)
Internal Problem Behaviors ² (n=3,053 and 2,911)	0.004	(0.005)	0.002	(0.007)
External Problem Behaviors ³ (n=3,124 and 3,000)	0.009	(0.005)	0.017+	(0.010)
Retained by third grade ⁴ (n=4,189 and 4,164)	0.010	(0.008)	0.013	(0.012)
Gain Scores				
Math Fall K to Spring K (n=3,959 and 3,876)	0.196**	(0.038)	0.183**	(0.049)
Math Fall K to Spring First (n=3,959 and 3,876)	0.059	(0.041)	0.080+	(0.044)
Math Fall K to Spring Third (n=3,959 and 3,876)	0.079+	(0.042)	-0.016	(0.046)
Reading Fall K to Spring K (n=3,781 and 3,682)	0.287**	(0.043)	0.225**	(0.043)
Reading Fall K to Spring First (n=3,781 and 3,682)	0.059	(0.042)	0.011	(0.045)
Reading Fall K to Spring Third (n=3,781 and 3,682)	-0.073+	(0.044)	-0.020	(0.045)

¹OLS coefficients are reported for math and reading outcomes. Probit marginal effects are reported for behavior and retention outcomes.

²Child exhibits internal behavior problems often or very often. The categorical variables for home language and missing observations for parents' religious attendance were dropped from this regression because they perfectly predicted failure.

³Child exhibits external behavior problems often or very often. The categorical variables for home language and missing observations for parents' religious attendance were dropped from this regression because they perfectly predicted failure.

⁴The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1 unless otherwise noted.

+ significant at 10%

* significant at 5%

** significant at 1%

**Table 6: Effects of Full-Day Kindergarten Attendance
Fixed Effects Results for All Students**

	Marginal Effect ¹	Std Err
Spring Kindergarten		
Math Scores - standardized (n=7,779)	0.182**	(0.041)
Reading Scores - standardized (n=7,413)	0.291**	(0.044)
Spring First Grade		
Math Scores - standardized (n=7,779)	0.077+	(0.041)
Reading Scores - standardized (n=7,413)	0.135**	(0.047)
Spring Third Grade		
Math Scores - standardized (n=7,779)	-0.008	(0.039)
Reading Scores - standardized (n=7,413)	0.023	(0.043)
Gain Scores		
Math Fall K to Spring K (n=7,779)	0.164**	(0.044)
Math Fall K to Spring First (n=7,779)	0.007	(0.045)
Math Fall K to Spring Third (n=7,779)	-0.096*	(0.042)
Reading Fall K to Spring K (n=7,413)	0.332**	(0.049)
Reading Fall K to Spring First (n=7,413)	0.076	(0.049)
Reading Fall K to Spring Third (n=7,413)	-0.079+	(0.046)

¹OLS coefficients are reported for math and reading outcomes.

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1 unless otherwise noted.

+ significant at 10%

* significant at 5%

** significant at 1%

**Table 7: Effects of Full-Day Kindergarten Attendance
Second Stage IV Results for All Students**

	Coefficient	Std Err
Spring Kindergarten		
Math Scores - standardized (n=7,835)	0.077	(0.056)
Reading Scores - standardized (n=7,463)	0.261**	(0.066)
Internal Problem Behaviors ² (n=5,964)	-0.006	(0.008)
External Problem Behaviors ³ (n=6,124)	0.040*	(0.018)
Spring First Grade		
Math Scores - standardized (n=7,835)	0.066	(0.059)
Reading Scores - standardized (n=7,463)	0.107	(0.067)
Internal Problem Behaviors (n=5,964)	-0.001	(0.011)
External Problem Behaviors (n=6,124)	0.030	(0.021)
Spring Third Grade		
Math Scores - standardized (n=7,835)	0.148*	(0.062)
Reading Scores - standardized (n=7,463)	0.074	(0.063)
Internal Problem Behaviors (n=5,964)	0.003	(0.014)
External Problem Behaviors (n=6,124)	0.023	(0.018)
Retained by third grade (n=8,353)	0.086**	(0.021)
Gain Scores		
Math Fall K to Spring K (n=7,835)	0.164*	(0.068)
Math Fall K to Spring First (n=7,835)	0.087	(0.068)
Math Fall K to Spring Third (n=7,835)	0.172*	(0.069)
Reading Fall K to Spring K (n=7,463)	0.337**	(0.075)
Reading Fall K to Spring First (n=7,463)	0.053	(0.069)
Reading Fall K to Spring Third (n=7,463)	0.009	(0.069)

¹Child exhibits internal behavior problems often or very often.

²Child exhibits external behavior problems often or very often.

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1.

+ significant at 10%

* significant at 5%

** significant at 1%

Table 8: Effects of Full-Day Kindergarten Attendance
Recursive Bivariate Probit Results For Mother Working Full-time Outcome
Marginal Effects

	All Students	Gender ¹		Poverty Status ²	
	All (n=7,677)	Female (n=3,867)	Male (n=3,810)	Poor (n=1,098)	Non-Poor (n=6,579)
Fall Kindergarten					
Mother works full-time	0.158**	0.150**	0.165**	0.225*	0.142**
Spring First Grade					
Mother works full-time	0.055	0.059	0.031	0.022	0.049
Spring Third Grade					
Mother works full-time	0.074	0.072	0.062	0.140	0.036

¹The categorical variable for missing observations for parents' religious attendance was dropped from the gender regressions because it perfectly predicted failure.

²The categorical variable for missing observations for parents' religious attendance was dropped from the poverty regressions because it perfectly predicted failure.

Notes: All estimates are weighted. Regressions include independent variables listed in Tables 2 and A.1 except for household income and with the addition of wage, unemployment, and welfare payment variables.

+ significant at 10%

* significant at 5%

** significant at 1%

APPENDIX

**Table A.1: Sample Descriptive Characteristics
First and Third Grade Variables**

	All Children		Full-Day Only		Half-Day Only	
	Mean	Std Err	Mean	Std Err	Mean	Std Err
Sample size	8,481		4,474		4,007	
First Grade Characteristics						
Income change between kindergarten and Spring first grade (percentage)	0.007	(0.001)	0.006	(0.002)	0.008	(0.002)
Number of parents in household changed between kindergarten and Spring first grade	0.075	(0.004)	0.087*	(0.006)	0.063	(0.005)
Child changed schools between kindergarten and Spring first grade	0.253	(0.008)	0.258	(0.010)	0.249	(0.011)
Third Grade Characteristics						
Income change between Spring first grade and Spring third grade (percentage)	0.011	(0.001)	0.012	(0.001)	0.010	(0.001)
Number of parents in household changed between Spring first grade and Spring third	0.109	(0.005)	0.117	(0.007)	0.100	(0.006)
Child changed schools between Spring first grade and Spring third grade	0.320	(0.007)	0.341*	(0.010)	0.297	(0.011)

Note: All means are weighted.

* significant at 5%

Table A.2: Kindergarten Policies by State

State	State Policy	Number of Students in Sample	Mean Attending Full-Day in State
Coded as a full-day policy for instrument			
Alabama	Full-day ¹	262	99.4%
Florida	Full-day	366	95.8%
Georgia	Full-day	182	94.7%
Hawaii	Full-day	121	100.0%
Louisiana	Full-day	253	100.0%
Mississippi	Full-day	124	100.0%
North Carolina	Full-day	251	97.4%
Virginia	Half and Full ²	59	100.0%
Coded as not a full-day policy for instrument			
Arizona	Half-day ³	116	64.5%
California	Half-day	1,060	16.9%
Connecticut	Half-day	100	54.7%
Delaware	Half-day	69	3.0%
Indiana	Half-day	199	24.4%
Kentucky	Half-day	128	79.4%
Maryland	Half-day	118	21.2%
Massachusetts	Half-day	224	25.0%
New Mexico	Half-day	30	16.9%
Oklahoma	Half-day	82	9.5%
Oregon	Half-day	33	100.0%
Pennsylvania	Half-day	503	29.0%
Tennessee	Half-day	199	78.1%
Utah	Half-day	97	6.9%
Washington	Half-day	63	45.7%
Wisconsin	Half-day	291	57.2%
Wyoming	Half-day	86	4.0%
Illinois	Half or Full ⁴	441	40.8%
Iowa	Half or Full	264	72.0%
Minnesota	Half or Full	114	7.0%
Missouri	Half or Full	295	83.2%
Ohio	Half or Full	317	31.6%
Rhode Island	Half or Full	74	4.7%
Texas	Half or Full	531	76.4%
Alaska	None ⁵	65	54.5%
Colorado	None	147	32.2%
Kansas	None	150	18.8%
Maine	None	208	24.9%
Michigan	None	303	19.1%
New Jersey	None	180	44.2%
New York	None	319	55.9%
South Dakota	None	58	100.0%

Table A.2: Kindergarten Policies by State (continued)

State	State Policy	Number of Students in Sample	Mean Attending Full-Day in State
Not included in sample			
Arkansas	Full-day	0	
District of Columbia	Full-day	0	
West Virginia	Full-day	0	
South Carolina	Half and Full	0	
Vermont	Half and Full	0	
Montana	Half-day	0	
Nebraska	Half-day	0	
Nevada	Half-day	0	
North Dakota	Half or Full	0	
Idaho	None	0	
New Hampshire	None	0	

¹State requires districts to offer full-day kindergarten programs.

²State requires districts to offer half-day and full-day kindergarten programs.

³State requires districts to offer half-day kindergarten programs.

⁴State requires districts to offer half-day or full-day kindergarten programs.

⁵State does not have a statewide policy - local education agencies determine.

Note: Mean attending full day is weighted.

Source: CCSSO (1998); Confirmed by searches of state education department web sites, findlaw.com, and personal communication with state department of education staff.

**Table A.3: First Stage Instrumental Variable Results
Spring Kindergarten Math Scores**

	Estimate	Std Err
Full-day policy instrument	0.569**	(0.010)
Child Characteristics		
Female	0.017+	(0.010)
Age at kindergarten entry (months)	0.007**	(0.001)
Race - Non-Hispanic Black (omitted is White)	0.043*	(0.019)
Race - Hispanic	0.005	(0.020)
Race - Other	0.024	(0.020)
Home language is non-English	-0.088**	(0.025)
Disability in kindergarten	0.017	(0.015)
Household Characteristics		
Number of children in household	-0.000	(0.005)
Single-parent family	-0.014	(0.016)
Household income (in log dollars)	-0.010	(0.008)
Mother graduated from high school	-0.002	(0.021)
Mother attended some college	-0.003	(0.023)
Mother graduated from college	0.024	(0.026)
Father graduated from high school	0.001	(0.020)
Father attended some college	-0.001	(0.020)
Father graduated from college	-0.041+	(0.023)
Number of books in child's home	-0.000**	(0.000)
How often parent reads books to child (Four categories from 1=not at all to 4=every day)	-0.009	(0.008)
How often parent plays games with child (Four categories from 1=not at all to 4=every day)	-0.005	(0.007)
Highest degree parent expects for child (Six categories from 1=less than high school diploma to 6=Ph.D., M.D. or other higher degree)	0.010*	(0.005)
Parents attend religious services several times a month or more (omitted is no religious attendance)	0.020	(0.014)
Parents attend religious services several times a year	0.018	(0.016)
Parents' religious attendance is missing	0.038	(0.119)
Child in non-parental care year before kindergarten	0.034*	(0.015)
Child in non-parental care in kindergarten year	-0.059**	(0.011)
School Characteristics		
Public school	-0.202**	(0.016)
Free and reduced-price lunch (percentage)	0.001**	(0.000)
School size (Five categories from 1=0-149 students to 5=750 students and above)	-0.042**	(0.006)
Kindergarten class size	0.017**	(0.001)
Location - Urban (Omitted is suburban)	0.130**	(0.012)
Location - Rural	0.212**	(0.015)
Years teacher has taught kindergarten	-0.002**	(0.001)

Notes: Standard errors are adjusted to account for multiple children in the same classroom. All estimates are weighted.

+ significant at 10%

* significant at 5%

** significant at 1%

Table A.4: OLS Estimates for Spring Kindergarten Outcomes

	Standardized Math Scale Score ¹	Standardized Reading Scale Score ¹	Internal Behavior Problems ²	External Behavior Problems ³
Sample size	7,835	7,463	5,964	6,124
Child attended full-day kindergarten	0.144** (0.029)	0.207** (0.029)	0 (0.003)	0.017** (0.005)
Child Characteristics				
Female	-0.055** (0.021)	0.125** (0.022)	0 (0.003)	-0.023** (0.005)
Age at kindergarten entry (months)	0.062** (0.003)	0.038** (0.003)	0 (0.000)	-0.001 (0.001)
Race - Non-Hispanic Black (omitted is White)	-0.388** (0.038)	-0.124** (0.044)	0 (0.005)	0.023* (0.012)
Race - Hispanic	-0.212** (0.037)	-0.094* (0.041)	-0.003 (0.004)	0.008 (0.010)
Race - Other	-0.095* (0.043)	0.078 (0.054)	0.003 (0.007)	0.004 (0.010)
Home language is non-English	-0.174** (0.046)	-0.032 (0.065)	-0.004 (0.004)	-0.030** (0.005)
Disability in kindergarten	-0.295** (0.030)	-0.261** (0.031)	0.011** (0.005)	0.017* (0.008)
Household Characteristics				
Number of children in household	-0.039** (0.010)	-0.079** (0.011)	0 (0.001)	-0.002 (0.002)
Single-parent family	-0.109** (0.032)	-0.129** (0.032)	0.002 (0.004)	0.006 (0.007)
Household income (in log dollars)	0.082** (0.019)	0.081** (0.018)	-0.004* (0.002)	-0.010** (0.003)
Mother graduated from high school	0.124** (0.043)	0.166** (0.039)	-0.008+ (0.005)	0.008 (0.009)
Mother attended some college	0.195** (0.047)	0.220** (0.042)	-0.007 (0.006)	0.005 (0.010)
Mother graduated from college	0.335** (0.055)	0.353** (0.053)	-0.012+ (0.005)	0.001 (0.012)
Father graduated from high school	0.024 (0.037)	-0.008 (0.040)	0.007 (0.007)	-0.004 (0.009)
Father attended some college	0.153** (0.040)	0.115** (0.041)	0.012 (0.008)	-0.008 (0.009)
Father graduated from college	0.288** (0.047)	0.222** (0.053)	0.014 (0.011)	-0.012 (0.009)
Number of books in child's home	0.001** (0.000)	0.001** (0.000)	-0.000* (0.000)	0 (0.000)
How often parent reads books to child (Four categories from 1=not at all to 4=every day)	0.023 (0.016)	0.092** (0.018)	-0.001 (0.002)	-0.006+ (0.003)
How often parent plays games with child (Four categories from 1=not at all to 4=every day)	0.044** (0.013)	0.014 (0.014)	-0.001 (0.002)	-0.001 (0.003)

Table A.4: OLS Estimates for Spring Kindergarten Outcomes (continued)

	Standardized Math Scale Score ¹	Standardized Reading Scale Score ¹	Internal Behavior Problems ²	External Behavior Problems ³
Highest degree parent expects for child (Six categories from 1=less than high school diploma to 6=Ph.D., M.D. or other higher degree)	0.059** (0.011)	0.052** (0.012)	0.001 (0.001)	-0.001 (0.003)
Parents attend religious services several times a month or more (omitted is no religious attendance)	0.009 (0.029)	0.006 (0.030)	-0.010** (0.004)	-0.009 (0.006)
Parents attend religious services several times a year	-0.011 (0.032)	-0.033 (0.033)	-0.004 (0.003)	0.003 (0.007)
Parents' religious attendance is missing	-0.258* (0.123)	-0.160 (0.227)	N/ A N/ A	N/ A N/ A
Child was in non-parental care year before kindergarten	0.086** (0.031)	0.040 (0.035)	0.005 (0.003)	0.022** (0.005)
Child was in non-parental care in kindergarten year	-0.082** (0.023)	-0.095** (0.026)	-0.003 (0.003)	0.008+ (0.005)
School Characteristics				
Public school	-0.118** (0.038)	-0.082+ (0.046)	0.003 (0.003)	-0.001 (0.008)
Free and reduced-price lunch (percentage)	-0.001+ (0.000)	-0.001* (0.000)	0 (0.000)	0 (0.000)
School size (Five categories from 1=0-149 students to 5=750 students and above)	0.021+ (0.012)	0.028* (0.014)	0 (0.001)	0.002 (0.003)
Kindergarten class size	-0.001 (0.002)	-0.005+ (0.003)	-0.001* (0.000)	0 (0.000)
Location - Urban (Omitted is suburban)	0.000 (0.029)	0.002 (0.033)	-0.005 (0.003)	-0.001 (0.006)
Location - Rural	-0.123** (0.034)	-0.146** (0.037)	-0.004 (0.004)	-0.002 (0.007)
Years teacher has taught kindergarten	-0.002 (0.002)	-0.001 (0.002)	-0.001** (0.000)	-0.001* (0.000)
Constant	-5.454** (0.289)	-3.966** (0.306)		
R-squared	0.29	0.18		

¹OLS coefficients are listed for this outcome.

²Child exhibits internal behavior problems often or very often. Probit marginal effects are listed for this outcome. The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

³Child exhibits external behavior problems often or very often. Probit marginal effects are listed for this outcome. The categorical variable for missing observations for parents' religious attendance was dropped from this regression because it perfectly predicted failure.

Notes: Standard errors are in parentheses and are adjusted to account for multiple children in the same school. All estimates are weighted.

+ significant at 10%

* significant at 5%

** significant at 1%