Who Benefits from Kindergarten?
Evidence from the Introduction of State Subsidization

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October 2007

Preliminary and Incomplete – Please do not cite

Abstract

Over the last seventy years, all states in the U.S. began to publicly subsidize kindergarten using state revenue. The variation in adoption dates across states allows for a unique opportunity to measure the effectiveness of the largest early education program implemented in recent history. The significant, immediate increase in the availability of kindergarten within a state is used to identify the effect of enrollment in kindergarten. The estimated effects from the instrumental variables specification indicate that kindergarten decreases later grade failure by 64 percent. In addition, the present study examines what types of children benefit from the increased availability of kindergarten using a reduced form model. Black children and children of low socioeconomic status benefit the most from the increased availability of kindergarten. Black children with access to kindergarten are 27 percent less likely to fail a grade in school and earn wages 4 percent higher as adults. Children of the poorest quartile of parents are 35 percent less likely to fail a grade. Overall, kindergarten has a significant and positive effect on academic and labor market outcomes primarily for black individuals and those who grow up in a lower socioeconomic status.

I would like to thank Kelly Bedard, Olivier Deschenes, Peter Kuhn, Jon Sonstelie, and Cathy Weinberger for their helpful comments.

1. Introduction

Over the last 70 years, a massive adoption of kindergarten in the public primary school system occurred in all 50 states in the U.S. This resulted in a dramatic increase in the availability of early childhood education. Recently, there has been a renewed push to increase the prevalence of early childhood education programs by such means as publicly provided full-day kindergarten or universal preschool. This paper hopes to shed light on the likely effects of these recent initiatives by examining the effect of the large-scale implementation of kindergarten programs in the middle of the last century. In particular, this study assesses how attending kindergarten benefits students and, more specifically, what types of children benefit from attendance. Do boys benefit more than the girls? Black children more than white children? Poor more than rich? In addition to determining who benefits from attending publicly supported kindergarten, this paper also estimates the magnitude of the effect.

Frederick Froebel formed the first kindergarten in Germany in 1837. The curriculum emphasized socialization and readied children for primary education. The kindergarten movement later expanded to the United States, taking root in Wisconsin nineteen years later. Over the next several decades, many towns and cities started offering kindergarten. Initially, all kindergarten funding came from either private or local sources such as local philanthropic organizations, private tuition payments, or local tax dollars. However, between 1935 and 1986, all U.S. states transitioned to subsidizing kindergarten using state revenue. This enabled states to provide kindergarten as a part of their public primary school educational system. In most states, this subsidization enabled a public school to count kindergarten students as a part of their enrollment for the purposes of calculating state aid. In other cases, the district or school was given additional state money in the form of a grant or appropriation for providing kindergarten. This decreased the districts' costs of providing kindergarten, thus increasing its availability. Ohio was the first state to subsidize kindergarten in 1935. The rest of the country followed and began subsidizing kindergarten during the next fifty years. Mississippi was the last state to join the movement when it began subsidizing kindergarten with state revenue in 1986.

Very few researchers have examined the educational or labor market effects of kindergarten attendance. Cascio (2004) uses a similar methodology to this paper to look at the

average effect of kindergarten enrollment in Southern and Western states. She finds that, on average, state funding of kindergarten decreases the probability that a child repeats a grade by 2 percentage points but that it had no effect on the rate of high school dropouts. Using the Current Population Survey, she finds some evidence that minority children benefit more than non-minority children. Spiess, Büchel and Wagner (2003) examine the effects of attending kindergarten in Germany. They find no significant relationship between kindergarten attendance and later school track placements for children of native German households. However, they find that children of immigrant households do benefit in terms of track placements from attending kindergarten.

Additionally, the evidence is mixed regarding the benefits of full-day kindergarten as opposed to half-day kindergarten. Clark and Kirk (2000) survey the literature and find diverse results. Much of the recent research finds a small positive effect on academic achievement and behavior (see DeCicca (2006), Fusaro (1997), and Walston & West (2004)). However, there are also many researchers who find no difference in later academic achievement between full-day and half-day kindergarten attendance (Karweit (1992)). Cannon, Jacknowitz and Painter (2004) find that full-day kindergarten increases behavior problems for boys but that it also increases math scores for girls. Unfortunately, many of these studies on kindergarten efficacy rely on small sample sizes that are neither representative nor adequate as to the size of their control groups.

The literature regarding preschool and earlier childhood education and intervention programs is much larger than that for kindergarten. Currie (2001) reviews the economics literature and finds that programs such as Head Start and closely related preschool and early school enrichment programs have significant short and medium-term benefits and that the effects are usually greater for disadvantaged children.[1] Gormley and Gayer (2003) examine a newly implemented pre-kindergarten program in Oklahoma and find that the program increased cognitive/knowledge scores, motor skill scores, and language scores for Hispanic and black children but had little impact on white children. A recent paper by Baker, Gruber and Milligan (2005) examines the introduction of universal childcare in Quebec in the late 1990's. They conclude that the children were actually worse off by becoming more hostile, possessing less motor and social skills, and tending to become ill more often.

[1] Ludwig and Miller (2007) use a regression discontinuity approach and find significant benefits of Head Start in terms of decreased mortality rates. Currie and Neidell (2007) find that when Head Start spending was higher, children attending Head Start have higher reading and vocabulary scores.

Although state subsidization of kindergarten began in all states between 1935 and 1986, the largest increase in state sponsored kindergarten occurred between 1960 and 1980. Therefore, this study uses policy changes between 1960 and 1980 to evaluate the effectiveness of state sponsored kindergarten. The effect of state-sponsored kindergarten can be isolated by comparing cohorts before and after state subsidization was introduced assuming that outcomes for each cohort would be the same except from the effect of kindergarten attendance.

This study uses data for the entire United States to estimate the effect of kindergarten enrollment on future academic and labor market outcomes. More specifically, the impact of state sponsored kindergarten can be examined across four dimensions by exploring differences in (1) how boys and girls respond, (2) how children of different races are affected, (3) how children of different socioeconomic status respond, and (4) how children of different ages are affected. The paper focuses on the following outcomes: grade failure, educational attainment, and labor market outcomes, such as wages and employment status. The evidence shows that attending kindergarten decreases the probability that a child fails a grade and increases the probability that a child finishes high school and becomes employed. There is little evidence of gender differences in reduced grade failure rates and some evidence that children of relatively different ages are affected differently due to kindergarten availability. However, large differences appear in grade failure between white and black children and between children of different socioeconomic statuses. More specifically, black children's failure rate is decreased by about 27 percent while white children benefit by about 15 percent. Consistent with this difference, the hourly wage rate for black children increases by about 4 percent later in life. The biggest gap between groups is between socioeconomic groups. The poorest children are about 26-35 percent less likely to fail a grade after the introduction of state funded kindergarten, while there is no effect on the failure rate of rich children.

2. Econometric Model

A. Cohort Level – Two Stage Least Squares

Ideally, one can estimate the effect of kindergarten attendance on future academic and labor market outcomes using individual-level data on kindergarten enrollment and outcome measures. This relationship can be estimated using the following equation:

$$Y_{sti} = \beta_1 + \beta_2 E_{sti} + X_{sti}\beta + S_s + T_t + \varepsilon_{sti} \quad (1)$$

where Y_{sti} denotes the outcome measure, such as grade failure, educational attainment or a labor market outcome, for individual *i* in state *s* and birth year *t*. E_{sti} is an indicator variable representing enrollment in kindergarten. X_{sti} is the vector of controls, S_s are state fixed effects and T_t are birth year fixed effects.

The coefficient β_2 measures the causal impact of attending kindergarten on the outcome measure. The causal interpretation depends on the assumption that $\mathrm{E}[E_{sti}\varepsilon_{sti} \mid X_{sti}] = 0$. However, kindergarten enrollment is not mandatory for most children and hence probably not random. Currently only eight states require children to enter school at age 5. Compulsory schooling does not start until age 6 in the remaining forty-two states. In addition, kindergarten enrollment was not random prior to becoming subsidized at the state level due to the fact that it was privately or locally funded. Therefore, this assumption does not hold. It is not clear in which direction the bias will occur. For example, communities that provided kindergarten before state subsidization were probably wealthier than communities without kindergarten. In addition, students who attended kindergarten by paying tuition would have generally been wealthier than non-attending children.[2] These children might be less likely to fail a grade or have better labor market outcomes regardless of kindergarten. Therefore, estimating equation (1) may lead to upward biased estimates of the effect of kindergarten enrollment. However, it was also the case that kindergarten was used by some organizations to socialize and "Americanize" immigrant children (Spodek, 1988). Kindergarten was used to help immigrant children by providing food and clothing, in addition to education in some areas (de Cos, 1997). In this case, it may be that equation (1) would be biased downward because these children may have been more likely to fail a grade or have worse labor market outcomes, holding everything else constant. Regardless of the direction of bias, random enrollment did not exist, and therefore ordinary least squares estimates will be biased, and an instrumental variables strategy should be employed.

Unfortunately, individual level data on kindergarten enrollment and data regarding academic and labor market outcomes do not exist from one source. However, data regarding state/cohort level kindergarten enrollment figures do exist in the *Digest of Education Statistics* and data on academic and labor market outcomes are available in the U.S. Census.[3] Equation (1)

[2] Cascio (2005) finds that these children had more highly educated mothers and came from smaller families.
[3] See Section 3A for more details regarding the kindergarten enrollment and the Census data.

can be estimated by aggregating the data regarding outcomes to the state/cohort level and merging this data with the aggregated enrollment data.

Instrumental variables estimates of equation (1) can be calculated by using the state subsidization of kindergarten (K_{st}) as an instrument for state-level kindergarten enrollment. More specifically, K_{st} is a dummy variable that indicates whether the state subsidized kindergarten during a particular year. The start of state subsidies created a large increase in kindergarten availability for almost all children in the state. This increased the probability that any particular child attended kindergarten. Using an estimation technique similar to Imbens and van der Klaauw (1995) and Angrist (1991), this paper uses variation in state/cohort level aggregate enrollment rates, E_{st} produced by policy changes to estimate the effect of enrolling in kindergarten. Figure 1 illustrates the percentage of five year olds enrolled in kindergarten. It displays the aggregated percentage of five year olds enrolled in kindergarten in the 27 states that began to subsidize kindergarten between 1960 and 1980. The largest increase occurs, about a 25 percentage point increase, between the year before the start of state subsidization and the year after the start of state subsidization.

The following first stage equation can be estimated as a part of a two stage least squares estimation strategy. The first stage equation can be written as:

$$\overline{E}_{st} = \delta_1 + \delta_2 K_{st} + \overline{X}_{st}\delta + S_s + T_t + \nu_{st} \qquad (2)$$

where $\overline{E}_{st}$ is the percentage of 5 year olds enrolled in kindergarten for each state for each birth year and K_{st} is an indicator variable that equals 1 if a state subsidized kindergarten in a particular year and 0 otherwise. The vector, $\overline{X}_{st}$, includes the state/birth year level mean values for the control variables. For completeness, the cohort level second stage can be written as:

$$\overline{Y}_{st} = \beta_1 + \beta_2 \hat{\overline{E}}_{st} + \overline{X}_{st}\beta + S_s + T_t + \varepsilon_{st} \qquad (3)$$

where $\hat{\overline{E}}_{st}$ are the predicted values from equation (2). Therefore, using the instrumental variables approach β_2 can be calculated, which estimates the effect of enrolling in kindergarten on future outcomes on children that are induced to attend due to state subsidization.

The two stage least squares estimate imposes the following non-testable exclusion restriction: $\mathrm{E}[K_{st}\varepsilon_{st} \mid \overline{X}_{st}] = 0$. If policy makers began to subsidize kindergarten due to other

factors that affect academic and labor market outcomes, the estimates for kindergarten could not be disentangled from those changes. However, most of the large changes in education programs came in the form of federal policy enacted during this time period, including the introduction of Title I of the Elementary and Secondary Education Act of 1965, and would have impacted all the states at the same time and therefore would be captured by the year fixed effects. Even though the previous assumption is non-testable, a number of state level policies regarding education that changed at the same time as kindergarten subsidization can be help constant because they may also affect academic and labor market outcomes. State Supreme Court rulings on the constitutionality of school-finance systems and school finance litigation information[4] can be used as control variables. The first wave of school finance litigation occurred in California in the 1970s beginning with the landmark case *Serrano v. Priest*. Most states experienced some type of school litigation within the next twenty-five years. However, only five states had challenges to their school-finance system within a five-year window of the beginning of kindergarten subsidization. These states are Arizona, Montana, Georgia, Idaho and Oregon. Including these changes as controls does not affect the results or conclusions of this paper.

Aside from policies, other time-varying factors might exist that could be correlated with student outcomes. More specifically, within-state changes in the laws affecting kindergarten need to be uncorrelated with other state-specific changes that might affect student outcomes. However, the results are similar if state-specific cohort linear or quadratic time trends are included.[5]

B. Individual Level – Subgroups

Much of the early childhood literature finds clear differences in the effect of early childhood interventions on children of different genders and socioeconomic statuses (Currie (2001)). Therefore, it is important to examine whether this is also true for kindergarten enrollment. Because kindergarten enrollment data is only available at the state/cohort level for the cohorts affected by the changes in subsidization, the above instrumental variables estimate cannot be calculated for subgroups because the enrollment data are not available in a disaggregated form. Therefore, I specifically examine how different groups of individuals are

[4] This information was collected from Murray, Evans, and Schwab (1998) and the National Center for Education Statistics at http://nces.ed.gov/edfin/litigation/index.asp.
[5] These results are available from the author upon request.

affected by the availability of state sponsored kindergarten using a reduced form approach using individual level data.

The reduced form allows the estimation of the average effect of increased availability of kindergarten on future outcomes. The following regression is run separately for boys and girls.

$$Y_{sti} = \gamma_1 + \gamma_2 K_{sti} + X_{sti}\gamma + S_s + T_t + w_{sti} \quad (4)$$

Figure 1 demonstrates the average increase of 25 percentage point gain due to the state funding of kindergarten. However, it may be the case that different states had different proportions of children enrolled in kindergarten before and after state subsidization. These differences could be due to differences in availability due to local or private funding but it also could be due to the difference in timing. States that begun to subsidize kindergarten at a later time than other states might have more children enrolled due to increasing trends in enrollment. These differences between states change the marginal group of children who are induced to attend kindergarten due to the increased availability. More concretely, Figure 2 displays the percentage of five year olds enrolled in the two largest states that began subsidizing kindergarten during the 1960's and 1970's: Texas and Florida. Panel A depicts the change in kindergarten enrollment in Texas five years before and after kindergarten became state funded in 1967. In 1967, the first year of kindergarten subsidization by the state, enrollment increased dramatically. Approximately 15 percent of five year olds were enrolled in kindergarten before it became state subsidized. Five years after state subsidization, approximately 85 percent of five year olds were enrolled. This corresponds to about a 70-percentage point increase. A slightly different pattern is observed in Florida in Panel B. The Florida data show a more gradual increase of kindergarten enrollment.[6] Before state subsidization, only about five percent of five year olds were enrolled in kindergarten. Five years after state subsidization, sixty percent of five year olds were enrolled. This translates into a 55 percentage point increase. The marginal children in Texas, who are the children that are induced to attend kindergarten due to the increased availability and decreased cost, might be significantly different than the marginal children in Florida. Therefore, the interpretation of γ_2 is the <u>average</u> effect of the increased availability of kindergarten for all the changing states.[7]

[6] Excluding observations right around the official year of change does not change the conclusions of this paper.
[7] Restricting the sample to states that have similar levels of five year olds enrolled in kindergarten before or after state subsidization or restricting the sample to states that have similar percentage point increase due to state subsidization does not substantially change the results or conclusions of this paper.

The effect of kindergarten on different groups of children can be estimated by interacting a control variable with the indicator for state sponsored kindergarten. For example, the differences in kindergarten effectiveness between black children and white children are estimated using the following regression.

$$Y_{sti} = \gamma_1 + \gamma_2 K_{sti} + \gamma_3 K_{sti} \times B_{sti} + \gamma_4 B_{sti} + X_{sti}\gamma + S_s + T_t + w_{sti} \quad (5)$$

Where B_{sti} is an indicator for the black students and $K_{sti} \times B_{sti}$ is the interaction between the dummy variable for state subsidized kindergarten and the dummy variable for black children. Therefore, γ_3 is the average differential effect of kindergarten availability on black students. X_{sti} represents the vector of controls. S_s are fixed effects for birth state and T_t are fixed effects for birth year.[8] All standard errors are clustered at the state level and are heteroskedastic-consistent.[9]

3. Data and Descriptive Statistics

A. Data Sources

The primary data source used in this study is the U.S. Census. Section 4 examines grade failure, the short-term outcome. It uses the 1 percent sample from the Form 2 state, metro, and neighborhood files from the 1970 U.S. Census. These samples make up a 3 percent sample of the United States in 1970. This data is merged with the 5 percent sample from the 1980 Census. The sample is restricted to individuals from these two Census years who are ages 6 to 15 years old, and were born in the United States. Section 5 expands the analysis to include longer run outcomes such as educational attainment and labor market outcomes. This analysis uses the 5 percent sample from the 2000 U.S. Census and restricts the sample to individuals between the ages of 25 and 50 who were born in the United States.

Kindergarten enrollment data is from the *Biennial Survey of Education*, later known as the *Digest of Education Statistics*. Due to the absence of data in 1956, 1958, 1960, 1962, and

[8] It is important to include controls for birth year or age since each individual has a different window of time depending on their age for completing the outcome measure. An alternative approach would be to use a hazard model.

[9] Even though it is possible to run the previous reduced form models using more aggregated data, the individual level data is used when examining the effect of kindergarten availability on subgroups. The aggregation of the data to the subgroup/state/cohort level has the potential of creating very few or no observations in particular cells. However, all results are similar. There is no change in interpretation if the data is aggregated to the subgroup/state/cohort level.

1964 these enrollment rates are linear interpolations.[10] The kindergarten enrollment in year t and the first grade enrollment in year t+1 were used to construct an enrollment ratio that approximates the enrollment rate for kindergarten in each year, t.

The date in which each state began funding kindergarten as a part of its public primary school education system at the state level was gathered by contacting each state's education department. Some of these dates were verified using information collected by Cascio (2004), Tanner and Tanner (1975) and Steiner (1972). Table 1 lists the year in which kindergarten first began to be subsidized using state revenue. I am unable to obtain the exact year of the beginning of state funding for twelve states. A star in Table 1 designates these states. It has been confirmed that these states all began to subsidize kindergarten using state money before 1960.[11] The date listed in Table 1 for the starred states is the year in which there was the largest increase in kindergarten enrollment. This analysis will focus on the time period from 1960 and 1980, where 27 states began subsidizing kindergarten. Therefore, the unconfirmed dates for these twelve states will not affect the analysis, as they did not began subsidizing kindergarten during the 1960's or 1970's.

This study uses both short run and long run measures of effectiveness or benefit. The first outcome measure concerns whether the student failed a grade in school.[12] An indicator measure of whether the child is below grade for her age is used as a proxy for failure or grade repetition. This measure is constructed from the Census data using the child's age and grade level and the state's cutoff date for kindergarten entry. If a child is below the grade level they should be in for their age, they are considered retained or failed. For instance, if a child should be seven years old in second grade but a seven year old is observed in first grade, that child is considered retained. This retention measure includes individuals whose school entry was delayed by their parents as well as individuals who failed a grade and were retained by their teachers. Therefore, the available data cannot disentangle children who failed and children who entered schooling late.[13] This measure is still valid as long as the rules about failing and parents' tendency to hold back their children do not change at the same time as the introduction of subsidies. Fortunately, there

[10] Kindergarten enrollment data is missing for select states in select years. The results of the analysis does not change if these data are also linearly interpolated.
[11] See Turner and Turner (1975) and/or Steiner (1972).
[12] Cascio (2005) and Oreopoulos, Page, and Stevens (2006) both use this proxy as a measure of educational achievement.
[13] Cascio (2005) examines the validity of using this proxy and finds that the misclassification attenuates regression coefficients by 35% when the proxy is an outcome using Current Population Survey data.

is no evidence that rules regarding failure have changed or that overall standards regarding failing within the public school system have increased over time (Roderick, 1994). In addition, parent's behavior regarding entry should not change because kindergarten is not compulsory in most states. If parents did respond at the same time as the policy change, they should be more likely to hold back their children because the children would be starting school at an earlier age. If this occurred it would bias the estimates downwards.

There is extensive literature documenting the association between grade retention and poor later educational outcomes.[14] Roderick (1994) reports a large association between being retained and dropping out of high school. Jacob and Lefgren (2002) show that the immediate consequence of being retained is increased academic performance, but that there is no effect on later math scores and a negative effect on reading scores. This paper also uses longer run academic outcome measures, such as the educational attainment of an individual, and labor market outcomes such as wages, time spent working and employment status.

B. Descriptive Statistics

Table 2 displays the summary statistics for the outcome measures by different groupings. The first outcome measure listed is the fraction of a cohort below grade for age, the proxy for grade failure. The mean value for individuals ages 6-15 is 13 percent. Males are 5 percent more likely to have repeated a grade than females. Black students are 8 percent more likely to be below grade than white students. The poorest quartile of students, the first quartile, is almost three times more likely to be below grade for their age than the richest quartile of students, the fourth quartile. The last grouping of individuals is by relative quarters of birth.[15] Children who are the relatively youngest, quarter 1, are approximately twice as likely to be behind a grade than children who are the relatively oldest, quarter 4.

Panel B and C display the statistics for the longer run outcome measures studied in this paper: educational attainment and labor market outcomes. These statistics are not broken up by SES quartiles or relative age quarters because the information does not exist regarding an individual's socioeconomic status as a student or her quarter of birth in the data.[16] Therefore, the

[14] See Holmes (1989) for a review of the literature.
[15] These statistics are for children born in states in which the cutoff is either October 1st or January 1st, the only cutoff dates in which a relative age measure can be perfectly assigned. See section 4E for more details.
[16] The 2000 U.S. Census does not contain the variable quarter of birth.

SES and relative age measures can not be established. Panel B focuses on the longer run academic measures. Females are more likely to make it to 9th, 10th, and 11th grade, become high school graduates, and attend college but are only slightly more likely to earn a B.A. degree. Black individuals are less likely than white individuals to have completed all the long run academic outcomes. Panel C includes six labor market outcomes: usual hours worked, usual weeks worked, whether the individual is employed, yearly income, ln of yearly income, and ln of hourly wage. Overall, males and white individuals have higher values in all six categories than females and black individuals, respectively.

4. Results – Grade Failure

A. Cohort Level – Two Stage Least Squares

The analysis begins by estimating the ordinary least squares, first stage, and two stage least squares models for the short run outcome variable, below grade for age, using the aggregate state/cohort level data. Table 3 contains these results. [17] Column 1 includes the coefficients from equation 1 with the outcome variable being the below grade for age indictor variable. The noisy point estimate of -1.4 indicates that there might be a negative relationship between kindergarten enrollment and failure rates. However, as discussed in Section 2, this OLS relationship may be biased due to correlation between the unobservable variables and kindergarten enrollment rates.

Column 2 contains the results from the first stage estimation strategy from equation 2. The introduction of state funding of kindergarten increases the kindergarten enrollment rate by about 25 percentage points. The F-statistic associated with the instrument in the first stage equation is 32. This indicates that state subsidization of kindergarten used as an instrument does not suffer from the weak instrument problem (Staiger and Stock (1997)).

The two stage least squares result is in column 3. These estimates can be interpreted as the local average treatment effect of the enrollment in kindergarten. The estimate pertains to the children who were induced to attend kindergarten due to the decrease in cost. The point estimate of -0.083 indicates that public kindergarten attendance decreases the probability of failure by 8.3 percentage points. This relationship is statistically significant at the five percent level and translates into a 64 percent reduction in repeating a grade. It is also worth noting that this

[17] Fixed effects for age, in addition to birth year, are included in regressions that use both the 1970 and 1980 Census.

estimate is larger than the point estimate found by Cascio (2004), but her sample is significantly smaller and is disaggregated by race.

B. Reduced Form by Gender

The results from the preceding section show a statistically significant negative relationship between attending kindergarten and failing a grade in school. These results are consistent with the literature regarding kindergarten but only answer the question about the average effectiveness of kindergarten. Much of the literature regarding preschool has shown that very specific groups of children are affected the most by early education interventions.[18] Therefore, it is important to examine which children specifically benefit from the introduction of kindergarten into the public primary school system. By using the reduced form analysis and by estimating equation 4, these issues can be investigated.

Table 4 reports the most basic results for the reduced form specifications. Column 1 displays the results for the female subsample. The coefficient on kindergarten indicates that the introduction of kindergarten into the public primary school educational system decreases failure rates by 2.1 percentage points. This translates into a 20 percent decrease in the failure rate. The results for the male subsample are similar. The introduction of state funded kindergarten decreases retention rates by 2.6 percentage points, which translates into a 17 percent decrease. The difference between boys and girls is not statistically significant. This is an interesting finding because conventional wisdom and previous literature find differences between boys and girls in terms of effects of early childhood education (Cannon, Jacknowitz and Painter, 2004). Using this metric, there is little evidence of this.

The IV estimates of Table 3 specifically measures the effect of enrolling in kindergarten on grade failure for the group of children who were induced to attend kindergarten due to state subsidization. These reduced form estimates can be interpreted as the average effect of increasing kindergarten availability by state subsidization on grade repetition. The instrumental variable estimates should always be larger in magnitude than the reduced form estimates since the first stage estimate will be a positive fraction.

[18] See Cannon, Jacknowitz and Painter (2004), Currie (2001), Gormley and Gayer (2003) and Spiess, Büchel and Wagner (2003).

C. Reduced Form by Race

I next explore the possibility that children of different races are affected differently by the introduction of state subsidized kindergarten. In this case, the sample is limited to children who are either white or black. The dummy variable of whether the child is black is interacted with the dummy variable for state sponsored kindergarten. Table 5 reports the coefficient for kindergarten (γ_2) and the coefficient for the interaction of kindergarten and black (γ_3) from equation 5. The results for females are reported in column 1. White females' failure rate decreased about 1.6 percentage points, a 17 percent decline. However, the black females' failure rates decreased about 4.5 percentage points, a 28 percent decline. The difference between the black and white females is statistically significant at the five percent level. The bottom of the table reports the F statistic for the joint significance of kindergarten effectiveness. For the black female, this is the F statistic of the joint test of significance for both the coefficient on kindergarten and the coefficient on the interaction between black and kindergarten.

The introduction of publicly funded kindergarten decreased the failure rates for white males by about 2 percentage points, which translates into a 14 percent decrease. However, black males are significantly more likely to have a reduction in failure rates. Their failure rates decrease by 5.7 percentage points, or 26 percent. This is a large and statistically significant difference.

There is significant evidence that children of different races are affected differently by the introduction of kindergarten into public school. This difference may be caused by the alternative situations children of different races face when kindergarten is not subsidized. If a child has access to high quality childcare in the absence of subsidized kindergarten, kindergarten attendance may not be as beneficial for that child.

D. Reduced Form by SES

A greater benefit to children of lower socioeconomic status has been noted in previous research. Head Start and the pre-K program in Oklahoma have both shown the most effect on children of lower socioeconomic statuses (Currie (2001) and Gormley and Gayer (2003)). Section 4C focuses on racial differences in the effectiveness of the introduction of publicly funded kindergarten, while holding socioeconomic status constant. This section will examine the different effects of kindergarten on children of different socioeconomic statuses.

Table 6 explores the relationship between socioeconomic status and kindergarten effectiveness. Indicator variables of which quartile of the socioeconomic distribution that each student belongs to is constructed by using the poverty measure in the Census. The 1st quartile corresponds to the poorest children while the 4th quartile corresponds to the richest children. These indicators of SES quartile are interacted with the indicator for kindergarten to measure the varying effect of the increased availability of state sponsored kindergarten on children of different SES groups. The omitted category in the regression is the children of the 4th quartile, the richest children. Column 1 once again displays the results for females. The introduction of state subsidized kindergarten only affects quartiles 1 through 3. Quartile 1, the poorest children, has a large and significant coefficient. The introduction of state funded kindergarten decreases the failure rate by 5.9 percentage points, or 35 percent. The second quartile is also statistically significantly impacted at the five percent level, with a 1.5 percentage point, or 18 percent decrease. The F statistics for quartiles 3 and 4 are not statistically significant at the five or ten percent level. Column 2 of Table 6 examines the effect on males and finds similar results. Only the poorest two quartiles of SES were affected by the introduction of state sponsored kindergarten. The poorest quartile is 6.5 percentage points, or 26 percent, less likely to fail whereas the second quartile students are 2.1 percentage points, or 13 percent less likely to do so. The richest two quartiles show no effect. Figure 2 graphically depicts the relationship between SES quartiles and the reduction of retention rates. Two stars indicate joint statistical significance at the five percent level. Panel A displays the results for the females and Panel B displays the results for the males. Once again, there is very little difference between the males and females.

E. Reduced Form by Relative Age

The final grouping of students is between children of dissimilar relative ages. There is a rich vein of literature discussing at what age children are ready to enroll in kindergarten or the appropriate age for beginning school.[19] However, a child's absolute age is not the only factor in determining her success in kindergarten and beyond. A child's age relative to her classmates may matter in terms of how much benefit that child receives from early childhood education. Recently, economists have shown that the relatively oldest children in a grade are more likely to (1) score higher on standardized math and science exams, (2) become high school leaders, (3)

[19] See de Cos (1997) for a thorough review of literature pertaining to kindergarten readiness.

take college entrance exams, and (4) attend university immediately after high school.[20] It is important to examine the effects of a child's relative age in relation to the benefits of kindergarten enrollment.

The state's cutoff date and individual's quarter of birth are used to construct a measure of relative age (*Q*) for each individual. The state's cutoff date was collected using historical state statutes and session laws. Given an absence of information regarding a statewide cutoff date in some states, no accurate measure of relative age can be assigned. Therefore, missing values are assigned to these children. If statewide cutoff data exists, the relative measure is constructed as follows: *Q1* = 1 for students born in the last quarter of the calendar year, which would make them the relatively youngest students prior to the cut-off; and *Q1* = 0 otherwise. *Q2*, *Q3*, and *Q4* are similarly defined for each subsequent quarter of birth. For example, using an October 1st cutoff, children born between July 1 and September 30 are the youngest (*Q1* = 1), while children born between October 1 and December 31 are the oldest (*Q4* = 1).

Ideally, the data would contain each individual's birth date. However, due to data restrictions, only the quarter of birth of the individual is provided. Therefore, this study only uses the quarter of birth measure for states that have a cutoff date of either January 1 or October 1. Other cutoff dates are inaccurate in assigning the relative age measure because it is unclear which children are relatively the oldest or youngest. For instance, if the cutoff date is November 1, children born in the last quarter of the year may either be the relatively youngest (if they are born in October) or the relatively oldest (if they are born in November or December).

Table 7 reports the coefficient from the interaction of the relative quarter of birth measures with the indicator variable for state sponsored kindergarten. The results for female students are reported in column 1 and displayed graphically in Figure 3, Panel A. The results show a downward pattern from a 2.6 percentage point decline for relative quarter 2 to a 1.7 percentage point decline for the oldest, relative quarter 4. However, the relatively youngest students are affected at a magnitude similar to the relatively oldest students.

The results for males reported in column 2 and displayed in Figure 3, Panel B show a similar pattern. The point estimates indicate that the introduction of kindergarten into the public primary school increases the failure rate for the relatively youngest males and decreases the failure rate between 2 and 3 percentage points for the other three quarters with a declining

[20] See Bedard and Dhuey (2006), Datar (2003), Dhuey and Lipscomb (2005), and Fredriksson and Öckert (2004).

pattern between relative quarter 2 and relative quarter 4. The coefficients in this section are not estimated very precisely. This is mainly due to the decreased sample size since the analysis can only use states that have a cutoff date of January 1st or October 1st. The coefficients are essentially of the same magnitude but are more precisely estimated if the boys and girls are pooled together in the analysis.

The patterns observed meet expectations, given the previous literature regarding relative age effects. The relatively youngest children are often at a disadvantage in terms of academic outcomes. Kindergarten attendance may level the playing field since it emphasizes socialization and school readiness, the very areas in which the relatively youngest are disadvantaged. However, the increase in failure rates for the relatively youngest males and the small magnitude of the results for the females is surprising.

The enrollment behavior of 5 year olds before and after state-funded kindergarten is examined because the positive or smaller results for the youngest boys and girls may be due to selection into kindergarten. Appendix Table 1 reports the results from the analysis using the same independent variables as before but uses an indicator for whether the child is enrolled in school as the dependent variable. This analysis uses only five year olds in the fall of 1959, 1969, and 1979 from the 1960, 1970, and 1980 Census. The analysis is run separately for males and females and for the January 1 and October 1 cutoff dates. The enrollment patterns of children with different relative ages are quite different and can be seen graphically in Appendix Figure 1. The difference in starting age makes a large difference in parental enrollment decisions.

The measure of below grade for age is a proxy for failure rates since it is unable to disentangle whether a child has failed a grade or whether the child's parents purposely delayed entry for that child. It has been shown that the parents have purposely delayed entry for children of the relatively youngest quarter in states that have a cutoff of January 1. Therefore, the estimates of the effective reduction of retention rates by relative quarter underestimate the effect for the relatively youngest quarter.

Despite the significant effects that relative age has on academic outcomes, there is less evidence that it influences the benefit the child receives from kindergarten enrollment. The relatively youngest students do seem to benefit more than the relatively oldest children but this comparison is small in relationship to the black/white difference or the difference in socioeconomic status. This explanation may be related to the previous one regarding alternative

childcare options when kindergarten is not available or is too expensive. Childcare options are not related to a child's relative age; therefore, a child's relative age may have little impact on the effectiveness of kindergarten outside the increased socialization and school readiness that kindergarten provides.

5. Results – Long Run Outcomes

A. Cohort Level - Two Stage Least Squares

The remainder of the paper focuses on longer run outcomes. Table 8 reports the results for all equations of interest for the longer run outcome variables. Column 1 reports the OLS result for the impact of enrollment in kindergarten on the outcome variable. Column 2 displays the coefficient δ_2 from the first stage estimated by equation (2). Lastly, column 3 shows the two stage least square estimates for β_2, using the introduction of state subsidization of kindergarten as an instrument for kindergarten enrollment.

The only statistically significant results obtained using the collapsed state/cohort level data are the first stage result and the results for 9th and 10th grade completion. The first stage coefficient is a 30.6 percentage point increase in the enrollment after state funded kindergarten is introduced and is tightly estimated. Column 3 coefficients indicate that enrolling in kindergarten will increase 9th and 10th grade completion by almost 1 percentage point. The point estimates for all other outcome variables are too noisy to interpret.

B. Reduced Form by Gender

The earlier results on grade repetition indicate that there are large differences in the benefit from kindergarten between subgroups which may hold true for longer run outcomes. Once again, the kindergarten enrollment data can not be disaggregated. Hence, the reduced form specification is used to estimate the average effect of increased kindergarten availability on different groups of individuals.

Table 9 reports the results from the reduced form equation (4) using the individual-level data for the long run academic outcomes by gender. The coefficient reported is γ_2 from equation 4. Column 2 reports the results for the male sample. The longer run academic outcomes are in Panel A. There are positive and statistically significant effects of kindergarten availability on all the academic outcome variables except for college attendance and college graduation outcomes.

The point estimate indicates that the increase of availability due to the introduction of kindergarten into the public primary school system increases high school graduation rates by 0.8 percentage points. Similar results are reported for 9th grade through 11th grade completion rates. The increase in availability of kindergarten increases high school graduation by about 8 percent. Panel B reports a statistically significant and positive result for employment status but no other results are significant. The educational attainment results for the female sample reported in column 1 are similar in magnitude to those of the males. However, the female results contain a puzzling outcome, indicating that after kindergarten becomes state funded, female students are less likely to earn a B.A. degree. The labor market outcome measures are reported for the sample of women but these results should be interpreted cautiously due to many changes in the women's labor market during this time period. Overall, there are three significant results, usual hours, usual weeks worked, and yearly income which are negative. Therefore, there are some effects on school completion rates and labor market outcomes due to the increase of kindergarten for both males and females.

B. Reduced Form by Race

Table 10 reports the point estimates for the indicator variable for kindergarten and the interaction between the indicator variable for black and the indicator variable for kindergarten from equation (5) using the long run outcome measures as the dependent variable. Panel A reports the results from the male sample whereas Panel B reports the results from the female sample. Columns 1 through 4 report point estimates similar to Table 9 but with slightly less precision in the high school graduate model in the male sample. The interaction variable between black and kindergarten is not statistically significantly different from zero in any of the four models. Column 5 shows no statistically significant results for the outcome variable some college. Column 6 contains an unexpected outcome. It indicates that after kindergarten became state funded, black students were less likely to earn a B.A. degree[21].

Columns 8-12 report the results for the labor market outcomes, employment status, usual hours works, weeks worked, total yearly income, and ln of hourly wage. All of the labor market outcomes except employment status are conditional on being employed. These models are the

[21] The inclusion of distinct time trends for black individuals causes this coefficient to change signs and stay at approximately the same magnitude but does not substantially change any other coefficients.

same as the academic outcome models, though the individual's current region of residence, marital status, and domicile in or outside a city are also held constant. There are two points worth mentioning for the male sample. First, the result for employment status is positive and significant for the coefficient on the indicator for kindergarten and negative and significant for the coefficient of the interaction variable. These differences may be due to the differences in the marginal children. Second, the point estimates for both yearly income and log hourly wage models are positive and statistically significant. The point estimate of 0.035 for the interaction in the log hourly wage model can be translated into a 3.5 percent increase in wages for black individuals due to an increase in the availability of kindergarten seats in the public primary school educational system. Again, the labor market outcome measures are reported for the sample of women but these results should be cautiously interpreted.

5. Conclusion

The introduction and subsidization of kindergarten in the public primary school education system allows us a unique opportunity to analyze the benefits of the largest implementation of an early childhood education program in recent history. The effect of kindergarten on a variety of academic and long run outcomes can be calculated by using the large increases in enrollment due to state subsidization assuming that state subsidization influences outcome measures only through its effect on enrollment. The subsidization of kindergarten decreased failure rates primarily for low income and black children and increased the future wages of black individuals. A possible explanation for these results is that the children who benefited most were the children who received lower quality care as a substitute for attending kindergarten. The subsidization of kindergarten helped level the playing field for the children least likely to receive high quality childcare in the absence of state supported kindergarten.

Overall, the finding that only the select groupings of children gain from kindergarten attendance is important because it suggests that targeting early childhood interventions for the most affected children would yield significantly more benefits per tax dollar spent than providing publicly funded schooling for all.

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Table 1. Year of Adoption of State Subsidization of Kindergarten

State	Year	State	Year
Alabama	1977	Nebraska	1945 *
Arizona	1971	Nevada	1949 *
Arkansas	1973	New Hampshire	1968
California	1946	New Jersey	1945 *
Colorado	1963	New Mexico	1975
Conneticut	1943	New York	1949 *
Delaware	1968	North Carolina	1973
Florida	1968	North Dakota	1980
Georgia	1978	Ohio	1935
Idaho	1975	Oklahoma	1969
Illinois	1951 *	Oregon	1973
Indiana	1945 *	Pennsylavania	1945 *
Iowa	1951 *	Rhode Island	1946 *
Kansas	1965	South Carolina	1973
Kentucky	1977	South Dakota	1947 *
Louisanna	1967	Tennessee	1973
Maine	1965	Texas	1973
Maryland	1967	Utah	1939 *
Massachusetts	1972	Vermont	1937 *
Michigan	1948	Virginia	1968
Minnesota	1947	Washington	1959
Mississippi	1986	West Virginia	1971
Missouri	1967	Wisconsin	1949
Montana	1971	Wyoming	1974

* indicates the date was not verified with the state's department of education and it is the date of the largest percentage increase of kindergarten enrollment.

Table 2. Summary Statistics

		Gender		Race		SES Quartiles				Relative Age*			
	All	Male	Female	White	Black	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Panel A: Short Run - Academic Outcomes													
Below Grade for Age	0.13	0.16	0.11	0.12	0.20	0.22	0.13	0.10	0.08	0.32	0.24	0.20	0.15
	(0.34)	(0.37)	(0.31)	(0.33)	(0.40)	(0.41)	(0.34)	(0.30)	(0.26)	(0.47)	(0.43)	(0.40)	(0.36)
Panel B: Long Run - Educational Attainment													
Completed at Least 9th Grade	0.99	0.99	0.99	0.99	0.98								
	(0.11)	(0.12)	(0.10)	(0.11)	(0.13)								
Completed at Least 10th Grade	0.98	0.97	0.98	0.98	0.97								
	(0.15)	(0.16)	(0.14)	(0.15)	(0.18)								
Completed at Least 11th Grade	0.96	0.95	0.96	0.96	0.94								
	(0.20)	(0.21)	(0.19)	(0.19)	(0.25)								
Completed at Least High School	0.91	0.90	0.92	0.92	0.83								
	(0.28)	(0.29)	(0.27)	(0.26)	(0.37)								
Completed at Least Some College	0.64	0.63	0.66	0.66	0.53								
	(0.48)	(0.48)	(0.47)	(0.47)	(0.50)								
Completed at Least B.A. Degree	0.31	0.31	0.31	0.32	0.17								
	(0.46)	(0.46)	(0.46)	(0.47)	(0.38)								
Completed at Least Advanced Degree	0.10	0.10	0.09	0.10	0.05								
	(0.29)	(0.30)	(0.29)	(0.30)	(0.21)								
Panel C: Long Run - Labor Market Outcomes													
Usual Hours Worked	35.50	41.40	30.03	36.22	31.36								
	(18.37)	(16.25)	(18.52)	(18.04)	(19.61)								
Weeks Worked	40.14	44.55	36.05	41.05	35.17								
	(19.53)	(15.99)	(21.52)	(18.91)	(22.05)								
Employed	0.80	0.85	0.75	0.81	0.74								
	(0.40)	(0.36)	(0.44)	(0.40)	(0.44)								
Yearly Income	32917	43334	23249	34663	23581								
	(40966)	(49040)	(28455)	(42819)	(27678)								
Ln Yearly Income	10.27	10.53	10.00	10.31	10.06								
	(0.91)	(0.78)	(0.95)	(0.91)	(0.88)								
Ln Hourly Income	2.76	2.88	2.64	2.79	2.61								
	(0.62)	(0.61)	(0.61)	(0.62)	(0.62)								

All statistics are population weighted. Standard deviations in parentheses. *Summary statistics are calculated using the sample of students in states that have a achool entry entrance cut off date of October 1 or January 1.

Table 3. The Effect of Kindergarten Enrollment on Grade Failure

	OLS	First Stage	2SLS
	(1)	(2)	(3)
Dependent Variable	Grade Failure	Enrollment	Grade Failure
Kindergarten		**0.249**	
		(0.044)	
Enrollment	-0.014		**-0.083**
	(0.017)		(0.038)
Female	0.076	0.156	0.091
	(0.082)	(0.241)	(0.080)
Black	0.200	-0.416	0.098
	(0.237)	(1.261)	(0.221)
Other Race	-0.040	-2.325	-0.201
	(0.400)	(1.967)	(0.454)
1st Quartile SES	**0.455**	***-1.520***	0.293
	(0.163)	(0.785)	(0.187)
2nd Quartile SES	**0.399**	0.104	**0.413**
	(0.161)	(0.760)	(0.183)
3rd Quartile SES	**0.499**	-0.184	**0.483**
	(0.185)	(0.628)	(0.203)
Observations	863	863	863

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include controls for census year, birth year, and state of birth.

Table 4. The Effect of State Subsidized Kindergarten on Grade Failure

	Female	Male
	(1)	(2)
Kindergarten (K)	**-0.021**	**-0.026**
	(0.008)	(0.010)
Black	**0.021**	**0.018**
	(0.006)	(0.006)
Other Race	**0.039**	0.019
	(0.018)	(0.019)
1st Quartile SES	**0.115**	**0.139**
	(0.009)	(0.009)
2nd Quartile SES	**0.049**	**0.067**
	(0.003)	(0.005)
3rd Quartile SES	**0.021**	**0.029**
	(0.001)	(0.002)
Observations	1319135	1370607

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for age, birth year, and state of birth.

Table 5. The Effect of State Subsidized Kindergarten on Grade Failure
Difference between Blacks and Whites

	Female	Male
	(1)	(2)
Kindergarten (K)	**-0.016**	**-0.020**
	(0.007)	(0.010)
Kindergarten * Black	**-0.029**	**-0.037**
	(0.011)	(0.010)
Black	**0.037**	**0.039**
	(0.011)	(0.010)
1st Quartile SES	**0.114**	**0.137**
	(0.009)	(0.009)
2nd Quartile SES	**0.049**	**0.067**
	(0.003)	(0.005)
3rd Quartile SES	**0.021**	**0.029**
	(0.001)	(0.002)
Observations	1299737	1350856
F statistic for Joint Test of Kindergarten Effectiveness		
White	**5.0**	**4.1**
Black	**6.1**	**7.8**

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for age, birth year, and state of birth.

Table 6. The Effect of State Subsidized Kindergarten on Grade Failure
Difference between SES Quartiles

	Female	Male
	(1)	(2)
Kindergarten (K)	0.003	-0.001
	(0.007)	(0.010)
Kindergarten * 1st Quartile SES	**-0.062**	**-0.064**
	(0.013)	(0.013)
Kindergarten * 2nd Quartile SES	**-0.018**	**-0.020**
	(0.007)	(0.008)
Kindergarten * 3rd Quartile SES	***-0.005***	-0.004
	(0.003)	(0.004)
Black	**0.018**	**0.015**
	(0.006)	(0.006)
Other Race	**0.037**	0.018
	(0.018)	(0.019)
1st Quartile SES	**0.154**	**0.179**
	(0.012)	(0.012)
2nd Quartile SES	**0.062**	**0.082**
	(0.006)	(0.007)
3rd Quartile SES	**0.026**	**0.033**
	(0.003)	(0.003)
Observations	1319135	1370607
F statistic for Joint Test of Kindergarten Effectiveness		
1st Quartile SES	**12.8**	**12.7**
2nd Quartile SES	**3.7**	**3.6**
3rd Quartile SES	1.5	0.6
4th Quartile SES	0.2	0.0

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for age, birth year, and state of birth.

Table 7. The Effect of State Subsidized Kindergarten on Grade Failure
Difference between Relative Age Quarters

	Female	Male
	(1)	(2)
Kindergarten	-0.014	***-0.021***
	(0.011)	(0.012)
Kindergarten * Relative Age Quarter 1	-0.003	***0.026***
	(0.012)	(0.014)
Kindergarten * Relative Age Quarter 2	***-0.012***	-0.010
	(0.007)	(0.007)
Kindergarten * Relative Age Quarter 3	-0.009	-0.004
	(0.006)	(0.005)
Black	**0.036**	**0.036**
	(0.008)	(0.010)
Other Race	**0.112**	**0.101**
	(0.021)	(0.022)
1st Quartile SES	**0.168**	**0.190**
	(0.009)	(0.010)
2nd Quartile SES	**0.075**	**0.093**
	(0.008)	(0.007)
3rd Quartile SES	**0.031**	**0.037**
	(0.004)	(0.005)
Relative Age Quarter 1	**0.146**	**0.199**
	(0.006)	(0.007)
Relative Age Quarter 2	**0.094**	**0.134**
	(0.006)	(0.007)
Relative Age Quarter 3	**0.057**	**0.074**
	(0.003)	(0.005)
Observations	196270	203614
F statistic for Joint Test of Kindergarten Effectiveness		
Q1	2.2	1.8
Q2	***2.9***	**4.0**
Q3	**6.6**	1.7
Q4	1.8	***3.1***

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for age, birth year, and state of birth.

Table 8. The Effect of Enrollment in Kindergarten on Long Run Outcomes

	OLS	First Stage	2SLS
	(1)	(2)	(3)
Panel A: Academic			
9th Grade	***0.004***	**0.306**	**0.008**
	(0.002)	(0.049)	(0.004)
10th Grade	***0.005***	**0.306**	***0.009***
	(0.003)	(0.049)	(0.005)
11th Grade	0.006	**0.306**	0.010
	(0.004)	(0.049)	(0.007)
High School Graduate	0.009	**0.306**	0.013
	(0.006)	(0.049)	(0.010)
Some College	-0.005	**0.306**	-0.027
	(0.017)	(0.049)	(0.028)
B.A. Degree	-0.016	**0.306**	-0.028
	(0.012)	(0.049)	(0.019)
Advanced Degree	0.002	**0.306**	0.002
	(0.002)	(0.049)	(0.005)
Panel B: Labor Market			
Usual Hours Worked	-0.296	**0.306**	0.673
	(0.236)	(0.049)	(0.483)
Weeks Works	-0.193	**0.306**	0.569
	(0.232)	(0.049)	(0.456)
Employed	-0.007	**0.306**	0.010
	(0.004)	(0.049)	(0.009)
Yearly Income	375	**0.306**	1225
	(401)	(0.049)	(827)
Ln Yearly Income	-0.002	**0.306**	0.001
	(0.018)	(0.049)	(0.031)
Ln Hourly Wages	0.009	**0.306**	-0.001
	(0.011)	(0.049)	(0.020)

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include controls for census year, birth year, and state of birth. There are 1115 observations in each regression.

Table 9. The Effect of Enrollment in Kindergarten on Long Run Outcomes

	Female	Male
	(1)	(2)
Panel A: Academic		
9th Grade	**0.004**	**0.006**
	(0.001)	(0.002)
10th Grade	**0.005**	**0.006**
	(0.002)	(0.002)
11th Grade	**0.007**	**0.008**
	(0.002)	(0.003)
High School Graduate	**0.010**	**0.008**
	(0.003)	(0.004)
Some College	-0.002	0.000
	(0.008)	(0.007)
B.A. Degree	**-0.011**	-0.003
	(0.005)	(0.005)
Advanced Degree	0.002	**0.010**
	(0.002)	(0.003)
Panel B: Labor Market		
Employed	0.000	**0.006**
	(0.004)	(0.003)
Usual Hours Worked	**-0.394**	-0.038
	(0.158)	(0.080)
Weeks Works	**-0.151**	0.036
	(0.061)	(0.029)
Yearly Income	***-365***	320
	(203)	(207)
Ln Hourly Wages	-0.007	-0.001
	(0.005)	(0.004)

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for birth year and state of birth. There are 1115 observations in each regression.

Table 10. The Effect of State Subsidized Kindergarten on Long Run Oucomes - Difference between Blacks and Whites

	Academic Outcomes							Labor Market Outcomes				
	Grade 9	Grade 10	Grade 11	H.S. Grad	Some College	BA Degree	Adv. Degree	Employed	Usual Hours	Weeks Worked	Yearly Income	Ln Hourly Wage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Male												
Kindergarten	**0.005**	**0.006**	**0.008**	***0.006***	-0.003	-0.002	**0.009**	**0.009**	-0.083	0.028	51	-0.005
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.074)	(0.030)	(198)	(0.004)
Kindergarten * Black	-0.001	-0.004	-0.006	0.000	0.002	**-0.024**	0.001	**-0.034**	0.019	-0.057	**1313**	**0.035**
	(0.003)	(0.004)	(0.006)	(0.008)	(0.012)	(0.011)	(0.007)	(0.008)	(0.133)	(0.078)	(376)	(0.007)
F statistic for Joint Test												
White	**7.7**	**6.2**	**5.9**	***3.2***	0.4	0.4	**6.7**	**8.8**	1.3	0.9	0.1	1.4
Black	**4.4**	***3.1***	***3.0***	2.2	0.2	**3.8**	**11.9**	**10.3**	0.7	0.7	**8.3**	**12.5**
Panel B: Female												
Kindergarten	**0.003**	**0.004**	**0.005**	**0.007**	-0.006	-0.007	0.003	0.002	**-0.423**	-0.084	**-482**	**-0.011**
	(0.001)	(0.002)	(0.002)	(0.003)	(0.007)	(0.004)	(0.002)	(0.004)	(0.169)	(0.054)	(203)	(0.005)
Kindergarten * Black	0.001	0.001	0.003	0.003	0.000	**-0.039**	-0.007	***-0.014***	0.241	**-0.432**	379	0.017
	(0.002)	(0.003)	(0.005)	(0.007)	(0.013)	(0.011)	(0.006)	(0.008)	(0.151)	(0.128)	(398)	(0.013)
F statistic for Joint Test												
White	**5.1**	**5.0**	**4.6**	**5.1**	0.8	2.8	1.8	0.3	**6.2**	2.4	**5.7**	**4.7**
Black	**4.7**	**3.9**	**4.6**	**3.9**	0.4	**10.5**	0.9	1.9	***3.1***	**7.0**	***2.8***	***2.5***

Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for birth year and state of birth.

Figure 1: Percentage of 5 year olds Enrolled in Kindergarten
All States that Began Subsidization Between 1960-1980

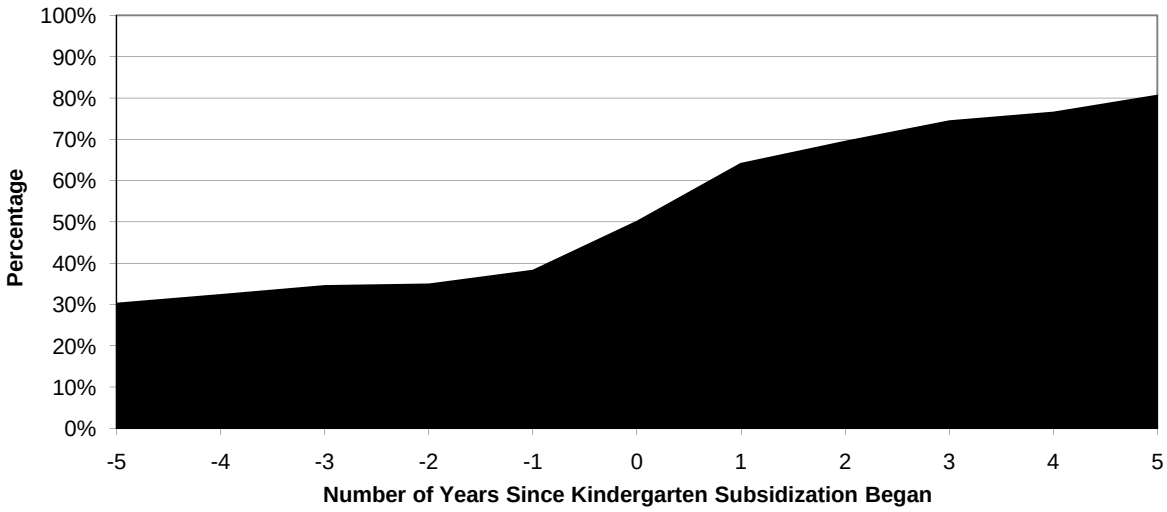
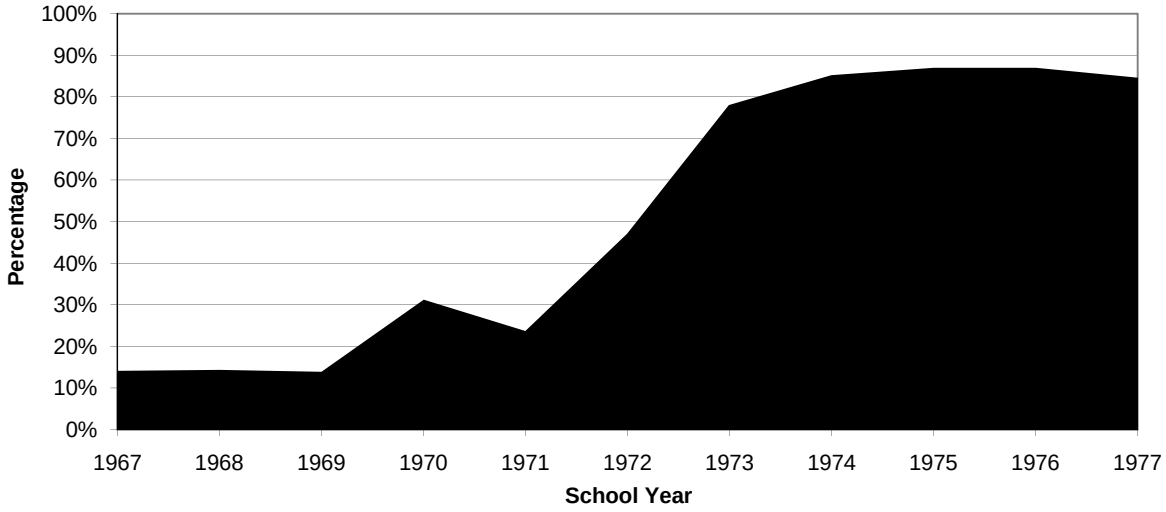


Figure 2: Percentage of 5 year olds Enrolled in Kindergarten
Panel A: Texas



Panel B: Florida

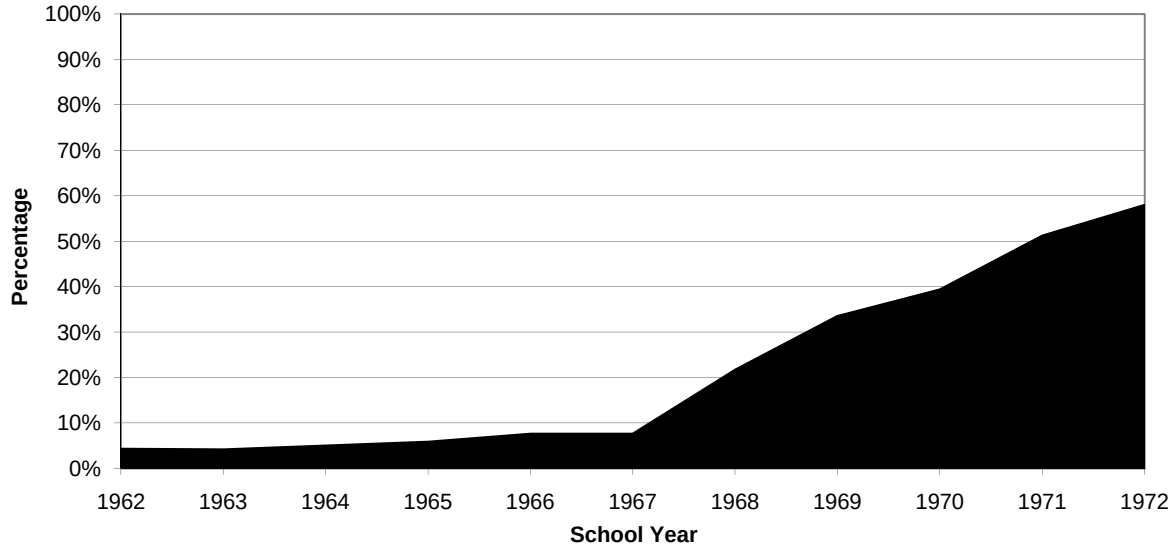
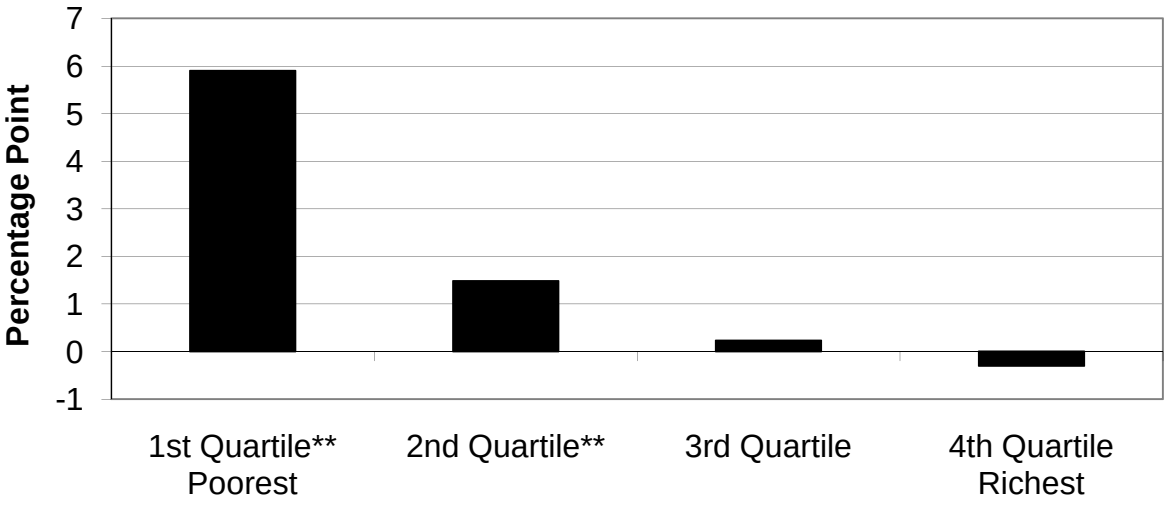


Figure 3: Effective Reduction of Retention by SES
Panel A: Female



Panel B: Male

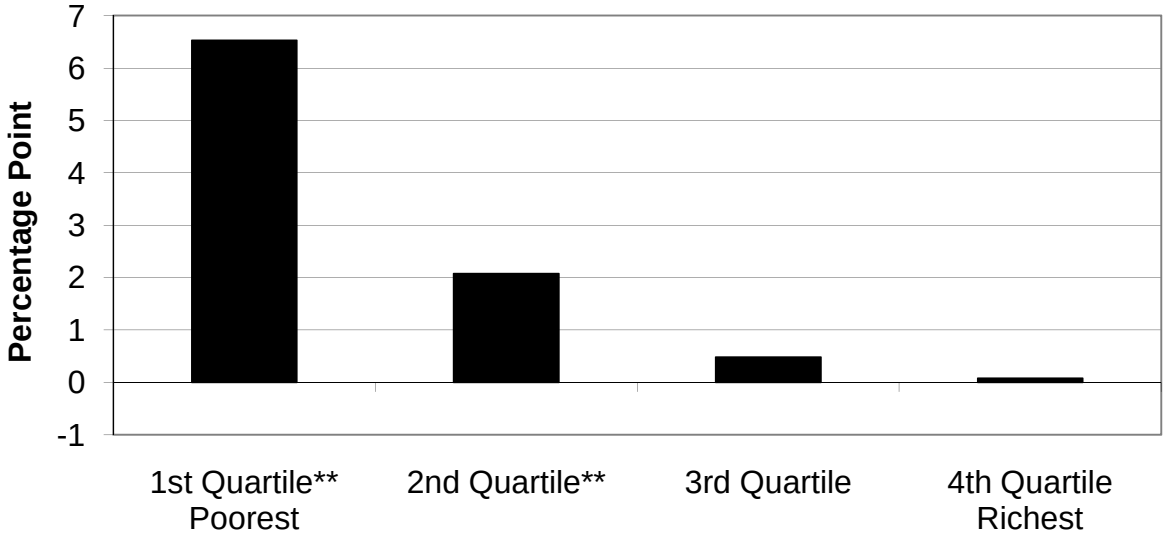
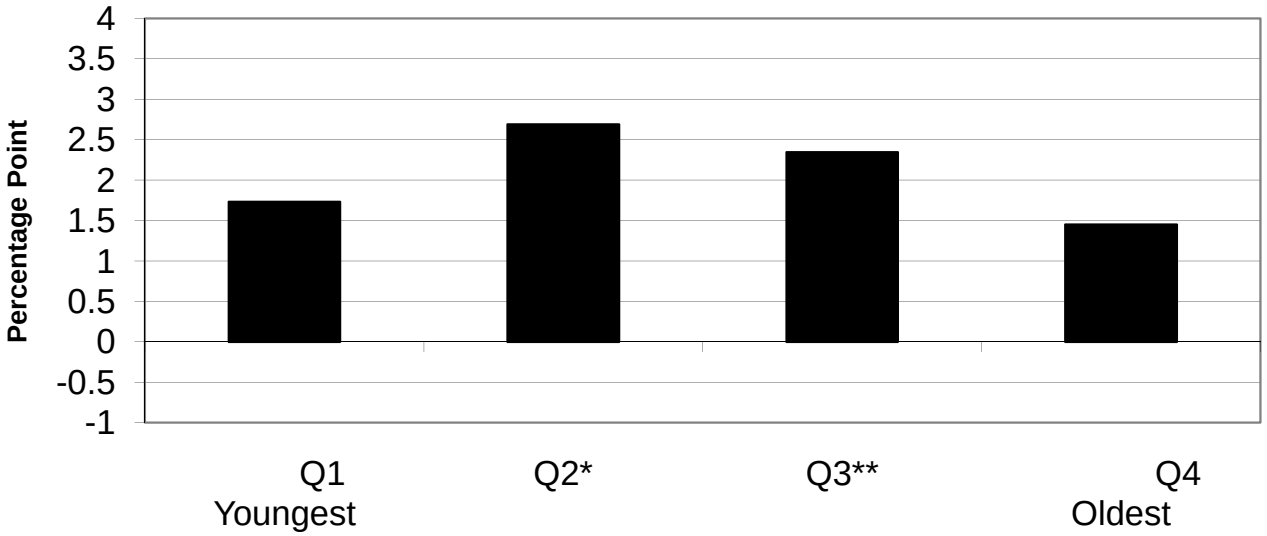
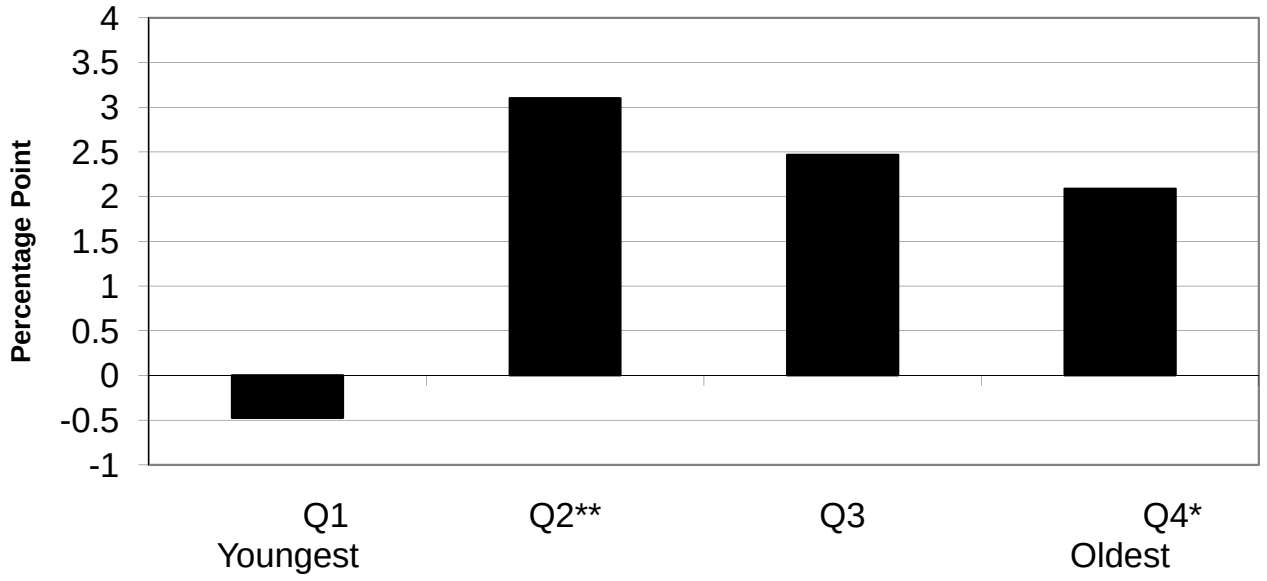


Figure 4: Effective Reduction of Retention by Relative Age
Panel A: Female



Panel B: Male



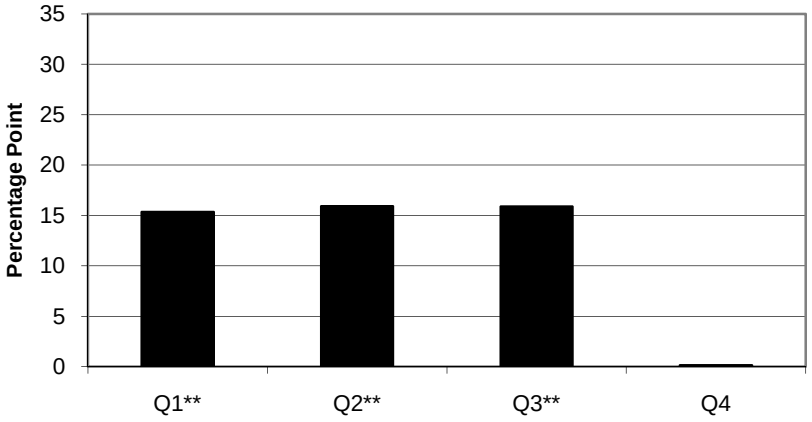
Appendix Table 1. The Effect of State Subsidized Kindergarten on Enrollment of Five Year Olds
Difference between Relative Quarters

	Female		Male	
	(1)	(2)	(3)	(4)
Kindergarten	0.001	**0.281**	0.055	**0.246**
	(0.041)	(0.061)	(0.057)	(0.058)
Kindergarten * Relative Quarter 1	**0.152**	**-0.451**	**0.128**	**-0.428**
	(0.030)	(0.050)	(0.020)	(0.041)
Kindergarten * Relative Quarter 2	**0.158**	-0.065	**0.118**	-0.040
	(0.035)	(0.052)	(0.026)	(0.029)
Kindergarten * Relative Quarter 3	**0.157**	**-0.065**	**0.158**	0.020
	(0.025)	(0.027)	(0.019)	(0.033)
Black	**0.038**	**0.052**	**0.062**	**0.057**
	(0.013)	(0.023)	(0.013)	(0.018)
Other Race	0.013	***0.092***	**0.048**	0.011
	(0.027)	(0.052)	(0.019)	(0.036)
1st Quartile SES	**-0.226**	**-0.169**	**-0.228**	**-0.177**
	(0.036)	(0.023)	(0.046)	(0.033)
2nd Quartile SES	**-0.136**	**-0.110**	**-0.136**	**-0.111**
	(0.036)	(0.025)	(0.053)	(0.030)
3rd Quartile SES	**-0.049**	**-0.056**	-0.047	***-0.051***
	(0.015)	(0.023)	(0.031)	(0.026)
Relative Quarter 1 (Youngest)	**-0.241**	**0.580**	**-0.204**	**0.550**
	(0.029)	(0.047)	(0.011)	(0.034)
Relative Quarter 2	**-0.220**	0.032	**-0.177**	-0.010
	(0.029)	(0.035)	(0.017)	(0.022)
Relative Quarter 3	**-0.214**	0.015	**-0.173**	-0.043
	(0.022)	(0.014)	(0.011)	(0.029)
Statewide Cutoff Date	October 1	January 1	October 1	January 1
Observations	17100	10464	17898	11106
F statistic for Joint Test of Kindergarten Effectiveness				
Q1	**44.8**	**76.6**	**38.1**	**91.8**
Q2	**12.9**	**11.5**	**17.4**	**12.9**
Q3	**55.7**	**15.5**	**38.6**	**9.1**
Q4	0.0	**21.5**	0.9	**18.2**

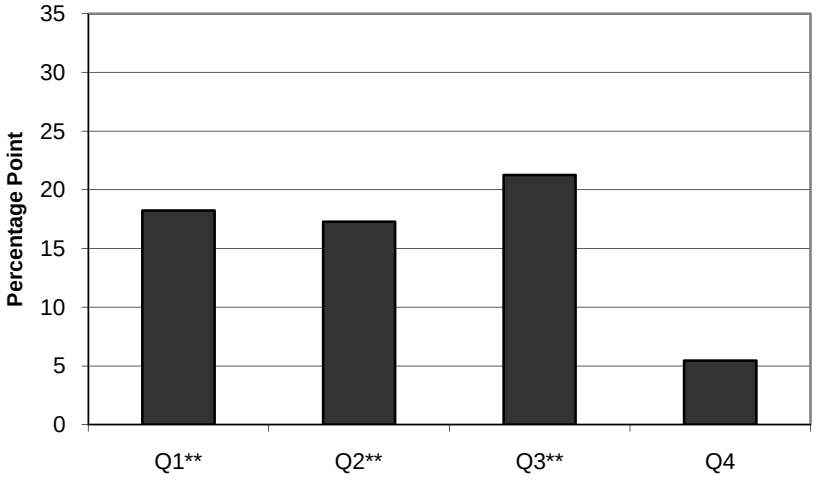
Heteroskedastic-consistent standard errors are in parentheses and are clustered at the state level. Bold (Italic) coefficents are significant at the 5 (10) percent level or better. All models include fixed effects for age, birth year, and state of birth.

Appendix Table:
Effect of Kindergarten on Enrollment of 5 yr olds

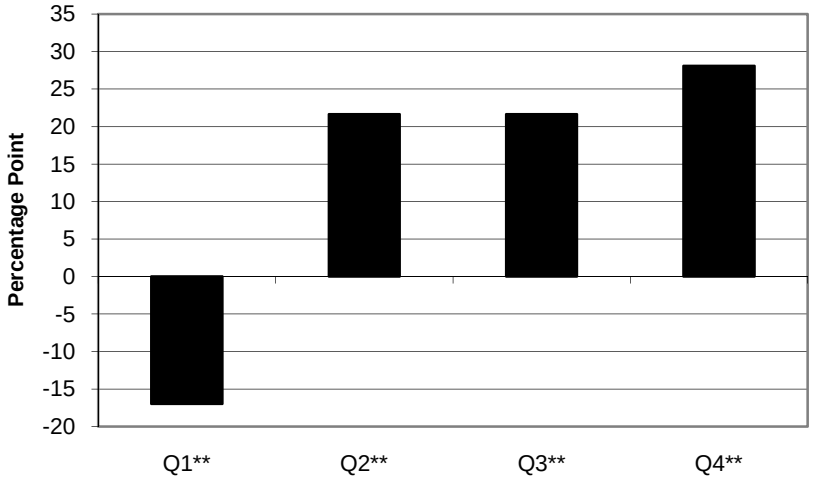
Panel A: Female, October 1 Cutoff



Panel C: Male October 1 Cutoff



Panel B: Female, January 1 Cutoff



Panel D: Male, January 1 Cutoff