The Economic Consequences of Early Childhood Education on the School System

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Rutgers University

Clive R. Belfield
Queens College,
City University of New York
belfield@qc.edu

Heather Schwartz
Teachers College,
Columbia University
Hls2105@columbia.edu

EXECUTIVE SUMMARY

This research integrates the academic impacts of pre-school with its economic implications to calculate the budgetary consequences for the school system. This calculation provides information on whether investments in pre-school pay off in the short run.

We use the third and fifth grade data from the longitudinal, national Early Childhood Longitudinal Survey - Kindergarten (1998) and the Schools and Staffing Survey (2000). We also review the academic literature on educational achievement and youth behaviors such as drug use, smoking, and teen pregnancy.

Novel findings on impacts of pre-school for children are:

- Effect size achievement gains in reading and math in third and fifth grade of 0.07-0.10
- Reduced rates of grade retention and special education placement in third and fifth grade
- Effect size improvements in externalizing behaviors and self-control of 0.04-0.09

These impacts can play a significant role in offsetting gaps in school readiness. For achievement, they are equivalent to one-third of the differences attributable to family background.

Novel findings on the impacts of pre-school and achievement for schools are:

- Higher rates of job satisfaction, lower rates of absenteeism, and reduced turnover of teachers
- Enhanced instructional productivity in the classroom
- Improved school safety (less fighting, fewer thefts, and lower rates of physical attacks)

Budgetary savings for school systems from the full impacts of preschool include:

- Special education expenditures
- Teacher pay
- School maintenance and facilities expenditures
- Teacher turnover and absenteeism
- Academic support programs

Based on estimates from a range of sources and methods, the cost-saving per additional pre-schooler is estimated conservatively at $3,700 over the K-12 period.

This amount is a present value and is directly comparable to the cost of providing pre-school. This cost-saving is equivalent to 60-80% of annual per child expenditures in public pre-school programs. It represents approximately 6% of total expenditures per public school student over the K-12 years.

Moreover, this cost-saving does not include savings for programs outside the school system but that are related to education (health, drugs, child protection, and juvenile justice). These extra cost-savings per pre-schooler are estimated at $1,000 over the K-12 period.

1 INTRODUCTION

The evidence that publicly-funded pre-school raises children's academic performance is strong (Barnett and Belfield, 2006). Model programs have also shown in close detail how pre-school influences children's educational experiences (e.g., whether they are placed in special education or held back in grade) and their attitudes to education (Schweinhart et al., 2006). Pre-school therefore has the potential to change how schools allocate resources and how efficient they are. With more proficient learners, schools' productivity should increase.

Here we comprehensively estimate the fiscal consequences of pre-school for the school system. The approach is two-stage: first, the impacts of pre-school are established; and second, these impacts are interpreted in money terms. As pre-school influences individuals' attitudes and behavior in school, it should also affect the education system.[1] This in turn changes the operation of a school, with consequences for the school's budget and expenditures. For example, more able students are less likely to be truant from school; this reduces a schools' spending on truancy officers. We term these effects 'learning productivity gains' from having better prepared and more proficient children in school. Learning productivity gains may translate into educational cost-savings in classrooms, schools, and for district operations. Data from the Early Childhood Longitudinal Study (ECLS, 1998) and the Schools and Staffing Survey (SASS, 2000) are used to identify impacts in terms of: child-specific measures (e.g. achievement, behaviors, retention, and special education placement); class-specific measures (e.g. teacher satisfaction, classroom orderliness); and school-specific measures (e.g. safety, vandalism, principal's time on discipline). Using national unit cost data, each of these impacts can be costed out to calculate the full fiscal effect of productivity gains. We focus only on the costs to the school system and not burdens placed on private individuals or society.

This research is novel in that no attempt has been made to detail and cost out the full range of benefits to the school system when children have higher levels of school-readiness.[2] It

[1] Our assumption is that the pre-school offered is high quality (such as in Georgia or Arkansas) and full-time, although not as intensive as the model programs (Perry Pre-School and Abecedarian).
[2] Belfield and Winters (2004) used a similar method for Wisconsin. However, this work was incomplete: it did not itemize or examine a full set of child-, class-, and school-specific outcomes. It was integrated into a specific pre-school proposal at the state level rather than set out as a general investigation.

also has general appeal in directly investigating the effects of pre-school for key stake-holders who heretofore have not been engaged: teachers, school personnel, and other education professionals. It may also provide guidance for the distribution of resources by school districts.

2 THE IMPACTS OF PRE-SCHOOL

2.1 The Pathways from Pre-School to Academic Achievement and Behavioral Change

There are many possible pathways through which pre-school may influence children. Broadly, pre-school may set the foundation for different relationships within the family, which in turn will influence child development and behavior. Pre-school may give children the capacities and competences to enter school ready to learn and achieve. These influences are not exclusive and may mutually interact (Reynolds et al., 2004). Also, because learning is cumulative with initial skills serving as a foundation for future skills, preschool may have lasting effects. Importantly, these influences also suggest that the impact of pre-school is likely to be observed across multiple dimensions.

Here we empirically identify these dimensions. We begin with the influence of pre-school on academic achievement in kindergarten and elementary school both for the individual and for other children through peer effects. Next we examine pre-school's influence on individual behavior; we consider behavioral scores and acts such as smoking and teen pregnancy. Because the relationship between pre-school and achievement is established, we incorporate evidence on how achievement influences behavior. For each influence, the goal is to estimate a plausible, policy-relevant impact of pre-school.

To calculate these impacts we refer to published, controlled-observational research across several disciplines. We also draw directly on the Early Childhood Longitudinal Study dataset. The ECLS dataset includes information on over 22,000 children across the U.S. who entered kindergarten in 1998. It also has information from their schools and their teachers (West et al., 2000). Test scores, student behaviors, and school climate data are available (but data on costs is poor). Subsamples of children have been followed through first, third and fifth grade. All this data can be linked to whether or not the child participated in center-based pre-school prior to

entering kindergarten. The big advantage of the ECLS is that there is data for the students, their teachers, and their schools, allowing for a comprehensive analysis. To identify the persistence of pre-school, we provide new estimates of the impacts for third and fifth graders.

Although the ECLS dataset is rich, it is not possible to causally link pre-schooling with any beneficial (or adverse) outcomes. But the goal is to discover policy-relevant relationships, rather than precise coefficients, and it is possible to control for the two most important factors: family background and child ability. Indeed, for a better understanding of the substantive effect of pre-school, we compare its impacts to that of family socio-economic status. Moreover, several high-quality studies have established that instrumental variables estimation yields very similar results to ordinary least squares estimation (Magnuson et al., 2007; Loeb et al., 2007). Impacts can be bounded, assuming that unobservable bias is smaller than observable bias (Altonji et al., 2003). Findings can be verified by through analysis of multiple grade levels. Finally, sensitivity analysis is also undertaken, using a range of specifications.

2.2 Academic Effects

Pre-school is associated with improved academic achievement. As reported by Barnett and Belfield (2006), center-based child care increases cognitive abilities by 0.10-0.33 standard deviations relative to home care. Similarly strong effects are found in Oklahoma by Gormley and Gayer (2005) and in a five state study by Barnett et al. (2005). The impacts of Head Start are somewhat smaller (Garces et al., 2002).

The ECLS provides further corroboration at the national level. In their very broad specification, Fryer and Levitt (2004, Table A2) find the effects of center-based pre-school to be extremely large, even exceeding the effect of a one-standard deviation increase in socio-economic status. Magnuson et al. (2004) find that pre-school attendance raises math and reading scores by 0.1 standard deviations at school entry; and for children from low-income families, these academic gains persist through into first grade.

Direst estimation from the ECLS, as reported in Table 1, shows the relationship between attendance in pre-school and standardized reading and math scores as far as fifth grade. The immediate effect of pre-school is strong: in kindergarten it is associated with 0.17 and 0.18

standard deviation increase in reading and math. The effect is positive but not statistically significant in first grade, but it is strongly positive in third and fifth grades: reading and math scores are almost 0.1 standard deviations higher for those who were in pre-school. In comparison, the effect size for socioeconomic status is 0.28; pre-school therefore offsets approximately one-third of this family background characteristic. Controlling for child characteristics, the estimated effect size of center-based pre-school relative to parental care on reading and math is approximately 0.16. This is about 43% of the raw difference between children who attend center-based pre-school and other children. As in the studies cited above, there is evidence of a test score advantage for children attending center-based pre-school.[3] These effects are probably underestimates of the actual impacts because they do not adjust for attrition bias in test-taking. In addition, it is unlikely that the effects are confounded with socioeconomic status, as that is controlled for in the equations. School choice effects are also unlikely to be the explanation: we find no correlation between pre-school and subsequent attendance at private school in third or fifth grade.

Grade retention is an alternative measure of academic performance. According to the 1999 Current Population Survey, about one third of 15- to 17-year-olds were old for their grade and the proportion of students who are old for their grade has doubled since the 1970s amongst children age 6-8 and increased by a third amongst adolescents (Byrd et al., 1997). Grade retention is a growing phenomenon and is strongly positively correlated with being a high school dropout.

Pre-schooling reduces grade retention rates. In a summary review of 24 studies, Barnett and Ackerman (2006) find that model programs reduce retention rates by 15 percent and public school programs by 8 percent. This relationship also holds from analysis of the ECLS, as shown in Table 2. First grade effects are negative but not significant. However, both third and fifth grade effects are evident: pre-schooling reduces grade retention by 20 percent. This effect is one-third as strong as that of family background.

[3] The aim of the econometric analysis is to approximate the impact of pre-school on achievement (and, in subsequent equations, on school conditions). No controls for endogeneity are applied, even though these would identify a more precise causal estimate of these impacts. It is unlikely that such controls would significantly reduce the impacts. (The strongest observable controls only reduce the impacts by 43%).

2.3 Peer Effects

As pre-school raises own achievement, this influences other students. Most research shows how peers' ability positively interacts with own ability. In early research, Summers and Wolfe (1977) reported increases in 6th grade test scores with a higher proportion of high-achieving students in the class; and Henderson et al. (1976) found a positive impact on individual math scores from increases in the mean ability of students in the class. Across the Texas school system Hanushek et al. (2003) find a 0.1 standard deviation increase in peer average achievement leads to an increase in own achievement of 0.02 standard deviations.[4]

Our focus is on peer effects in the early years (peer effects within pre-school are found by Henry and Rickman, 2007). Hoxby (2000) finds a third-grader in a class where the average student scores 1 point higher posts a math/reading score which is 0.6 points higher. Using the ECLS dataset, Nores (2006) finds mixed, non-robust, and small peer effects in the early grades (K-3) according to peer ability and peer behavior. In contrast, our analysis using the ECLS shows positive peer effects when the peer measure is pre-school attendance across the school. Using the same functional form as for individual pre-school attendance, we regress individual achievement in reading and math in kindergarten on the proportion of the school population who attended pre-school. As shown in Table 3, the effect is positive and strongly statistically significant, even after controlling for school-level socioeconomic status and individual pre-school attendance. The substantive effect is interpreted as follows: attending a school where no other children were pre-schoolers compared to a school where all children had pre-schooling is associated with reading and math scores that are 0.3 standard deviations lower. Because children change school frequently, it is not possible to estimate this peer effect beyond kindergarten using the ECLS data. However, it is possible to treat the effect of pre-school on achievement as a peer effect for later grades.

From these individual gains and peer effects, it is possible to calculate the average impact on the achievement of each child if pre-school was universal. All children in the cohort would

[4] Behavioral peer effects have also been identified. Figlio (2005) finds that adding one additional disruptive student into a classroom is associated with a national percentile test score drop of four points in math. Likewise, adding one additional disruptive student into a classroom is associated with a misbehavior increase of 4 and 3 percentage points for boys and girls respectively.

obtain a peer gain of 0.02 standard deviations and a direct gain of 0.1 standard deviations. The overall effect would therefore be 0.12 standard deviations, extended over at least the first five grades of school.

2.4 Placement in Special Education

The effect of pre-school on rates of special education is well-documented. In a review of 20 studies, Barnett and Ackerman (2006) report that model programs reduce special education rates by 20 percent and public school and Head Start programs by 5 percent. An in-depth study of the effect of pre-schooling on special education has been undertaken by Conyers et al. (2002), using data from the Chicago Child-Parent Centers program. The study shows that special education placement is lower for pre-school children as far as grade 8 (with no data collected beyond 8th grade). Importantly, Conyers et al. (2002) find the effect is broadly consistent across disability types (not all disability types could be identified in the research because of small samples). Except for emotional/behavioral disorders (where there is no difference), pre-school attendance is associated with special education placement rates which are lower by: 60% for mental retardation; 32% for speech/language impairment; and 38% for specific learning disabilities.

From direct analysis of the ECLS Table 4 shows special education diagnosis as a function of pre-schooling and socioeconomic status. The effect of preschool is to reduce special education rates and this relationship is maintained into third and fifth grades. However, the sample is too small to yield statistical significance (as also is the case for results presented in Gilliam and Zigler, 2000).

2.5 Rated Behavior in School

Given the positive correlation between achievement and pro-social behaviors, pre-school should be associated with improved behaviors. These relationships can be examined using behavioral scores but Duncan et al. (2004) argue that scores of 'soft skills' have relatively low predictive power. Alternatively, we can compare actions, typically deviant ones such as drug use. We make this comparison in the next section, noting here that this research is not perfect: it tends to use 'soft' measures of education (such as 'attachment to school') rather than achievement or attainment.

The ECLS data do not permit analysis of actions because the sample is too young. Moreover, behavioral ratings by teachers show inconsistent findings (see also Finn and Pannozzo, 2004). As shown in Table 5 early ECLS results indicate that externalising behavior and self control are *worse* for pre-schoolers. However, the results for the third and fifth grade samples are more plausible: both externalising behavior and self control are improved for the pre-schoolers with effect sizes close to 0.1. Moreover, the effect is substantively significant: it is at least 60% as large as the effect size for socioeconomic status.

2.6 Crime and Delinquency in School

Crime, delinquent behavior, and violence are significant in school: over half of all crimes against children aged 12-18 occur in school or on the way to school (Gottfredson et al., 2005). In any given month, 4% of children felt it was too unsafe to go to school; for high school students, across a year and on school property, 7% were threatened or injured with a weapon, 15% were in a physical fight, and 33% reported damage to their possessions (Brener et al., 1999). Delinquency grows with age: beginning seriously at age 11 it grows progressively to age 18 at a rate of approximately 5% per year (Jang, 1999). And early teenage delinquency strongly predicts youth (late teenage) delinquency (Herrenkohl et al., 2000).

Thus far, information is only available from model pre-school programs and even then only on juvenile arrests in general without distinguishing if the offence took place in school. These model pre-school programs report strongly beneficial effects. Participants in the Chicago CPC program report an average of 0.45 juvenile arrests, compared to 0.78 for those not in the program (Reynolds et al., 2001). In the Perry Pre-School program, 15% reported at least one arrest by age 19, compared to 25% for those not in the program (Belfield et al., 2006). The Seattle Social Development program also found lower rates of crime by age 21 (Hawkins et al., 2005).

Generally, research shows a strong link between academic performance and crime and disorder in school. The link obtains across multiple dimensions of disorderly behavior, e.g. threats to teachers, school conduct, and bullying, and for both male and female students (Wagman Borowsky, 2004; Jones et al., 2001). Most research gives primacy to individual-level factors on school disorder but peers are also influential and there is a substantive effect of

institutional context or 'school climate' (Welsh et al., 1999; Haynie and Osgood, 2005; Welsh, 2000). In a meta-analysis of delinquency and drug prevention interventions, Wilson et al. (2001) find that environmentally-focused (i.e., school site) and cognitive-focused programs are the most effective. Often, the relationship is expressed in terms of attachment to school (Welsh, 2001), but two recent studies find a one standard deviation increase in GPA reduces delinquency by 0.23 standard deviations and serious adolescent violence by 0.14 standard deviations (Haynie and Osgood, 2005; Bellair and McNulty, 2005).[5]

Being old for grade is also predictive of increased rates of behavior problems. Based on a nationally representative sample of 9,079 children who participated in the Child Health Supplement of the 1998 National Health Interview Survey, Byrd et al. (1997) found that, among white (but not black) students, those who were retained within a grade were three times more likely to have extreme problem behaviors (classed as above the 90th percentile on the 32-item Behavioral Problem Index or BPI). This 90 percentile cutoff point has been associated in another study with an increase in mental health referrals (Gortmaker et al., 1990), and the BPI score is a widely used measure of significant behavioral problems (e.g., moody, cheats, anxious, cries too much, loses ones temper, etc.)

Our analysis of the ECLS dataset shows how pre-school ameliorates school disorder. For the kindergarten year, Table 5 shows how problems at school are related to the proportion of children who had attended pre-school. Student absenteeism is lower and order and discipline is better as the pre-school enrollment rate increases. Table 6 shows the correlation for achievement and school safety. When achievement is higher by one standard deviation the school reports less fighting, fewer weapons in school, fewer thefts, and fewer physical attacks. This effect holds at higher grades also: as shown in Table 7, schools report fewer problems with vandalism or attacks on children/teachers as achievement goes up. Thus, the effect of pre-school on achievement should indirectly reduce conduct disorder in school.

[5] Stewart (2003) finds a somewhat smaller impact of GPA on general school misbehavior, and Herrenkohl et al. (2000) a larger impact of GPA, but these analyses control for a range of other confounders (e.g. attachment to school).

2.7 Smoking and Substance Use

Smoking and substance use are prevalent among American children. According to the 2005 nationally representative Monitoring the Future survey of adolescents, approximately one-fifth of 8th graders, one-third of 10th graders, and one-half of twelfth graders report having used some illicit drug in their lifetime (Johnston et al., 2006). The most commonly used substance is alcohol, followed by cigarettes. As of 2005, 4% of 8th graders, 7% of 10th graders, and 14% of 12th graders report smoking cigarettes daily. While self-reported usage rates have been dropping for a number of drugs such as marijuana, cigarettes, methamphetamine, and steroids, the use of prescription drugs and inhalants has increased since 2000.

Model pre-school programs do show reduced rates of smoking and substance abuse, but the differences are not statistically significant because the sample sizes are small (Masse and Barnett, 2002; Schweinhart et al., 2005). The Seattle Social Development program shows lower rates of drugs involvement by age 21 (Hawkins et al., 2005).

More clearly, low academic achievement is associated with smoking and substance abuse. But the relationship is reciprocal. Students who place little value on doing well academically are more likely to engage in deviant behavior such as drug use and to spend time with peers engaged in similar behavior (Elliot et al., 1989). Likewise, taking drugs predicts subsequent decline in academic motivation and outcomes (Weng et al, 1988).

To parse out the independent effects of academic performance and substance use on each other, lagged variables are typically used. Andrews et al. (1997) use longitudinal data from a study of 763 families with adolescents living in the Northwest. Using lagged predictors, they find varying effects of academic motivation by substance type. Increased academic motivation, independent of deviant behaviors such as aggression or delinquency or family relationships or self-esteem, decreased the likelihood of smoking cigarettes. For marijuana use, though, low self-esteem and deviance mediated the relationship between low academic motivation and subsequent use of the drug (with no relationship between academic motivation and alcohol consumption). Piko et al. (2005) also find evidence of academic and peer effects on smoking rates. Among surveyed 626 Iowan teenagers in 2001, a one standard deviation increase in

school grades is associated with a 0.15 unit decrease in smoking. Tucker et al. (2003) used longitudinal data from 2,496 California and Oregon students and found that grade 8 experimental smokers with poor grades were 50% more likely to smoke regularly in grade 10 than eighth grade experimental smokers with good grades.[6]

The evidence for grade retention is also pertinent: delays in school progress are predictive of a host of behavioral and academic problems. While connected to poor academic performance, being retained within a grade is itself predictive of drug use. Based on outpatient clinic reports from 1,396 Washington D.C. adolescents and after controlling for their age and gender, students who were old for their grade were 40% more likely than age-appropriate students to use drugs (Guagliardo et al., 1998). These findings confirm those from the Youth Risk Behavior Survey of 1,396 rural New York adolescents, where being old for grade was strongly associated with being a smoker, drinking alcohol, using cocaine in the past month, ever using crack, or injecting other illicit drugs (Byrd et al., 1996).

2.8 Teen Parenthood

Approximately 4% of female adolescents aged 15-19 became pregnant in 2000 (Boonstra, 2002). Teen parenthood is of policy concern because it is associated with teen dropout rates, welfare dependency, and poor health outcomes for the children (Maynard, 1996).

In trying to identify behaviors that predict teen parenthood, Xie et al. (2001) used longitudinal data from grade 7 through early adulthood for 475 adolescents. They found that both individual and peer factors affected the likelihood of becoming a teen parent but there were important differences by gender. Female students who were rated as aggressive by their teacher were 25% more likely than non-aggressive female peers to become pregnant. However, their academic performance did not matter. Boys rated as academically competent by their teachers were 78% less likely to become teen fathers than their male peers.

Results from the model programs bear these relationships out. As reviewed by Barnett and Belfield (2006), teen parenting rates are reduced significantly from 45% to 26% (ABC program),

[6] A Canadian 6-year study of 1,293 novice smokers at 10 schools (7th grade students at baseline) examined the escalation of smoking intensity over time. Although two-thirds of novice smokers remained in the low-intensity non-progressing category over time, poor academic performance highly predicted the one-third of students whose cigarette use rapidly escalated.

37% to 26% (Perry Pre-school), and from 27% to 20% (Chicago Child-Parent Centers). However, these are very high baseline rates of teen parenting compared to the national average.

2.9 Health Status in School

It is possible that pre-schooling will affect health status and health-related behaviors (a general overview is given by Cutler and Lleras-Muney, 2006). It may improve health directly through the delivery of services or it may help in identifying conditions for children.

Studies have shown that pre-schooling affects general behavior and the prevalence of risk factors associated with problem conditions (McCarton et al., 1997). Such health gains associated with screening, immunization, and nutrition. In a review by the Center for Disease Control and Prevention, the effect size impact for social risks after pre-schooling was -0.41 (CDCP, 2002). Gains in health screening rates are 44% (Smokowski et al., 2002). Welfare levels for pre-schoolers were found to be 13% higher than for those who had not participated (Reynolds et al., 2004). Emotional and mental health has also been found to be positively affected (Hawkins et al., 2005).

The most commonly diagnosed childhood behavior disorder is Attention-Deficit / Hyperactivity Disorder (ADHD) (Deutscher and Fewell, 2005). The National Institutes of Health estimate that approximately 3-5% of school age children have ADHD, while the American Academy of Pediatrics estimate 4-12% of 6-12 year olds have the disorder.[7] Palfrey et al. conclude that 2-4 years of age is a critical time period in which to detect symptoms of ADHD. In a longitudinal study of low birth weight and premature children (who are at higher risk of ADHD), Deutscher and Fewell (2005) found that children scoring high on an inattentiveness factor (short attention span, doesn't follow directions, easily distracted, not staying on task) were more likely to have an ADHD diagnosis as of age 8. Given its association with problem behaviors, pre-school may help in the diagnoses of childhood behavioral disorders.

[7] ADHD is defined as a "persistent pattern of inattention or hyperactivity-impulsivity," and as such, student behavioral problems and academic difficulties often predict an ADHD diagnosis. Indeed, a majority of children diagnosed with the disorder exhibit aggressive or oppositional behavior (65%), and a significant percentage have a reading disability (24%), or are three times more likely than their peers to have a learning disability (Deutscher and Fewell, 2005).

3. ECONOMIC CONSEQUENCES

3.1 Effects on Educational Costs and Efficiency

There are several approaches to calculating the economic consequences of the academic and behavioral impacts of pre-school. One approach is to itemize the specific inputs that will be affected if achievement and behavior are improved. This is the approach used here. Each of the impacts is costed out separately using budgetary data and we report annual figures and present values spread over the K-12 schooling period using a discount rate of 3.5%. We assume annual per pupil spending of $8,044.

Ideally, we would like to cross-relate impacts to direct expenditures in a bottom-up approach. However, this is not straightforward because costs are not itemized. The breakdown of spending according to NCES data is given in Table 8.[8] An alternative breakdown, which is more pertinent to our analysis, is given in Table 9. This uses a classification developed by Rothstein (2005). Noticeably, both versions give similar totals. Broadly, academic support programs are $400-$800 per student; direct expenditure on health and psychological services are $80 per student; and direct expenditure on security and violence protection is approximately $40 per student. (These represent lower bounds of the costs to schools, because they do not include the opportunity cost of teachers' time). Also, Table 9 shows that pre-school has the potential to influence almost 90% of the budgets of schools.

Our review also considers education budgets. We investigate reports of spending that are documented in Children's Budgets, a number of which are now available at the state-level. These are useful for spending that is not allocated to schools but is education-related.

Federal spending is also significant. Total federal spending on elementary and secondary education is $68 billion (NCES, 2004, Table 358). Of this total, $38 billion is allocated through the Department of Education in areas such as education for the disadvantaged ($15bn), impact aid and school improvement ($10bn), and special education ($10bn). The Department of Agriculture spends $13 billion on child nutrition programs. The Department of Health and Human Services

[8] This figure is conservative because it only refers to current expenditures and does not include capital expenditures. The latter are assumed to be invariant to moderate (or even sizeable) changes in student achievement. Capital expenditures are annually over $1,000 per student.

spends $8 billion; this is mainly for Head Start, although $1 billion is allocated to Social Security student benefits. And the Department of Labor spends $6 billion, mainly on Jobs Corp and training programs. Title I appropriations amount to $14 billion, a large proportion of which is devoted to academic support programs (e.g. state grants for Reading First).

An alternative approach is to use literature on education cost functions and efficiency to calculate the additional cost per low-achieving student. However, a review of this literature suggests this approach is less than ideal.[9] There is considerable methodological disagreement on how to model costs. The effects of poverty, socioeconomic status, and achievement are confounding: cost studies typically find high poverty students require more resources, but high achieving students also do so, even as poverty and achievement are negatively correlated; and for efficiency studies, poverty and socioeconomic status are confounded. (This may reflect the fact that the cost-function is U-shaped in student ability, with disadvantaged students and gifted/talented students being high cost). Terms such as efficiency, costs, and expenditures are not defined precisely and often modeled simultaneously (e.g., with efficiency measures being used as a control in a costs equation). Input quantities and prices are selectively included in costs functions (teacher salaries are typically included, but not facilities costs). For our purposes, both efficiency and costs results would be needed separately. Finally, it is not clear whether actual expenditures are optimal and so whether they reflect the true cost of different student demographics.

Notwithstanding, a recent study gives some indication of the additional costs of educating disadvantaged students (Duncombe and Yinger, 2005). Education funding formulas allocate approximately 25% more funds to disadvantaged (non-special education) students, or approximately $2,000. These figures give some idea of the magnitude of the additional spending resulting from a failure to ensure that all children are proficient learners. However, based on costing equations, this allocation should be more like 110%-215%. This ratio gives more indication of the economic burden of less proficient learners.

[9] This review is based on research by Duncombe and Yinger (1998, 2000, 2005); Imazeki and Reschovsky (2006); Banker et al. (2004); Baker (2001); Jacques and Brorsen (2002); and Noulas and Ketkar (1998). This approach would be preferable because we could then calculate the marginal costs of change rather than assume that the average cost equals the marginal cost.

3.2 Special Education and Grade Retention

Previous studies have estimated the economic consequences per child from reduced rates of special education. These range from approximately $2,100 to $8,200 (Currie, 2001; Belfield et al., 2006). However, these are for populations where the rate of special education ranges from 12% to 33%, which is considerably above the national rate of 15%. So these are likely to be overstatements. In another respect they are conservative in that they do not consider any benefit arising even as a child remains entitled to special educational services. As examples, pre-schooling may help with learning such that the special educational services that child receives will be more efficiently delivered; or pre-schooling may raise the amount of time that a child spends in regular classes. Thus, the provision of special education – for a given disability – would be more efficient. Conventionally, all that is being counted is placement out of special education.[10]

Costs for special educational services vary significantly across disabilities, so a simple formula from the comprehensive, nation-wide study by CSEF (2004) is applied: average expenditure per special education student is estimated at 1.91 times more than for children in regular classes. Using the impacts from Barnett and Ackerman (2006) and Conyers et al. (2002), along with national figures on per-pupil spending (NCES, 2003), it is possible to calculate the full cost-saving over the K-12 period. In present value terms, the cost-saving per pre-schooler would be $1,300. (This figure is per pre-schooler, not per pre-schooler in special education).

Reduced grade retention is also typically cited as a cost-saving to school districts. However, economic analysis shows that this effect is not fiscally important: few students are retained in grade and the additional present value cost of one year of schooling is not high (when offset against the benefits). However, most grade retention is in the early grades, so it becomes more important in present value terms. Assuming a reduction in retention by 8% (Barnett and Ackerman, 2006) with a baseline of 15% grade retention, the present value cost savings per pre-schooler are approximately $50.

[10] Funding for special education expenditures comes from federal, state, and local levels. Although special education is a large proportion of total education spending by the federal government, the federal contribution is typically less than 15% of the total expenditure; by far the bulk of funding for special education comes from state and local government sources (CSEF, 2004, Exhibits I-2, I-3).

3.3 Effects on Instructional Productivity

Student behavior impacts on instructional productivity in a number of ways. We focus on teacher satisfaction, job tenure, and pay. Simply put, if students are more proficient, teachers will be more productive. These effects cannot be detected using data from trials, but only from large sample surveys.

Regression analysis from the ECLS reported in Table 10 row 1 shows that where more children in a class have had pre-school the teacher is less likely to problems with student behavior. Principals recognize how this relationship in turn affects teacher absenteeism and teacher turnover: where more of the class is pre-schooled, teacher absenteeism and turnover are lower. These relationships are shown in Table 10, rows 2 and 3. Teachers themselves recognize how student behavior influences whether they "really enjoy their present teaching job" and whether they "would choose teaching as a career again". In both cases, as reported in Table 11, poor student behavior reduces attachment to the job.[11] Data from the SASS 2000 affirms these relationships. As shown in Table 12 column 1, where a school has serious problems with student attendance, conflict, or disorder, teachers report much lower job satisfaction. Teachers in more dangerous schools are half as likely to report they are satisfied with their jobs. The consequences are evident for quit rates too: these are higher for teachers and professional and administrative staff in more dangerous schools (Stinebrickner, 1998). See Table 12, columns 2 and 3. Teachers in these schools quit at rates that are 1.3 to 1.6 times higher than in safe schools.

Importantly, student behavior strongly impacts on pay: where student behavior is worse or directly dangerous, education staff demand more pay in compensation. (Districts do not necessarily pay more, but instead recruit less qualified or experienced teachers with adverse consequences for student achievement). Table 13 shows this relationship – higher wages in more dangerous schools – using the 2000 Schools and Staffing Survey. The effect is especially strong for teachers, with some (weak) evidence for principals (and with professional and

[11] Diagnosed conditions, such as ADHD, are well-known to raise teachers' stress levels on all measured subscales, e.g. student needing support, withdrawal, student conduct disorder, loss of satisfaction from teaching (Greene et al., 2002).

administrative staff unaffected). On average, teacher wages must be 3 percent higher in dangerous schools (controlling for other individual characteristics, including experience, and the poverty status of the school).

An alternative way to measure the wage bill costs of poor student performance is to consider teacher job satisfaction. In studies of teacher labor markets, considerable weight is placed on job conditions relative to salaries (Lankford et al., 2002). Calculating the value to a teacher of such an improvement in job satisfaction is not straightforward (Walden and Sogutlu, 2001). Empirical estimates of the link between pay and satisfaction are very difficult to substantiate even with very simple correlations because workers take their pay into account when reporting job satisfaction. However, it is possible to cross-relate this gain in satisfaction to other determinants of satisfaction; this will yield a proximate effect. Using the link between union membership and job satisfaction (negative) and the link between union membership and pay (positive), a very low estimate of raising job satisfaction by the amounts reported in the Tables would be a 2% increase in salary (Heywood et al., 2002).

Given average teacher salaries and benefits, we can calculate the cost of low job satisfaction (AFT, 2005). Assuming this low job satisfaction continues over the K-12 period, and applying a discount rate of 3.5%, we then calculate the total present cost-savings from improved conditions as a result of more proficient students. The total K-12 cost-savings are approximately $1,200 in compensating wage differentials per pre-schooler.

Teacher quits also impose costs on districts, as the conventional costing assumption is that the cost of turnover is equivalent to 33% of the salary of the new hire (SBEC, 2000). Many quits are a function of low job satisfaction: Iverson and Currivan (2003) find that when teacher job satisfaction rises by one standard deviation, quits fall dramatically, by 32%. The estimates above show quit rates that are approximately 1.4 times higher in poor-performing schools. Annually, around 9% of the teaching staff changes (NCES, 2003), so the quit rate could be lowered by approximately 3 percentage points. Conservatively, this would save $45 per student. In present value terms over the K-12 period, the cost-saving from lower quit rates would be $400.

Finally, teacher absenteeism is lower when learning productivity is higher. As shown in the Tables above, this relationship is very strong and substantively greater than the effect on quits. The cost of quits is measured in terms of the numbers of substitute teachers that a school district must hire: on average, school systems employ 1 substitute teacher for every 15 regular teachers.[12] Including the cost of hiring and paying a new substitute teacher, we estimate a cost-saving of $200 per pre-schooler.

3.4 Deployment of Staff

As well as its influence on the wages paid to each teacher, students' attributes may influence the deployment of staff. Where behavioral problems are greater, schools may need more school psychologists and they may have to forgo teachers in regular classrooms. To test this hypothesis we use the SASS data to compare the deployments of staff in schools above and below median achievement. The overall effect on deployment does not appear to be dramatic. Table 14 shows the distribution of teachers across job types for 1,165 elementary schools, split into those above and below the median in reading scores. There are few differences in deployment: higher achieving schools have slightly more teachers in regular classrooms, and slightly fewer ESL/bilingual and special education teachers. But the differences are not statistically discernible using these data. In part this is because we cannot control for higher spending, which is positively correlated with ability, but also because some of the deployment differences are likely to be manifest at the district level, for which we do not have data.

Alternative evidence suggests that staff deployment will be affected. For example, there are approximately 30,000 school psychologists in public schools across the U.S. (Curtis et al., 2002). Many spend large amounts of their time on special education related activities, including a substantial amount of time devoted to assessments.[13] Similarly, students in poor health are

[12] Teacher professional development requirements are likely to be influenced by student behavior. Specifically, courses must be provided on responding to student actions and the need for these would be reduced if student behavior were improved. Given the average professional development requirement of 4-5 days per year, there is a potential impact on 2% of the overall teaching budget. However, because there is no clear data on the link between student behavior and professional development needs, or the costs of such programs, this impact is omitted from this economic analysis.

[13] More specifically, psychologists report that 41% of their time is devoted to special education assessments, 26% to report writing, 25% to meetings, and 8% to related activities. On average, a school psychologist reported conducting 9.3 special education initial evaluations per year. However, 10% of surveyed psychologists reported completing 75 or more initial evaluations per year (US DOE, 2001).

amongst the most frequent users of school nursing or health care services.[14] Students with chronic health conditions requiring medication tend to obtain an Individualized Health Care Plan (IHCP), and meet with nurses multiple times more than non-IHCP students. For example, in Boston Public School system during the 2000-2001 school year, non-IHCP students had an average of 7 encounters with a school nurse whereas IHCP students had an average of 118 encounters. Much of this care is for administering medication, with administration of psychotropic agents accounted for 71% of all 227,105 medications (Schainker et al., 2005).[15] A similar study in Texas public schools found that over half of all 107,000 students with special health care needs were being given medication (Koenning et al., 1995).

3.5 Behavioral Effects

Substance Abuse

The costs of substance abuse are significant (CASA, 2001). The educational costs associated with such abuse are: student-related (programs for at-risk children, for student assistance, and for those with substance-related learning difficulties); staff-related (administrative costs for monitoring and enforcing substance abuse policies, training and staff development); and school-wide (drug-testing programs and special facilities for substance-abusing students, legal expenses, and property damage). CASA (2001) estimates – very approximately – that 10% of all educational expenditures are related to alcohol and substance abuse. However, there is little explanation for this figure and it seems very high given the figures in Tables 8 and 9.

Instead we calculate an estimate based on the lost instructional time from educating children about drugs. Annually, children spend 20 school hours per year on drug, alcohol, and tobacco use (even in kindergarten, 12 hours are required, NCES, 1997). Programs include counseling, in-school suspension, monitoring programs to identify high risk students, support groups, and community service providers. Conservatively, this is 1% of instructional time which is

[14] Using data from the 1981 National Health Survey and Child Health Supplement, Gortmaker et al. (1990) found that after controlling for competing explanations, 25% of children with an extreme behavior disorder (top 10th percentile of the BPI) visited a mental health professional versus 4% of children not ranking in the top decile.

[15] This likely undercounts the incidence of medical administrations since more than three-fourths of 649 nationally surveyed nurses reported that, in their absence, they delegated medication administration to "unliscenced assistive personnel" (Udesky, 2005).

approximately $6,000 per child (using items from Table 8). Based on the literature reviewed above, this lost time might be reduced by as much as one-fifth. If so, the present value K-12 savings would be $120.

In addition, there is substantial federal funding for substance abuse from the Safe and Drug-Free Schools and Communities program. In Fiscal Year 2002, the appropriation was for $654 million, with $472 million allocated in state grants and $182 million held for national programs. If drug usage can be ameliorated, additional savings may also be possible. However, there is no straightforward evidence on education and drug usage to calculate this impact.

Conduct disorder

Conduct disorder also imposes significant costs on schools. Approximately three-quarters of students participate in violence prevention programs in school. Across the public school system, 44% of schools required all staff to be 'substantially involved' in school violence efforts or programs. Almost 60% of schools run violence prevention programs and most of these schools run more than one such program. There are 2.3 disciplinary actions (transfer, expulsion, or suspension) per 1,000 children each year (NCES, 2002).

Conduct disorder also influences how schools spend on facilities. Tabulations from the SASS show that: 2% of schools required daily metal detector checks; 8% required random metal detector checks; 21% performed drug sweeps; 23% had a daily presence of police or security; 15% used video surveillance. Expenses on operation and maintenance are $760 per child annually (Table 8) and direct expenses on security and violence prevention approximately $40 (Table 9). These are conservative estimates of the cost of conduct disorder, because over time student violence affects the amortization of facilities.

Adding together the lost instructional time and the savings to expenditures on violence prevention and security, a conservative cost-saving per pre-schooler is $290 over the K-12 period.

Health Services in Schools

Health research illustrates the economic consequences of students who are not proficient learners. Foster and Jones (2005) use detailed family information to estimate the costs per child

with varying degrees of conduct disorder. Costs are divided into those for health services, education (special education and grade retention), and juvenile justice. In sixth grade, annual spending on a child diagnosed with conduct disorder totaled $5,600, of which $2,600 was spending for health services and $3,000 by schools. In comparison, spending for an at-risk child (but without a diagnosed conduct disorder) was $1,500, of which $500 was for health and $1,000 for schools. Thus, the annual difference is approximately $2,000. By 12th grade, these total amounts have risen to $19,000 and $3,000 respectively (including significant extra expenditures on juvenile justice). The annual difference for the school system from an increment in conduct disorder is $2,400. This amount is only for at-risk groups and not all children, but it is an understatement because it does not include any instructional costs (and some of the health service costs should also be counted).[16]

Total annual school spending per student on services for health, attendance, speech pathology at $415 (Table 8); using a more narrow definition of regular health and psychological services the spending is $84 (Table 9). Conservatively, we use the latter estimate and apply the 13% improvement in child well-being identified above as an estimate of the savings from improved health status. Over the K-12 period, the present value cost-savings would therefore be $110 per child.

3.6 Total Cost-savings to the Education System

We summarize the total present value cost-savings over the K-12 period in Table 15. The total cost-saving to the school system from a high quality pre-school program would be approximately $3,700 per child. In order of importance, the savings begin with special education. Pre-school has a strong and persistent impact in reducing special education placement, and each year of special education is almost twice as costly as mainstream schooling. The next most important cost-saving is the teacher wage bill: again, the impact of having more proficient students is strong and payments to teachers are by far the largest single expense of a school district.

These numbers are indicators of the potential cost-savings and will vary according to the characteristics of the school district. Clearly, school districts with high rates of special education

[16] Similarly, Newacheck and Kim (2005) estimate that children with special health care needs had annual health care expenditures of $2,100 compared to the average of $600.

and working conditions that are poor will save the most. Other factors which may be important to the size of the savings are: whether children attend public school kindergarten; whether the pre-school programs can be targeted to those most in need; and how long the effects of pre-school last. However, the numbers are conservative both in line items that are omitted and in not fully capturing the opportunity cost of lost instruction time.[17]

3.7 Related Cost-savings Outside the School System

Government agencies provide a range of programs to support children and some states have collated a Children's Budget, i.e. the total spending on investments in children. Based on analysis of six of these for various states and localities, we report data from three that have consistent line items (San Diego, Colorado, and Ohio).[18]

As shown in Table 16, there are significant annual expenditures on health services, drug prevention, and juvenile justice.[19] Taking the average across the three Children's Budgets, these expenditures amount to $762 per child annually. Assuming the conservative impacts reported by Reynolds et al. (2002), these costs would be 13% lower for pre-schoolers. Over the K-12 period, therefore, the present value cost-savings would be $1,020 per pre-schooler.

As noted above, federal spending on educational programs in elementary and secondary school is significant. Budget expenditures which are likely to be affected (and are not considered above) are education for the disadvantaged, impact aid and school improvement, child nutrition programs, the Safe and Drug Free Schools program, Social Security student benefits, and Jobs Corp and training programs. In the aggregate, these federal expenditures amount to $45 billion annually. Even tiny changes from pre-school could therefore have significant impacts on federal spending. But, to be conservative we do not include these items in our final calculations.

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[17] For example, we noted above the strong impact of pre-school on teenage pregnancy rates. However, there is no adequate data on the expenditures of schools in relation to teenage pregnancy. Also, we note the significant expenditures on discrete programs to raise academic achievement (e.g. Reading First). Given the strong impact of pre-school on achievement, pressure on these programs would be alleviated.

[18] Unfortunately, the Children's Budgets cannot easily be read to find the amount invested per child over a single period of time. Also, they mix predicted expenditures with actual spending.

[19] This total is likely to be conservative, because we have omitted some possible costs. We have excluded spending on pregnancy and pre-natal spending from the calculations of the costs of teenage pregnancy. We have also not counted the in-kind transfers (from parents, community groups, and non-profit agencies). Expenditures from the State Children's Health Insurance Program also could not be apportioned.

4. CONCLUSIONS

There is consistent and sizeable evidence of multiple effects of pre-school on student academic performance and behavior. The effects are often substantively, as well as statistically, significant and apply at both the individual and school-level. Although the effects are more dramatic for the model programs, they focus on at-risk groups. The effects for public programs are still sizeable and they are persistent over the early grades with little evidence of attenuation. Enhanced achievement can act as a conduit for the impacts of pre-school in other domains. Although these secondary impacts are not easily measured, because many of the behavioral measures are 'soft', the results accord with research on later youth behaviors. This evidence has contributed toward policy for universal or large-scale pre-school programs.

The economic consequences of the impacts of large-scale pre-school programs for schools are less well-known. The consequences for special educational placement are typically cited (along with grade retention, although this is far less economically important). However, as important is the impact on teachers' productivity, which can be proxied for by job satisfaction, absenteeism, and quits. For example, we estimate that universal pre-school would be 'worth' at least 2% of salary for each teacher annually. Economic consequences from lost instructional time, security and violence prevention, and health services should also be taken into account. And because the benefits of pre-school are durable, the economic consequences last over multiple years.

Overall, the school system cost-savings from pre-school are $3,700.[20] This amount is expressed as a present value and can be directly compared to the investment costs of pre-schooling. Moreover, the figure appears to be robust: we have used multiple methods to obtain this result from a range of datasets. Given that education is primarily a state and local financial responsibility, a clear majority of this saving (perhaps as much as 90%) would be recouped within a state. In addition, there are cost-savings of $1,020 to other government agencies charged with supporting child development. (A larger proportion of these cost-savings accrue to the federal government). These cost-savings raise the short-term benefits of pre-school.

[20] We have framed these impacts as cost-savings, but they may instead allow school systems to redistribute resources or to further improve attainment and achievement.

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Table 1
Impact of Center-based Pre-school on Academic Performance

	Reading Score (standardized)		Math Score (standardized)		Retained in grade	
Effect of pre-school attendance in:						
(1) Kindergarten	0.17	(0.02)**	0.18	(0.02)**	n.a.	
(2) 1st grade	0.02	(0.02)	0.03	(0.02)	-0.49	(0.55)
(3) 3rd grade	0.07	(0.02)**	0.08	(0.02)**	-0.23	(0.10)*
(4) 5th grade	0.09	(0.02)**	0.10	(0.02)**	-0.20	(0.10)*

Source: ECLS, school-level data from child-level questionnaire.
Notes for achievement equations: Estimation (1) Random effects Maximum Likelihood Estimation (N=11,739). Robust standard errors in parentheses. Estimation also includes: constant term; care by parents, relatives, non-relatives, Head Start, and other care; school-level socio-economic status (squared); region (4); city/urban (2); child gender, disability, age (squared), siblings, english-language proficiency, ethnicity (4); father/mother works (2); welfare receipt (3); mother's age; and mother's education (4). Public school children only. Estimation (2) from Magnuson et al. (2006). Estimations (3) and (4) by authors follows estimation (1) (N(3)=9,388; N(4)=9,341). **, * significant at 1%, 5%.
Notes for grade retention equations: Standard errors in parentheses. Estimate for first grade is from Magnuson et al. (2007). Logit estimations. Each equation includes: constant term, mother's education, urbanicity, parents work, mother's age, AFDC/TANF receipt, age (squared), siblings, ethnicity, gender. School fixed effects (except for private school equation). No weights are applied (weighted estimation does not change the coefficients except for private school, where pre-school enrollment is negatively associated with pre-school). * significant at 5%; ** significant at 1%.

Table 2
Impact of School-level Center-based Pre-school on Test Scores in Kindergarten

	Reading score in kindergarten (standardized)		Math score in kindergarten (standardized)	
Peer measure: Percent in school with center-based pre-school	0.30	(0.10)**	0.33	(0.08)**
Individual center-based pre-school attendance	0.16	(0.02)**	0.16	(0.02)**
Student observations	*11,739*		*12,548*	

Source: ECLS, school-level data from child-level questionnaire (base year, 1998).
Notes: Random effects Maximum Likelihood Estimation; group variable is school (*n*=711). Robust standard errors in parentheses. Estimation also includes: constant term; care by parents, relatives, non-relatives, Head Start, and other care; school-level socio-economic status (squared); region (4); city/urban (2); child gender, disability, age (squared), siblings, english-language proficiency, ethnicity (4); father/mother works (2); welfare receipt (3); mother's age; and mother's education (4). Public school children only. **, * significant at 1%, 5%.

Table 3
Impact of Center-based Pre-school on Special Education Placement

	Special education (diagnosed disability)
3rd grade:	
Attended pre-school	-0.07 (0.06)
Socioeconomic status (std.)	-0.55 (0.26)*
N children	*9,450*
N schools	*1,731*
5th grade:	
Attended pre-school	-0.07 (0.06)
Socioeconomic status (std.)	-0.25 (0.05)**
N children	*9,354*
N schools	*1,751*

Source: ECLS, school-level data from child-level questionnaire.
Notes: Standard errors in parentheses. Logit estimation. Each equation includes: constant term, mother's education, urbanicity, parents work, mother's age, AFDC/TANF receipt, age (squared), siblings, ethnicity, gender. School fixed effects. No weights are applied (weighted estimation does not change the coefficients). * significant at 5%; ** significant at 1%.

Table 4
Impact of Center-based Pre-school on Behavior

	Externalizing behavior	Self control
Effect of pre-school attendance on behavior in:		
(1) Kindergarten	0.11 (0.03)**	-0.07 (0.03)*
(2) 1st grade	0.14 (0.03)**	-0.11 (0.03)**
(3) 3rd grade	-0.06 (0.02)**	0.04 (0.02)
(4) 5th grade	-0.08 (0.02)**	0.09 (0.02)**

Source: ECLS, school-level data from child-level questionnaire.
Notes: Public school children only. Estimations (1) and (2) from Magnuson et al. (2006). Estimations (3) and (4) Random effects Maximum Likelihood Estimation (N(3)=7,985; N(4)=8,840). Robust standard errors in parentheses. Estimation also includes: constant term; care by parents, relatives, non-relatives, Head Start, and other care; school-level socio-economic status (squared); region (4); city/urban (2); child gender, disability, age (squared), siblings, english-language proficiency, ethnicity (4); father/mother works (2); welfare receipt (3); mother's age; and mother's education (4). Externalizing problem behaviors is a composite of five items teachers rated about individual students. The items were on a scale of 1 (never) to 4 (very often). The items are: child argues; child fights; child gets angry; child acts impulsively; child disturbs ongoing activities. Self-control is a composite of four items teachers rated about individual students. The items were on a scale of 1 (never) to 4 (very often). The items are: respecting the property rights of others; controlling temper; accepting peer ideas for group activities; responding appropriately to pressure from peers. **, * significant at 1%, 5%.

Table 5
Impact of Center-based Pre-school on School Behavior

	Center-based pre-school: Percent of school	
Principal notes problem at this school:		
Student absenteesim	-1.19	(0.43)**
Order and discipline	-1.01	(0.41)**
N	*536*	

Source: ECLS, data from school administrator questionnaire (base year, 1998).
Notes: Probit Estimation. Robust standard errors in parentheses. School-level weights. Public schools only. Equation includes: constant; region (3); urbanicity; percent free-lunch; enrollment Hispanic>5%, African American>5%; school size (4). **, * significant at 1%, 5%.

Table 6
Impact of Academic Achievement on School Safety

	1 sd increase in reading at grade level	
Fighting Observed	-0.09	(0.11)
School Judged Not 'Very Safe'	0.14	(0.09)
Weapons Brought Into School	-0.20	(0.10)*
Thefts Reported In School	-0.27	(0.11)*
Physical Attacks	-0.31	(0.09)**
Number of schools	*410*	

Source: ECLS, school-level data from school administrator questionnaire (base year, 1998).
Notes: Probit Estimation. Robust standard errors in parentheses. School-level weights. Public schools only. Equation includes: constant; region (3); urbanicity; percent free-lunch; enrollment Hispanic>5%, African American>5%; school size (4). **, * significant at 1%, 5%.

Table 7
Impact of Academic Achievement on School Danger

	Odds Ratio School Reports Problems with Vandalism and with Attacks on Children or Teachers	
	Reading	Math
School-level standardized test score	0.67***	0.86**
Observations	*998*	*1266*

Source: ECLS-5th grade (2006).
Notes: Logit estimation. Public school sample only. Coefficients control for school size (4), Limited English proficiency (4), and proportion of children free-lunch eligible. ***, p<0.01.

Table 8
Expenditures per pupil for public elementary and secondary education

	Amount	Percent of total
Instruction	$4,934	53%
Student services (health, attendance, speech pathology)	$415	5%
Instructional services (curriculum development, staff training, libraries, media, computer centers)	$385	4%
General administration	$165	2%
School administration	$452	5%
Operation and maintenance	$764	8%
Student transportation	$325	4%
Other support services	$275	3%
Food services	$310	3%
Enterprise operations	$19	>1%
Total student services	*$8,044*	
Capital outlay	$1,016	11%
Interest on school debt	$239	3%
Total expenditures	**$9,299**	

Source: NCES (2002)

Table 9
Per pupil spending on items affected by pre-k

	Amount	Percent of all school spending
Regular education	$5,468	59%
Special education	$1,581	17%
Compensatory education	$400	4%
Attendance, counseling, dropout prevention, alternative education	$381	4%
Vocational education	$279	3%
Regular health and psychological services	$84	1%
Security and violence prevention	$37	<1%
All pre-k affected programs	**$8,230**	**89%**

Notes: 2002-03 data. Classification follows Rothstein (2005).

Table 10
Impact of Center-based Pre-school on Teaching Productivity

	Center-based pre-school: % of school	
Teacher thinks student behavior does not interfere with teaching	0.87	(0.24)**
N	*2079*	
Principal notes problem at this school:		
Teacher absenteesim	-1.66	(0.43)**
Teacher turnover	-0.64	(0.53)
N	*536*	

Source: ECLS, data from school administrator questionnaire (base year, 1998).
Notes for school-level estimation: Probit Estimation. Robust standard errors in parentheses. School-level weights. Public schools only. Equation includes: constant; region (3); urbanicity; percent free-lunch; enrollment Hispanic>5%, African American>5%; school size (4). **, * significant at 1%, 5%.

Table 11
Impact of Student Behavior on Teacher Satisfaction

	Teacher Really enjoys Present Teaching Job	Teacher Would Choose Teaching Career Again
Student behavior does not interfere with my teaching	0.69 (0.08)**	0.51 (0.08)**
N	*2,079*	

Source: ECLS, data from teacher questionnaire (base year, 1998).
Notes: Population-Averaged Probit Estimation; group variable is school (*n*=637). Robust standard errors in parentheses. Teacher-level weights. Public school teachers only. Equation includes: constant term; region (3); urbanicity (2); teacher education, gender, and tenure. **, * significant at 1%, 5%.

Table 12
Effects on the Quit Rate and Job Satisfaction

	Job Satisfaction Odds Ratio	**Quit Rate Odds Ratio**	
	Teachers	**Teachers**	**Professional / Administrative Staff**
School has serious problem with:			
Student tardiness	0.45***	1.26***	0.64
Student absenteeism	0.50***	1.26***	1.50
Physical conflict among students	0.32***	1.37***	1.96*
Robbery or theft	0.38***	1.37***	0.69
Vandalism of school property	0.36***	1.41***	0.59
Student drug abuse	0.55***	1.31***	2.76***
Student possession of weapons	0.41***	1.62***	1.61
Observations	*41,242*	*41,242*	*622*

Source: SASS (2000).
Notes: Quit rate is based on response 'No/undecided' to the question 'Do you plan to remain in teaching?' Job satisfaction is based on 1-5 scale response to the statement 'I am satisfied with my job as a teacher'. Logit estimation, columns 1 and 2. Ordered logit estimation, column 3. Coefficients control for gender, certification, education, experience, experience squared, ethnicity (2), and poverty status of the school (3). ***, p<0.01; **, p<0.05. n.d. not determined.

Table 13
Percent Increase in Wages from School Characteristics

	Percent Increase in Wages from School Characteristics		
	Teachers	**Principals**	**Professional / Administrative Staff**
School has serious problem with:			
Student tardiness	5.1***	9.8	-1.9
Student absenteeism	3.4***	11.7	-7.4
Physical conflict among students	2.8***	29.1	-20.1
Robbery or theft	2.3**	12.2	-1.7
Vandalism of school property	3.7***	21.0	-24.9
Student drug abuse	1.2**	11.7	4.0
Student possession of weapons	3.7**	n.d.	29.2
Observations	*41,242*	*216*	*622*

Source: SASS (2000).
Notes: OLS estimation. Coefficients control for gender, certification, education, experience, experience squared, ethnicity (2), and poverty status of the school (3). ***, p<0.01; **, p<0.05. n.d. not determined.

Table 14
Differences in Staff Deployment across Schools by Test Scores

	Number of Staff per 100 Students			
	School with Reading Test Scores < Median		**School with Reading Test Scores > Median**	
Number of teachers:				
Regular classroom	4.69	(1.50)	4.97	(1.74)
Gym, drama, music or art	0.49	(0.42)	0.69	(0.56)
Special education	0.80	(0.58)	0.66	(0.56)
ESL/bilingual	0.29	(0.46)	0.15	(0.37)
Reading specialists	0.28	(0.30)	0.26	(0.38)
Gifted/talented	0.13	(0.20)	0.14	(0.23)
Nurses or health professionals	0.15	(0.12)	0.16	(0.16)
Psychologists or health workers	0.17	(0.16)	0.15	(0.15)
paraprofessionals	1.35	(1.11)	1.39	(1.19)
Librarians and library media specialists	0.19	(0.14)	0.22	(0.18)
Observations	*580*		*585*	

Source: ECLS 5th grade (2006).

Table 15
Present Value K-12 Cost savings from expanded pre-school provision per child

	Present value cost-saving per pre-schooler across K-12 education	
Special education	$1,300	35%
Teacher compensating wage differentials	$1,200	33%
Teacher turnover	$400	11%
Violence prevention	$290	8%
Teacher absenteeism	$200	5%
Substance abuse prevention	$120	3%
Health services	$110	3%
Grade retention	$50	1%
Total cost-saving	**$3,670**	

Source: Belfield (2005) and authors' calculations. *Notes:* Discount rate of 3.5% applied. Costs for large-scale pre-school programs. Costs do not include adjustment for lost instruction time (e.g. on drugs education programs) or academic support programs.

Table 16
Annual federal and state spending on non-school programs per child

	San Diego	Colorado	Ohio	Average
Health care programs	$37	$144	$605	$262
Substance abuse prevention/treatment	$9	$0	$2	$4
Child protection	$260	$299	$466	$342
At risk youth / juvenile justice	$129	$109	$225	$154
Total	**$435**	**$553**	**$1,298**	**$762**

Source: Children's Budgets for locality. Budgets do not include lost instructional time or Safe and Drug Free Schools program costs.