# The Extent, Patterns, and Implications of Kindergarten "Redshirting"

Daphna Bassok & Sean F. Reardon

## Abstract

Kindergarten "redshirting"—the decision to delay a child's kindergarten entry—may have consequences not only for the redshirted child but for other children whose grade cohort is affected. We use nationally-representative data to estimate the prevalence of redshirting, its relationship to observable characteristics, and its impact on the composition of kindergarten cohorts. We find that only 4 percent of children delay kindergarten, a lower number than typically reported. Male, white and high SES children are most likely to delay kindergarten. However, we find no evidence that delayed entry is related to children's social or cognitive skills prior to school entry. Given the low redshirting rates nationwide, redshirting has only modest effects on the magnitude of national kindergarten-entry achievement gaps.

**Keywords:** school readiness, kindergarten, academic redshirting

**The Extent, Patterns, and Implications of Kindergarten "Redshirting"**

According to scholarly and popular reports, "academic redshirting" in kindergarten—the practice of delaying a child's entry into kindergarten for a year—has become increasingly common (Bazelon 2008; Paul 2010; Weil 2007; Graue and DiPerna 2000). In the past, most children entered kindergarten at age five, but a recent New York Times article noted that in 2008, 17 percent of kindergarten entrants were six years or older (Paul, 2010). While the shift towards later school entry is partially explained by changes in school entry laws, the bulk can be attributed to the increasingly common practice of redshirting (Deming & Dynarski, 2008).

Some accounts suggest that the growth in redshirting is a reaction to the increasingly "academic" nature of kindergarten—as kindergarten has become less play-centered and more organized around the development of literacy and math skills, some parents may delay their children's entry because they believe their child is not developmentally ready (Cosden, Zimmer, & Tuss, 1993; Graue, Kroeger, & Brown, 2002; Noel & Newman, 2003). Other accounts emphasize the strategic nature of parents' decisions—redshirting reflects parents' desire to ensure their child will enter a kindergarten class older, taller, and with higher levels of social, behavioral, and cognitive skills—relative to his or her classmates—than if he or she entered at the age when first eligible to enroll (Frey, 2005; Graue et al., 2002; Matlack, 2011).

Redshirting—regardless of parents' reasons for it—produces a dynamic situation in which individuals' decisions and their consequences may depend explicitly on the decisions of others. A child's relative position in the developmental distribution of his or her classmates depends not only on whether he or she enters kindergarten 'on time,' but also on whether (and which) other children do so. If the children who redshirt are those with the lowest academic or social skills at the time when they are eligible to enroll, their delayed entry will tend to compress

the skill distribution of a kindergarten cohort. Conversely, if those who enter late are disproportionately from more advantaged backgrounds and have higher social and cognitive skills, their decisions may widen the skill distribution of a kindergarten cohort. In turn, school curricula and instructional practices may be affected by the composition of a grade cohort.

Because of this dynamic interdependence between parental decisions and grade cohort composition, it is important to understand the factors that shape parental decisions regarding the timing of kindergarten entry as well as the collective implications of these decisions. In this paper we provide evidence to inform three aspects of these processes. First, we use a large, prospective, nationally-representative dataset to estimate the proportion of students who delay school entry. There is considerable variation in estimates of the percentage of students who are redshirted; our data provide more credible evidence than many other sources.

Second, we investigate how redshirting is related to family and child characteristics. When making kindergarten entry decisions parents may consider their child's cognitive and academic ability, physical development, and social and emotional skills. They likely consider not only their child's development in some absolute sense, but also relative to their friends and local age peers. While public kindergarten is free, the decision to redshirt a child means a family must pay for an additional year of preschool or a parent must forego some employment to take care of a child. For low-income families, then, redshirting may be prohibitively expensive. Existing research tells us little about how parents make decisions about delaying kindergarten, and the current study aims to fill this gap.

Finally, we investigate how aggregated parental decisions shape the composition of a kindergarten cohort. Although individual parents make kindergarten entry decisions based on the costs and benefits they perceive for their own child and family, the aggregated decisions of

parents could have ramifications for the learning experiences of all children, over and above any individual impacts. As long as some children enter kindergarten when they are legally eligible while others delay, redshirting will expand the age and potentially ability distribution of kindergarteners. Greater variation in age and ability within a classroom may have important consequences for children's learning if it affects the pedagogical approach a teacher takes. In addition, if non-poor, white children are systematically starting school later than their poor and minority peers, this could exacerbate socioeconomic and racial achievement gaps.

Although a growing body of research on school entry age has estimated the returns to delayed kindergarten entry for individual children (Bedard & Dhuey, 2006; Black, Devereux, & Salvanes, 2008; Datar, 2006a; Dobkin & Ferreira, 2010; Elder, 2010; Stipek, 2002), we are aware of no studies that have investigated the impact of families' aggregated decisions on grade cohort composition and aggregate outcomes. In the current analysis, we partially fill this gap, by describing how the aggregated decisions of parents shape the composition of a kindergarten cohort. We leave the investigation of how parental decisions and cohort composition shape instructional practices and collective outcomes for future research.

## Background

### *Schooling and the Grade-Structure of Childhood*

To understand redshirting, it is useful to think about how school as a social institution shapes our notions of time, particularly developmental time. Before children enter school, perhaps the most common question they are asked by adults is "how old are you?" (Chudacoff, 1989). After they begin formal schooling, however, the more common question is "what grade are you in?" Thus, after the start of schooling, one's grade becomes a more salient marker of

developmental time than one's age. A child's grade cohort serves as a primary reference and peer group throughout childhood: students generally compete against (and so are compared to), their grade peers in sports; they take grade-specific and -normed achievement tests; in high school they are ranked according to their relative performance in their grade; and so on.

In thinking about their children's entrance into kindergarten, parents may, quite reasonably, consider where their child will fit in the distribution of their grade peers. For children born near the birthdate cutoff for entry into kindergarten, a small difference in chronological age may translate into a large difference in one's position in the distribution of one's grade peers. Thus, the choice of when to enroll one's child in kindergarten may be quite consequential in terms of the child's relative rank within a grade cohort.

The characteristics of a child's grade peers that are most salient to parents may differ among parents and may vary across time. If success in sports is most important to parents, they may consider their child's height and physical development relative to his or her grade peers; if academic success is most important, they may focus on cognitive skills. In the current accountability era of U.S. education policy, test scores have become a particularly salient marker of success in schooling; as a result, we might expect parents to be particularly concerned with their children's cognitive skill relative to their potential grade peers.

*Recent Trends in Kindergarten Entry Age*

Two factors determine the age at which a child enters the public schooling system—the age at which the school system allows parents to enroll their child and parents' decision about whether to enroll their child when first eligible. In the early half of the 20$^{th}$ century, as kindergarten became institutionalized as part of the public school system, the percentage of five

year olds enrolled rose from approximately 0 to 60 percent. (Cuban, 1992). In recent decades, however, the percentage of six year olds enrolled in first grade or above has gradually dropped from 96 percent in 1968 to 83 percent in 2008 (Deming & Dynarski, 2008; Paul, 2010) .

In part, this shift in age is explained by changes in school entry laws. Between 1975 and 2000, 22 states increased the minimum entry age for kindergarten (Stipek, 2002). While in 1975 only six states required that children entering kindergarten turn five before September 14th, by 2004 29 states mandated this (Elder & Lubotsky, 2009). Within the current high-stakes accountability context, states are under intense pressure to demonstrate standardized test score gains. Changes in entry cut-offs result in older cohorts. It may be that older children are more "ready" for the demands of school and that this heightened "readiness" places them on a higher learning trajectory. Beyond this, because older children outperform younger ones on standardized tests, shifting the kindergarten entry cut-off back can create the appearance of a one-time boost in average achievement (Barua & Lang, 2009; Bedard & Dhuey, 2009).

*The Extent of Redshirting*

Policy shifts in entry laws only partially explain why children are systematically entering kindergarten at a later age. The decisions of individual parents to delay entry also play a part. Estimates about the prevalence of redshirting vary substantially. Early efforts to describe the incidence of redshirting focused on individual districts or states and reported that between 7 and 19 percent of families delay kindergarten entry (Bellisimo, Sacks, & Mergendoller, 1995; Brent, May, & Kundert, 1996; Cosden et al., 1993; Graue & DiPerna, 2000). Because each of these studies relies on distinct definitions of redshirting, it is difficult to determine whether the wide range of estimates reflects regional differences in redshirting patterns, changes over time, or

measurement error.

In recent years, several studies have provided estimates of redshirting based on nationally-representative data. Byrd, Weitzman, & Auinger, (1997) find that in a national sample of children ages 7 to 17, approximately 12 percent are "old-for-grade" and have never repeated grades, which they argue is a strong proxy for delayed kindergarten. Using parent-reported data from the National Household Education Survey (NHES) of 1993 and 1995, Zill, Loomis, & West, (1997) report that approximately 9 percent of first and second graders delayed kindergarten entry. Lincove & Painter (2006), who use retrospective data from the National Education Longitudinal Study of 1988, also report redshirting rates around 9 percent but base these estimates only on children with summer birthdays (for whom redshirting is likely most common). Finally, estimates from the kindergarten cohort of the Early Childhood Longitudinal Study (ECLS-K), which tracks a nationally-representative sample of children who entered kindergarten in 1998 are lower; 5 percent if calculations are based on children's age at kindergarten entry and 7 percent if parents' reports of are used (Datar, 2006a).

While informative, these studies, which place the national red-shirting rate between 5 and 12 percent, rely on data from cohorts born in the late 1970s through the early 190s. Kindergarten entry behaviors have likely shifted due to changes in kindergarten cutoff dates, increased understanding about child development, large-scale expansions in preschool opportunities and increased school-level accountability. In addition, these studies rely on retrospective parental reports or fairly crude proxies to identify redshirting and most do not account for differences across states in school entry laws (Datar, 2006a is an exception). To date, none of the nationally-representative studies have used prospective data that allows researchers to directly observe children's school entry decisions. The current study leverages prospective, nationally

representative data to provide more recent and reliable estimates of redshirting.

### *Who Redshirts?*

The popular press emphasizes that white children, boys, and children from families with more resources are over-represented among redshirters, a claim confirmed by earlier research (Datar, 2006b; Dobkin & Ferreira, 2010; Zill et al., 1997). A nationally representative survey of parents with children ages 3-5 not yet enrolled in school indicates that 3 percent of parents with a high school diploma or less planned to delay kindergarten entry compared to 12 percent of parents with a Bachelor's degree, and that white parents were more than twice as likely to plan to redshirt relative to Black and Hispanic parents (O'Donnell & Mulligan, 2008).

No study we are aware of has modeled the kindergarten entry decision accounting for differences in children's development at the time the school entry decision is made. For instance, while previous studies have shown that boy are more likely than girls to delay kindergarten, they have not explored whether this difference was explained by actual differences in development between boys and girls. In this study we describe differences in school entry patterns across groups, and explore whether gaps are partly explained by differences in children's ability.

### *The Potential Individual and Aggregate Implications of Redshirting*

As noted above, a parent's decision to redshirt their child may affect not only that child's subsequent development and outcomes, but also other children's outcomes. Thus, when considering the implications of academic redshirting there are two classes of effects to consider: the individual impact on a given child if he or she delays entry rather than enrolling when first eligible; and the collective impact on the distribution of developmental outcomes that results

from the aggregate decisions of all parents.

There has been substantial interest among researchers, policy makers, and parents, in understanding the extent to which age at school entry (both true and relative) impacts children's short and long-term outcomes (Dhuey & Lipscomb, 2008; Elder, 2010; Evans, Morrill, & Parente, 2010; Fredriksson & Ockert, 2005; Jurges & Schneider, 2007; Puhani & Weber, 2007; Stipek, 2002). Estimating the impact of delayed school entry is challenging and the findings from the most rigorous studies are mixed. For instance, Bedard & Dhuey (2006) show that students who are young relative to their classmates score significantly lower on standardized tests than their older peers and more likely to attend four-year college. However, other studies report negative or mixed results, and suggest that any relative age advantage is counteracted by spending one fewer year in the labor force (Black et al., 2008; Dobkin & Ferreira, 2010).

In the current paper we do not attempt to add to the literature on the individual impacts of age at entry. Instead, we provide preliminary evidence about two ways in which, when aggregated, individual decisions may influence children's peer environments at school. We then explore how these differences may impact average school-entry skill differences among demographic groups of children. No matter where a state sets their kindergarten cut-off date, some children will end up being relatively young while others relatively old, potentially creating a zero-sum game with respect to the benefits (or detriments) of being among the oldest children in a class. This, in and of itself, will play no role in narrowing or exacerbating racial or social achievement gaps. However, *compliance* with a state's cut-off date may differ across groups. We hypothesize that low-income families are more likely to comply with kindergarten entry laws primarily because of their need for affordable child care arrangements. In our study we test this hypothesis, as well as its implications for achievement gaps.

A second way redshirting could impact students' aggregate learning experiences is by influencing the range of ability or maturity in kindergarten cohorts. When some individuals adhere to school entry laws while others do not, the range of ages in kindergarten cohorts will spread beyond the proscribed 12-month range. It is unclear a priori whether greater within-grade age variation will have positive or negative implications for children. Although we are unable to address this question directly with our data, we can provide some intuition by describing how children who do and do not redshirt differ on various developmental outcomes. If students who delay kindergarten would have been among the least developed on a particular outcome had they entered "on time," then by delaying kindergarten by a year they will contribute to a narrowing of the skill distribution relative to what it would have been had they entered on time. On the other hand, if children with average or above average developmental levels delay kindergarten entry, then by the time they enter kindergarten a year later, they will likely be at the very upper end of the distribution, not only with respect to age, but also potentially size, cognitive ability and social skills. We explore this issue and provide evidence on how the characteristics of children who redshirt influence the composition of kindergarten classrooms.

To summarize, the current paper adds to the previous literature in several ways. First, we provide more reliable and current information about the extent of redshirting nationwide, and the characteristics of children who delay school entry. Second, we examine whether the decision to delay kindergarten is related to observable differences in children's cognitive, social or physical development. Finally, we discuss the implication of these findings for the composition of kindergarten classrooms and for achievement gaps across groups.

## Data

This paper utilizes data from the Early Childhood Longitudinal Study- Birth Cohort (ECLS-B) which is the first study to track a large, nationally-representative sample from birth to school entry. The base sample includes approximately 10,700 infants born in 2001. Data were collected at five time points, and each wave includes direct child assessments as well as detailed parent interviews. Wave 4 was conducted in the fall of 2006 when the majority of the sample began kindergarten. Approximately a quarter of the sample was not yet age-eligible for kindergarten in their state and some children who were age eligible did not enroll. The fifth round of data collection tracked the subsample of children who entered kindergarten in the fall of 2007. This means we are able to observe each child both in the year they turn five and in the year they enter kindergarten, regardless of whether these occur in the same or different years. This key feature of the ECLS-B is in contrast to datasets such as the kindergarten cohort of the ECLS which focus on grade rather than age cohorts.

We observe each child's month of birth as well as their state of residence at age five. We use these two pieces of information, combined with data on state kindergarten cut-off dates, to determine whether the child was age eligible for kindergarten in 2006, and the distance (in months) between their birthday and the state cut-off. Data on state kindergarten cut-off dates, collected by the Education Commission of the States, is presented in Table 1. Entry cut-off dates vary from as early as July 1 in Indiana to January 1 in Connecticut, with the modal entry cut-off date set at September 1. Nine states, most of which are in the Northeast, do not have a state-mandated kindergarten entry cut-off. These states, which typically allow individual districts to determine their own kindergarten entry policies, are omitted from our analysis.[1]

The ECLS-B includes rich contextual information about children and families. We use data on gender, race and socio-economic status to examine whether the likelihood of compliance

with kindergarten entry laws varies across groups. In addition, the dataset provides several measures of children's "school readiness." The combination of measures available in the ECLS-B allows us to assess the extent to which kindergarten entry decisions are based on children's ability as well as parents' perceptions of their readiness.

The direct cognitive assessments provide measures of children's pre-literacy and mathematics ability at Wave 3 when the children are approximately four years old. These assessments measure skills including phonological awareness, letter recognition, print conventions, number sense, counting, and pattern understanding. We use each child's theta scores in math and literacy to construct standardized measures of students' ability.

In addition to direct assessments, the ECLS-B surveyed each child's primary care provider (preschool teacher, babysitter, etc.) and included a series of questions about the child's behavior, social skills and maturity. The items, which are modified from the Preschool and Kindergarten Behavioral Scales, Second Edition, ask caregivers whether the child makes friends easily, shares toys, works independently and acts impulsively. We use factor analysis to construct a single measure from the twenty teacher-reported measures and standardize it with mean 0 and standard deviation 1. Higher values indicate better adjustment and social skills.[2] Parents also answer similar questions about their child's social skills. We construct an analogous factor and find the correlation with the provider-reported assessments is modest (0.35).

Finally, parents were asked about their child's proficiency on a set of "basic" skills which include letter and color recognition as well as counting. We constructed a variable that ranges from 0 to 3 depending on the number of the basic skills the child could demonstrate across the following three measures: (1) child knows (at least) some of the letters of the alphabet; (2) child can identify the colors red, yellow, blue, and green by name and; (3) child can count up to 10 or

higher. Just over 70 percent of the children in our sample met all three of these basic skills, and an additional 18 percent met two of three.

## Methods

*How Many Children are Redshirted?*

We classify children as redshirters if they are born before their state's cut-off date for kindergarten enrollment, but do not enroll in kindergarten until 2007 (a year after they are eligible). We classify children as on-time entrants if they are born before their state's cut-off and enroll in kindergarten in 2006 or if they are born after their state's cutoff and enroll in 2007. Finally, we classify children as "greenshirters" (early entrants) if they are born after their state's cutoff and enroll in 2006. We then describe the prevalence of each of these behaviors within our nationally representative sample.

*Who Redshirts?*

We use regression to estimate (1) the extent to which families comply with state kindergarten entry laws and (2) the relationship between observable child and family characteristics and kindergarten entry. For each child we calculate the difference (in months) between the child's birth date and the kindergarten cut-off in their state (we call this difference $D_i$).[3] We also construct an indicator variable,$P_i$, which is equal to 1 if the child's birthday occurs *before* their state's cut-off for kindergarten (if $D_i < 0$). We fit models predicting kindergarten entrance in 2006 as a function of children's birth date relative to the kindergarten cut-off in their state. Our base model, which we fit using logistic regression, is[4]

$$\eta_i = \ln\left(\frac{\Pr(K\ Entry_{2006} = 1)}{1 - \Pr(K\ Entry_{2006} = 1)}\right)$$

$$= \beta_0 P_i + \beta_1 D_i \cdot P_i + \beta_2 D_i^2 \cdot P_i + \beta_3 (1 - P_i) + \beta_4 D_i \cdot (1 - P_i) + \beta_5 D_i^2 \cdot (1 - P_i)$$

Here $\left(1 + e^{-(\beta_0 + \beta_1 D + \beta_2 D^2)}\right)^{-1}$ indicates the estimated proportion of children who enter kindergarten when they are first eligible (those who are not redshirters) among those born -*D* months prior to the state cut-off date for their state. Likewise $\left(1 + e^{-(\beta_3 + \beta_4 D + \beta_5 D^2)}\right)^{-1}$ indicates the proportion of early enrollers among those with birthdates *D* months after the cut-off date.

If all families made choices strictly based on the states' kindergarten entry regulation then whenever $P_i$ was equal to 1, we would observe children entering kindergarten in 2006, and similarly, whenever $P_i$ was equal to 0, the child would enter in 2007. Compliance with kindergarten entry rules, however, is imperfect. We explore how the likelihood of non-compliance is related to covariates. To do this, we fit models in which we interact child and family characteristics (i.e. race, SES, gender) with $P_i$ as well as 1-$P_i$.[5] These interaction terms measure whether compliance with state cut-offs differs across groups. A significant interaction between a covariate and *P* indicates an association between that covariate and the likelihood a child enrolls in kindergarten, conditional on them being age-eligible. In other words, this interaction measures differences in the likelihood of redshirting. Similarly, a significant interaction between a covariate and (1-$P_1$) indicates an association between that covariate and the likelihood of greenshirting.

*Aggregate Implications of Redshirting*

Next, we take advantage of the unique design of the ECLS-B to provide intuition about the aggregate effects of redshirting. To do this we first combine data from Waves 4 and 5 to construct a synthetic kindergarten entry cohort. For any given outcome (i.e. pre-literacy performance) we create a new variable which is set to the 2006 value of the outcome if the child

entered kindergarten in 2006 (older compliers and greenshirters) and the 2007 value if the child entered a year later (young compliers and redshirters). Under the assumption that patterns of redshirting and greenshirting do not change significantly from 2006 to 2007, the distribution of this new variable approximates the true range of abilities among a kindergarten entry cohort.

We then assign each redshirter two rankings. The first is their percentile on a given outcome relative to all children within the synthetic kindergarten cohort, controlling for the month in which they were assessed. This ranking tells us how redshirters are performing relative to other first-time kindergarteners in the fall of the year when they begin school. The second ranking aims to measures where the redshirters would fall on this same distribution, had they started kindergarten when they first became eligible. Recall that children who begin kindergarten in 2007 are assessed both at age five and again at age six. We use each redshirter's age five score to approximate their performance had they started kindergarten in 2006, and again assign them a percentile rank relative to the synthetic kindergarten entry cohort. By constructing these two ranking scores and comparing them, we can estimate the extent to which redshirting changes an individual child's relative placement within a cohort of kindergarteners, holding constant the enrollment decisions of other children. This approximates the comparison of interest to an individual parent, who decides the timing of his or her own child, but who does not control the decisions of other parents.

We also estimate the extent to which both the average achievement levels and the variation of achievement among kindergarteners changes in a world where redshirting is eliminated. To do this we construct a hypothetical "no redshirting" kindergarten cohort similar to the synthetic kindergarten cohort described above except that in the hypothetical cohort all redshirters are assigned their scores from 2006, the year when they could have entered

kindergarten, rather than 2007, the year they actually entered.[6] We then compare the distribution of scores in this hypothetical cohort to that in the observed synthetic kindergarten cohort. We examine the extent to which redshirting influences overall levels of performance, the variation in performance among the cohort, and achievement gaps between key demographic subgroups.

## Results

### *The Extent of Redshirting*

Table 2 breaks down our sample into four categories based on kindergarten entry behaviors. The first column shows the percentage of children whose birthdays fall before the kindergarten cut-off in their state and who, in compliance with the law, begin kindergarten in 2006. The second column shows a second group of compliers who begin kindergarten in 2007 because their birthday falls after the state cut-off. The final columns show two types of non-compliers. The first, shown in column 3, are the greenshirters: children born after the cut-off who enter in 2006 nonetheless. Redshirters, shown in column 4, are children who are age-eligible for kindergarten in 2006 but who delay and do not actually enroll until 2007.

The first row of the table shows that, on average, about 70 percent of children comply with kindergarten entry laws and start in 2006, and another 24 percent comply and start the following year. Thus, 94 percent of children comply with their local kindergarten entry cut-off dates. Two percent fall in the "greenshirters" category.[7] On average, these children who enroll "early" have kindergarten experiences that are significantly different from "complier" children. For instance, 14 percent of "greenshirters" are home schooled for kindergarten, 18 percent attend private schools, and 22 percent attend transitional classrooms (i.e. transitional kindergarten, two-year kindergarten, pre-first grade, etc.). The comparable figures among children who entered

kindergarten the year they were age-eligible are 2, 11 and 2 respectively.

We find that 4 percent of children redshirt. Note that this rate is substantially lower than what has been reported in previous papers and the popular press, which generally report that 9 to 10 percent of children delay kindergarten entry (Stipek, 2002; Zill et al., 1997). There are several potential explanations for these differences. First, unlike any of the previous research, we make use of prospective, rather than retrospective, data based on a survey that specifically aims to increase our understanding of the transition into kindergarten. In addition, our figures rely on the most recent nationally-representative data available.

As a check on our estimate of the extent of redshirting, we also use data from the October Supplement of the Current Population Survey (CPS). The CPS surveys a nationally representative sample of households annually; in October, parents are surveyed regarding the age and school enrollment status of their children (U.S. Department of Commerce, 2006). The CPS data show that in October, 2006, the year that the ECLS-B children turned five, 15 percent of six-year-olds were enrolled in kindergarten and an additional one percent were attending preschool or pre-kindergarten. This figure (16 percent) over-estimates the extent of redshirting for at least two reasons. First, some of the six year olds observed in kindergarten—specifically those whose birthdays lie between their state's kindergarten cut-off and the day in October when their CPS interview is conducted—complied with their states' kindergarten entry rule. For instance, a child born on October 1st in a state with a September 1st kindergarten cut-off, will be eligible for kindergarten the year they turn six. Population-weighted estimates suggest that among six-year-olds living in states with state kindergarten entry cut-offs, about eight percent of six year olds fall into this category.[8,9] In other words, we would expect to see eight percent of six year olds in kindergarten in October, based strictly on their states' cut-off.

In addition, the CPS indicates that three percent of six-year-olds are repeating kindergarten. These children likely began kindergarten when age-eligible but were retained in grade. Once we account for these kindergarten repeaters and the eight percent who are compliers, we are left with approximately 5 percent of six-year-olds who should properly be classified as redshirters. This figure is well-aligned with the evidence from the ECLS-B.

*Who Redshirts?*

The remainder of Table 2 highlights differences in school entry patterns across groups. Redshirting is twice as likely among boys as it is among girls. While 2.3 percent of children in the lowest SES quintile delay kindergarten entrance, the figure is 6.4 among children in the highest quintile. The differences across racial groups are particularly striking. Nearly 6 percent of white children are classified as redshirters. In contrast, fewer than 1 percent of black children delay entry. The figures for Hispanic and Asian children are only 2 and 2.7 percent, respectively.

The patterns for greenshirting, or early entrance, are largely the reverse. Girls are more likely than boys to start kindergarten before they are legally eligible. About 3.6 percent of children in the lowest SES quintile do so compared to only 1.4 percent of children in the highest SES quintile. We observe relatively high rates of early entrance among Asian and black children (5.8 and 4.6 percent respectively) compared to the low rates we see among whites and Hispanic children (1.1 and 1.7 percent).

Figure 1 expands on these findings graphically. It shows how the aggregate patterns discussed above are related to proximity to the kindergarten cut-off date. The curve reflects the predicted probability of starting kindergarten in 2006 estimated using a logistic regression. Nearly all children born 5 or more months before their state cut-off enter kindergarten in 2006.

The likelihood of starting kindergarten in 2006 drops rapidly for children who are more proximate to the cut-off date and among children born in the month before the cut-off, about 80 percent actually enroll "on time." Figures 3-5 show the same information, broken down by gender, race and SES. The gap in the likelihood of redshirting is most pronounced for children with birthdays just before their state cut-offs, particularly between low and high SES children.

*Are Differences in Kindergarten Entry Explained by Developmental Differences?*

During Wave 3, when children were age four, parents were asked a series of questions regarding school readiness and their plans for enrolling their children in kindergarten. Table 3 shows that about a fifth of parents indicated they had concerns about their child's readiness. The parents of boys were nearly twice as likely as those of girls to indicate readiness concerns (23.5 and 12.5 percent respectively.) Parents in the lowest SES quintile were also much more likely to identify concerns relative to families in the highest SES quintile (20.4 compared to 12.6). The most commonly cited issues were around academic, behavioral and speech readiness. Notably, only 2.5 percent of parents with school readiness concerns indicated that their child's relative age in kindergarten was the reason.

Parents were also asked whether their child would enter kindergarten early, on time, or late. There are striking differences across groups in kindergarten entry plans. Among girls' parents, 4.3 percent indicated they were planning to wait, compared to 7.8 percent of boys. Because parents also expressed much more concern about their boys' readiness, this suggests that developmental concerns may be behind parents' kindergarten entry decisions.

That said, only 4.2 percent of parents in the lowest SES quintile indicated they planned to delay kindergarten entry compared to 8 percent of parents in the highest quintile. In addition,

nearly 15 percent of parents in the lowest SES quintile planned to enter their child into kindergarten early compared to only 5 percent of parents in the highest SES quintile. Though parents in the lowest SES families are more likely to be concerned about their children's readiness for kindergarten, they are far more likely to indicate they plan to enroll them in kindergarten early, and are also less likely to delay kindergarten. These patterns are consistent with our hypothesis that poor families feel more urgency to enroll their children in kindergarten due to the expensive costs of childcare. It may also be that parents of low-income children believe the programs that are available for their child in kindergarten are superior to available alternatives, irrespective of the child's "readiness." It is striking that such gaps in parents' plans across groups are evident about a year in advance of kindergarten entry. It is unclear however, if these differences in entry plans are caused by different norms, constraints, or expectations across groups, or whether they are a reflection of true differences in readiness among children.

Next we examine whether red-shirting is explained by children's developmental outcomes at age four. Because the bulk of non-compliance behavior occurs in the months before and after the cut-off, we focus on children born within three months of their states' cut-off for our regression analysis. The first two columns of Table 4 show results from a series of linear probability models predicting kindergarten entry in 2006.[10] These models provide information about bivariate relationships between child characteristics and kindergarten entrance behaviors. Each model is numbered, and the results can be read horizontally. For instance, the first row shows the coefficients on an interaction term between "pre-cut-off" and "female" and another on the interaction between "post-cut-off" and "female." They show that among children who will turn 5 in the 3 months *before* their state's kindergarten cut-off, boys are 6 percentage points more likely to redshirt. The coefficient on the "post-cut-off" term is positive but insignificant.

The next model shows that among children who will turn 5 in the 3 months *before* their state's kindergarten cut-off white children are far more likely to redshirt than non-white children. Black children are 14 percentage points more likely than whites to begin kindergarten in 2006, and the rates are 13 and 11 percentage points respectively for Hispanic and Asian children. Black and Asian children are also much more likely to "greenshirt." Note, however, that there are substantially fewer than 100 Asian children in the sample whose birth date lies in the three months after the cut-off, so the estimates for Asians are imprecise.

The models for SES are consistent with our earlier discussion. We find that a one standard deviation decrease in socioeconomic status is associated with a 7 percentage point increase in the likelihood of entering kindergarten among age-eligible children. We also find strong associations in the expected direction between redshirting and both poverty status and maternal education (not shown).[11] Note that aside from the racial differences discussed above, we find no significant associations between demographic characteristics and early entrance.

In the lower panel we present results from models that examine whether kindergarten entry decisions are also systematically related to measures of child development. We might expect that parents of children with lower social or cognitive skills would be more likely to delay their child's kindergarten entry, and similarly that children with stronger social or cognitive skills would enter early. In general, we do not observe these patterns. We find no relationship between redshirting or early entrance and children's social skills as measured by either their parents or their teachers. Similarly, there is no relationship between entry behaviors and parents' assessment of their children's basic skills. We do observe an association between entrance behaviors and children's direct mathematics and reading assessment. Among children born in the three months prior to the cut-off date for their state, a standard deviation increase in math

score is associated with a three percentage point *higher* likelihood of redshirting. This means that, at least within the bivariate context, it is actually the higher performing children who are delaying kindergarten rather than those children who are struggling (note this relationship is only marginally significant, $p<.10$).

Finally, we observe that children who had very low birth weights are more likely to delay kindergarten. In additional models, not shown, we find no relationship between kindergarten entry timing and their age four height, weight, or body mass index. We therefore posit that the significant relationship with low birth weight and kindergarten entrance may be capturing a host of developmental outcomes rather than a simple measure of physical development. With the exception of very low birth weight and the "counterintuitive" mathematics and reading results, our measures of child development are not significant predictors of redshirting or early entrance.

In columns 3 and 4 we explore whether trends hold up within a multivariate context by running a single regression that includes all key demographic and developmental variables within a single model. Race, SES and gender are all correlated, and the coefficients change somewhat when they are included in a single model, but the overall patterns are the same. It is notable that the racial differences in school entry patterns are still pronounced in this context, and the results remain largely unchanged if we also account for family structure, poverty, and other family characteristics (results not shown). This may suggest differences in norms around redshirting across communities.

The combined model also allows us to examine whether some of the demographic gaps we observe are explained by differences in development across groups. For instance, we can examine whether the higher rates of redshirting among boys are explained away when we account for either social or cognitive ability measures. This does not appear to be the case. The

coefficients for all the demographic characteristics are virtually unchanged when we account for children's abilities. Once we account for SES and other demographic covariates, children's math and reading ability are no longer related to their likelihood of starting kindergarten on time. We still observe that children with very low birth weight are more likely to delay kindergarten, however, no other measures of child development are related to the entry decision.[12]

*Implications for Aggregate Cohort Composition and Achievement Gaps*

Our results so far highlight two key patterns. The first is that the overall rate of redshirting is relatively low compared to most prior estimates. Redshirting is not nearly as common as some popular accounts would suggest. Second, our findings show substantial differences in kindergarten entry behaviors across demographic groups, with little evidence that these gaps are explained by developmental differences across children. In this final results section we discuss the implications of these findings for individual children, for the composition of cohorts, and for achievement gaps.

We start by estimating how redshirters' relative standing within a kindergarten entry cohort would differ had they entered kindergarten when they were first age eligible. Table 5 shows that redshirting substantially increases a child's relative position within a national kindergarten cohort. By definition, redshirting will have a substantial impact on a child's relative age in a cohort. On average, had a redshirting child entered kindergarten when eligible, he or she would typically rank at the 24$^{th}$ percentile of the age distribution. By waiting a year, their rank rises, on average, to the 96$^{th}$ percentile. On average, children who redshirt would be in the 40$^{th}$ percentile of literacy ability, had they started school in the fall of 2006 when they were first eligible. We estimate that by 2007, when they actually enter school, their rank rises more

than 20 percentile points, to the 63rd percentile. Similar patterns hold for their math scores as well as their physical development. The table shows that postponing kindergarten by a year makes a substantial difference in a redshirting child's relative position. It is worth noting that redshirters' performance at age 5 would not place them at the bottom end of the national distribution for any of the developmental outcomes. In fact, had they entered "on time" these children would typically be between the 39th and 48th percentile with respect to literacy, math, height and weight. This suggests that by delaying kindergarten these children are likely contributing to an expansion of the overall skill distribution in a kindergarten cohort.

Next we examine the scenario where red-shirting is fully eliminated. In Table 6 we describe the average developmental outcomes for the synthetic kindergarten entry cohort, and then present the same descriptive statistics but assign each of the redshirters their scores from 2006, when they were first eligible for school. Based on the results presented above, we would expect average scores, as well as the variation around these scores to drop, because redshirters will have systematically lower scores the year they were first eligible to enroll in kindergarten than they have in the following year, when they did enroll. The table shows that while the point estimates do indeed move in this direction, the change is slight, ranging between 2 and 5 percent of a standard deviation decrease in mean outcomes in the scenario where no children redshirt. Further, there are no sizeable differences in the standard deviations of these outcomes. Given that the percentage of children who redshirt is relatively low, the overall impact on cohort composition at the national level appears minimal.

Finally, in Table 7 we explore the implications of redshirting on achievement gaps. Our earlier findings imply that redshirting will exacerbate achievement gaps. White, wealthy and male children are much more likely to redshirt than their minority, poor or female peers. They

are therefore systematically older at kindergarten entry, and in turn are also systematically older whenever they take achievement tests that are used to measure achievement gaps. Black and Asian students also "greenshirt" which further broadens the age gaps between children by race. In Table 8 we present results from OLS regressions estimating math and reading Z-scores (M=0, SD=1) on race, gender and SES separately. We run these models in two different ways. First we use children's cognitive scores at kindergarten entry. These models approximate the achievement gap (in standard deviation units) among a kindergarten cohort, accounting for state fixed effects. We then run the same models but assign the redshirters their age 5 outcomes.

The first column shows the substantial gaps in math ability among the synthetic kindergarten entry cohort. Black children perform more than half of a standard deviation lower on this assessment than white children, and Hispanic children are doing even worse. Asian students appear to perform somewhat better than their white peers, and girls slightly outperform boys, although these patterns are not statistically significant. The largest gaps are evident for socioeconomic status. Children in the lowest SES quintile score more than a standard deviation below those in the highest SES quintile. The gaps in reading (shown in the third column) follow similar overall trends, and here the patterns are significant for both Asians and girls.

Columns two shows the math achievement gap when we assign the redshirters their 2005 rather than 2006 score. As expected, in nearly all cases, the groups of children who are most likely to redshirt (i.e. whites, males and high-SES children) decrease their relative advantage compared to other children under this scenario. Racial gaps between white children and black and Hispanic children narrow in the "no red shirting" scenario, as do SES gaps. In addition, the extent to which Asian children and girls outperformed their white and male peers increases in the no redshirting scenario. That said, the magnitude of the differences between the models is not

large. Because relatively few children delay kindergarten, redshirting does not substantially exacerbate national achievement gaps as measured in kindergarten.

## Discussion

Our investigation of delayed kindergarten entrance adds to the literature on school entry in several ways. First we use a large, nationally-representative dataset to provide the first detailed exploration of families' decisions to delay kindergarten entry. Unlike previous studies that only observe children once they enter kindergarten or later in life, our study makes use of data on a full age-cohort of five year olds, some of whom do and do not enter kindergarten in 2006. In addition, we have access to parent, care-giver and direct assessments of children's development *prior* to age five, so we can carefully examine whether parents decisions about kindergarten entry are related to observable measures of child development.

Our findings show that nationwide approximately 4 percent of children delay kindergarten, a substantially lower rate than has been reported in the past. We demonstrate that the likelihood of redshirting is much higher among children whose birthday falls in the months before the cut-off and that redshirting varies substantially across gender, race and SES. Very poor and black families rarely delay kindergarten entry despite the fact that these families are more likely to indicate concerns about their children's school readiness. The findings are consistent with our initial hypothesis that low-income families may view redshirting as prohibitively expensive. Giannarelli and Barsimantov (2000) report that, on average, low-income families spend 16 percent of their earnings on child-care. Within this context, the patterns we observe are not surprising.

We also examine whether rates of redshirting, as well as the gaps in these rates across

groups, are explained in part by observable measures of child development including parent and teacher reports and direct assessments. We find little evidence that this is the case. In fact, children who redshirt tend to perform *better* during pre-kindergarten than many of their complier peers, although these differences are eliminated if we account for SES. The absence of a relationship between nearly all of the developmental measures and the likelihood of delayed kindergarten entry suggests parents' decisions to red-shirt may be driven more by concerns about their child's relative age or relative physical development in their classroom than their actual cognitive or behavioral development. The evidence on the impact of relative age on student learning trajectories is mixed, and recent research suggests benefits from delayed school admission may be counteracted by losses associated with one less year in the labor force. Still, parents' desire to give their child an edge in what they perceive as a competitive environment may make it appealing for those who can afford it to give their child the "gift of time."

In the mid-eighties, a series of papers highlighted the strong relationship between month of birth and the likelihood of playing on a major league hockey team (R. H. Barnsley & Thompson, 1988; R. H. Barnsley, Thompson, & Barnsley, 1985). These papers show that in Canada, which imposes a strict, January 1$^{st}$ cut-off for junior hockey programs, players with birthdays just after the cut-off are far more likely to end up on elite hockey teams as adults. In his book "Outliers: The Story of Success," which spent 11 weeks as the number one book on the New York Times Bestseller List, Gladwell (2008) popularized this finding as an example about the potential importance of relative age. According to Gladwell, this phenomenon is explained by the large differences in size, and in turn athletic ability, between young children born ten to twelve months apart. He hypothesizes that not only do the children with an early birthday start out with an advantage but the focused attention and training they receive due to their initial talent

perpetuates gaps in ability. Parents may feel that by letting a child enter school as one of the youngest children in their kindergarten class, they are relegating them to the academic equivalent of a lifetime in "junior varsity" team or the "minors."

Our own results suggest that while redshirting substantially impacts an individual child's initial standing within a kindergarten cohort, it does not substantially alter the aggregate composition of kindergarten cohorts, nor does it substantially exacerbate achievement gaps. This is because, at the national level, the extent to which children redshirt is low enough, that the impact is not large. This should not, however, be interpreted to mean that redshirting bestows benefits for selected individuals without causing any negative repercussions for the group. First, our work shows that differential redshirting patterns systematically cause white, high SES, boys to be older relative to their peers. This implies that if redshirting rates are on the rise, and if differences in this behavior persist across groups, poor, black and Hispanic children may be negatively impacted by redshirting practices.

Second, the current study presented findings at the national level (controlling for fixed state characteristics). We would expect that in certain schools, districts, or communities redshirting is far more pronounced than what we see at the national level. Indeed in their investigation of redshirting across Wisconsin school districts, Graue and DiPerna (2000) find that the rate of redshirting varies from 3 to 94 percent. In contexts with more pronounced rates of delayed kindergarten, redshirting may have substantial impacts both on the composition of kindergarten cohorts and on achievement gaps. A child's position within their own classroom or school will likely have a greater effect on their early development than their relative standing among a national sample. It would therefore be valuable, in future work, to study the impacts of redshirting with large samples of children entering kindergarten within the same community.

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**Figure 1**

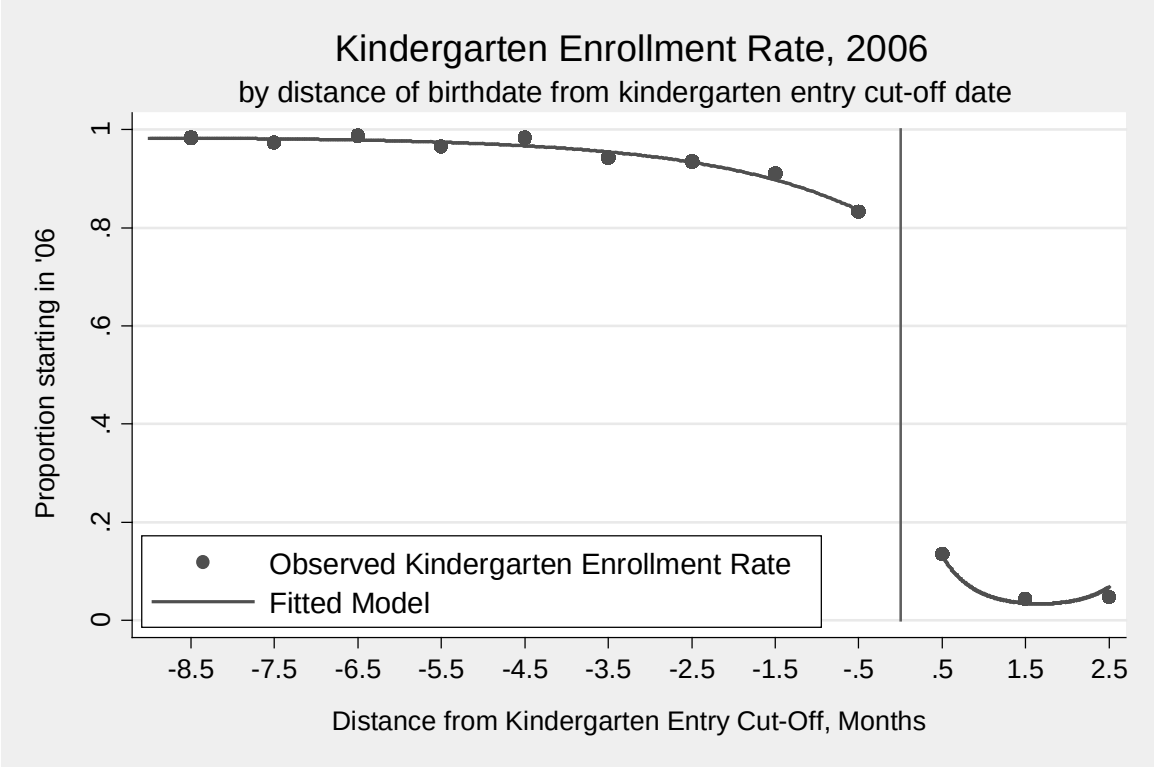


**Figure 2**

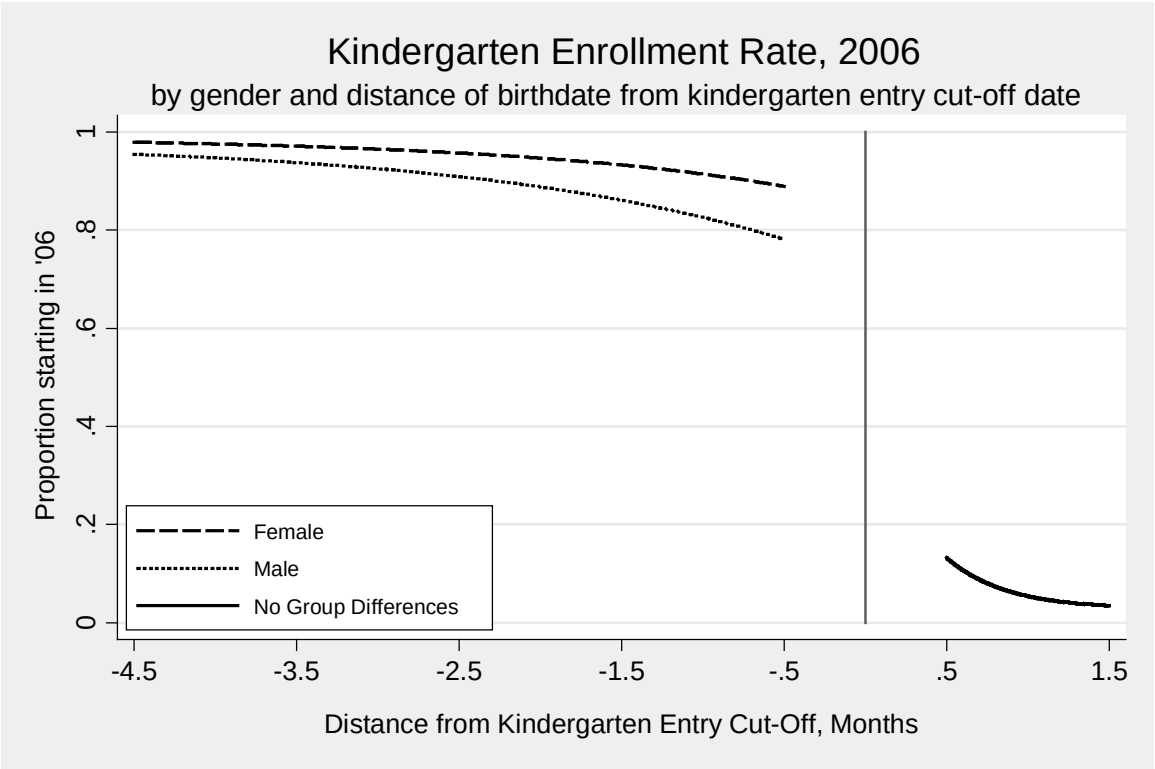

**Figure 3**

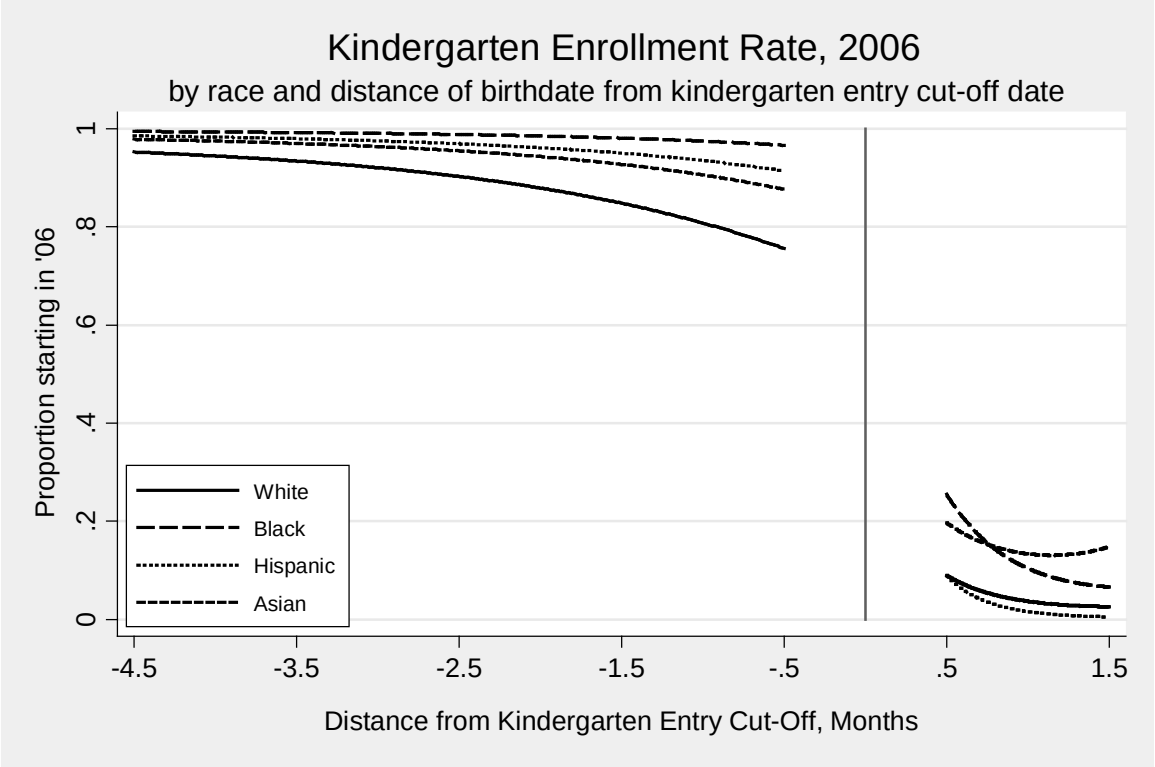


**Figure 4**

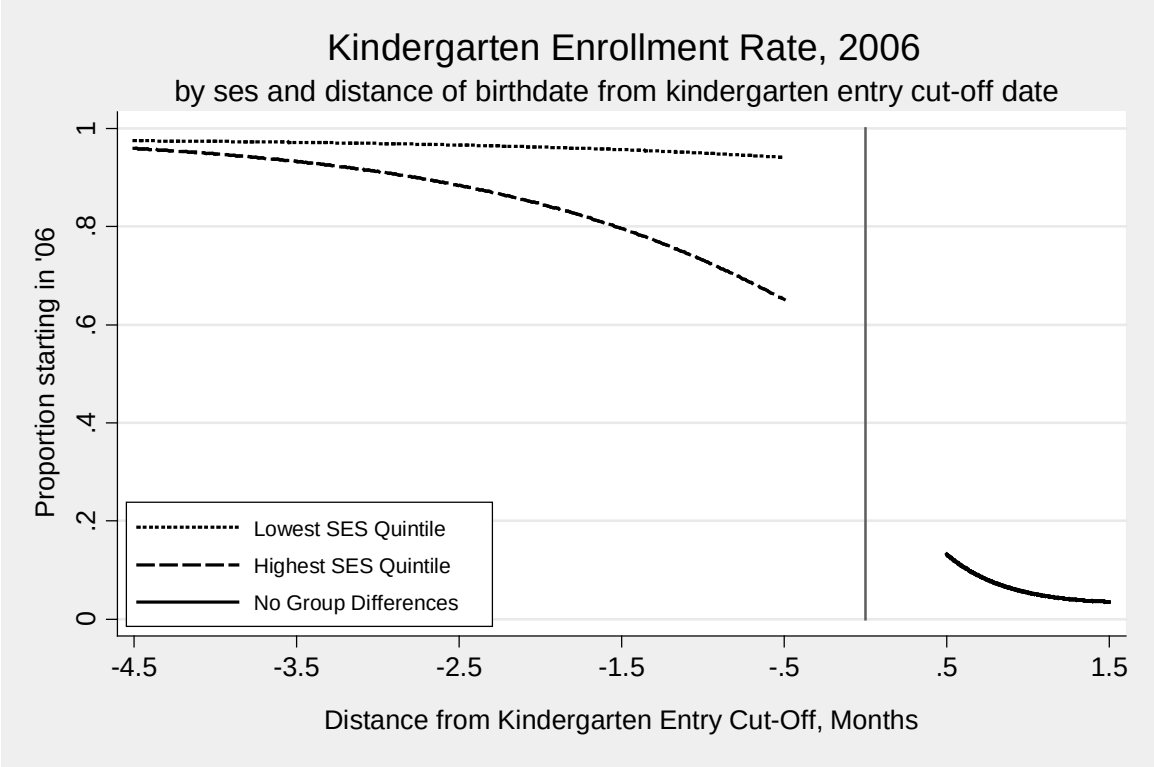

Table 1: State cut-offs for kindergarten entry, 2005

| Cut-Off | State |
|---|---|
| July 1 | IN |
| Aug 1 | HI |
| Aug 15 | AK |
| Aug 31 | DE, KS, WA |
| Sept 1 | AL, AZ, FL, GA, ID, IL, MD, MN, MS, ND, NM, OK, OR, RI, SC, SD, TX, WI, WV |
| Sept 2 | UT |
| Sept 10 | MT |
| Sept 15 | AR, IA, WY |
| Sept 30 | LA, NV, TN, VA |
| Oct 1 | KY |
| Oct 15 | ME, NE |
| Oct 16 | NC |
| Dec 1 | MI |
| Dec 2 | CA |
| Dec 31 | DC |
| Jan 1 | CT |
| No State Cut-Off | CO, MA, MO, NH, NJ, NY, OH, PA, VT |

Source: Education Commission of the States, http://www.ecs.org/clearinghouse/58/28/5828.pdf

**Table 2: Kindergarten Entry Decisions, by demographic characteristics**

| | "On-Time" Kindergarten Entry Based on Child's birthday | | Early Entrants | Late Entrants | |
|---|---|---|---|---|---|
| | Started Kindergarten in 2006 | Started Kindergarten in 2007 | Greenshirt | Redshirt | ~N |
| **Total** | | | | | |
| | 70.1 | 24.0 | 2.0 | 3.9 | 5,550 |
| **Gender** | | | | | |
| Male | 68.7 | 24.4 | 1.6 | 5.2 | 2,800 |
| Female | 71.5* | 23.6 | 2.3 | 2.5*** | 2,750 |
| **SES Quintiles** | | | | | |
| First Quintile (LOWEST) | 69.5 | 24.7 | 3.6 | 2.3 | 1,100 |
| Second | 68.5 | 26.4 | 1.6** | 3.4 | 1,050 |
| Third | 73.8* | 22.0 | 1.8** | 2.4 | 1,100 |
| Fourth | 70.3 | 23.1 | 1.4*** | 5.2*** | 1,100 |
| Fifth Quintile (HIGHEST) | 68.4 | 23.8 | 1.4*** | 6.4*** | 1,250 |
| **Race** | | | | | |
| White | 69.1 | 24.1 | 1.1 | 5.8 | 2200 |
| Black | 67.1 | 27.7* | 4.6*** | 0.6*** | 850 |
| Hispanic | 74.0*** | 22.4 | 1.7 | 2.0*** | 1,150 |
| Asian | 74.8 | 16.7* | 5.8*** | 2.7 | 600 |
| Region | | | | | |
| South | 67.4 | 27.8 | 2.3 | 2.5 | 2,450 |
| Midwest | 63.4* | 26.8 | 2.3 | 7.6*** | 1,200 |
| West | 77.5*** | 16.9*** | 1.5 | 4.1** | 1,750 |

Note: Each cell is a row percentage. Stars indicate significant difference between the marked group and the top category within each group. + 0.10 * 0.05 ** 0.01 *** 0.001

**Table 3: Parents' expectations for their child's kindergarten enrollment, at Wave 3 when child is age 4 years.**

| | Do you have concerns about child's readiness? | When will child begin school? | | |
|---|---|---|---|---|
| | % with Concerns | Will Enter Early | When Old Enough | Will Wait |
| **Total** | 18.1 | 9.5 | 84.5 | 6.1 |
| **Gender** | | | | |
| Male | 23.5 | 9.4 | 82.8 | 7.8 |
| Female | 12.5*** | 9.6 | 86.2 *** | 4.3 *** |
| **SES Quintiles** | | | | |
| First Quintile (LOWEST) | 20.4 | 14.8 | 81.0 | 4.2 |
| Second | 18.6 | 11.7 ** | 82.7 | 5.6 |
| Third | 20.1 | 9.1 *** | 85.5 ** | 5.3 |
| Fourth | 19.0 | 7.1 *** | 85.8 ** | 7.1 ** |
| Fifth Quintile (HIGHEST) | 12.6*** | 4.7 *** | 87.3 *** | 8.0 *** |
| Race | | | | |
| White | 16.7 | 5.0 | 87.4 | 7.6 |
| Black | 16.5 | 17.8 *** | 77.5 *** | 4.7 ** |
| Hispanic | 21.4*** | 13.5 *** | 83.1 *** | 3.3 *** |
| Asian | 20.8 | 13.5 *** | 79.9 ** | 6.6 |
| Multiple | 17.8 | 13.9 *** | 80.5 ** | 5.6 |
| Region | | | | |
| South | 18.8 | 11.3 | 82.6 | 6.1 |
| Midwest | 20.1 | 8.0 ** | 83.6 | 8.5 ** |
| West | 19.0 | 10.3 | 84.8 + | 4.9 |

Note: The wording of the survey item: *Most school districts have guidelines about when a child can start school based on his or her date of birth. Do you expect to enroll child in kindergarten or pre-first grade early, when he/she is old enough based on birth date, or will you wait until he/she is older? Do you have any concerns about whether child will be ready to start kindergarten?*; Stars indicate significant difference between the marked group and the top category within each group. + 0.10 * 0.05 ** 0.01 *** 0.001

**Table 4: Differences in the likelihood of starting kindergarten in 2006, by demographic and developmental characteristics**

| | | Bivariate Models | | Multivariate Model | |
|---|---|---|---|---|---|
| | | Pre Cut-off | Post Cut-off | Pre Cut-off | Post Cut-off |
| 1 | Female | 0.060* | 0.032 | 0.057* | 0.040+ |
| | | (0.026) | (0.024) | (0.026) | (0.023) |
| 2 | Black | 0.136*** | 0.091* | 0.096*** | 0.090* |
| | | (0.026) | (0.041) | (0.023) | (0.044) |
| | Hispanic | 0.129*** | -0.017 | 0.107*** | -0.026 |
| | | (0.028) | (0.024) | (0.032) | (0.022) |
| | Asian | 0.114** | 0.175** | 0.133** | 0.220** |
| | | (0.037) | (0.068) | (0.044) | (0.076) |
| | *p*(F-Test) | .000 | .004 | | |
| 3 | SES | -0.069*** | -0.010 | -0.058* | -0.012 |
| | | (0.018) | (0.014) | (0.023) | (0.016) |
| 4 | Midwest | -0.069 | 0.067+ | -0.010 | 0.051 |
| | | (0.044) | (0.037) | (0.046) | (0.035) |
| | South | 0.059+ | 0.040 | 0.063+ | 0.028 |
| | | (0.030) | (0.027) | (0.035) | (0.025) |
| | *p*(F-Test) | .001 | .164 | | |
| 5 | Social Skills | 0.020 | -0.010 | 0.007 | -0.014 |
| | (Parents) | (0.015) | (0.012) | (0.015) | (0.013) |
| 6 | Social Skills | 0.005 | 0.002 | -- | -- |
| | (Teacher) | (0.019) | (0.010) | | |
| 7 | Basic Skills | -0.008 | 0.007 | 0.008 | 0.019 |
| | (Parent) | (0.013) | (0.016) | (0.018) | (0.016) |
| 8 | Math | -0.026+ | 0.018+ | -0.004 | 0.014 |
| | | (0.014) | (0.010) | (0.022) | (0.015) |
| 9 | Reading | -0.024+ | 0.011 | 0.009 | 0.002 |
| | | (0.013) | (0.013) | (0.018) | (0.023) |
| 10 | Low Birth | 0.035 | 0.025 | 0.003 | 0.044 |
| | Wgt | (0.026) | (0.032) | (0.027) | (0.034) |
| | V. Low Birth | -0.083* | -0.005 | -0.123** | -0.027 |
| | Wgt. | (0.041) | (0.031) | (0.040) | (0.029) |
| | *p*(F-Test) | .028 | .701 | | |

Note: + 0.10 * 0.05 ** 0.01 *** 0.001; Results shown in columns 1 and 2 are from 10 separate regression models (linear probability models). The first column shows the coefficient on the covariate interacted with an indicator for a date of birth that is pre cut-off. The second shows the coefficient on the covariate interacted with an indicator for a date of birth that is post cut-off. Each model includes indicator variables for whether the child was born before or after their state cut-off as well as months from cut-off (pre & post). Excluded groups, by model, are: males, white children, none, and western states. The race model includes children who are multiple and other races, but due to small sample sizes, these groups are not shown. For similar reasons, results for the Northeastern region are not shown. Columns 3 and 4 show results from a single multivariate model (N=1900). The teacher reported measure of social skills is excluded from this model because it is only available for children who experienced non-relative care at age four, and therefore leads to a substantial drop in sample size. However, models which include this variable provide very similar results. All analyses are weighted and (as per NCES requirements) sample sizes are rounded to the nearest 50. Models include children born within three months of their state cutoff.

**Table 5: Redshirting and relative position: Redshirters' observed and counterfactual percentile ranks in synthetic kindergarten entry cohort, by developmental outcome**

| Literacy | Math | Height | Weight | Age |
|---|---|---|---|---|
| *Avg. observed percentile rank of redshirters:* | | | | |
| 62.8 | 66.5 | 68.5 | 57.8 | 95.6 |
| (29.4) | (30.4) | (26.1) | (24.6) | (5.1) |
| *Avg. counterfactual percentile rank of redshirters had they entered school in 2006:* | | | | |
| 40.6 | 47.8 | 41.0 | 38.9 | 24.0 |
| (32.3) | (31.5) | (29.3) | (24.4) | (18.7) |

Row 1 shows the observed percentile ranking of redshirters within the synthetic kindergarten entry cohort. Row 2 shows their percentile in the hypothetical case in which they entered kindergarten when they were first eligible.

**Table 6: Developmental outcomes at kindergarten entry for synthetic kindergarten cohort and hypothetical kindergarten cohort with no redshirting.**

| | | *Observed Synthetic Kindergarten Cohort* | *Hypothetical Kindergarten Cohort with no Redshirting* |
|---|---|---|---|
| Literacy | | | |
| | Mean | 0.65 | 0.61 |
| | SD | 0.79 | 0.80 |
| | 10th Percentile | -0.40 | -0.49 |
| | 90th Percentile | 1.57 | 1.54 |
| Mathematics | | | |
| | Mean | 0.64 | 0.61 |
| | SD | 0.76 | 0.76 |
| | 10th Percentile | -0.33 | -0.36 |
| | 90th Percentile | 1.59 | 1.54 |
| Height (in inches) | | | |
| | Mean | 44.37 | 44.27 |
| | SD | 2.26 | 2.27 |
| | 10th Percentile | 41.61 | 41.54 |
| | 90th Percentile | 47.19 | 47.03 |
| Weight (in pounds) | | | |
| | Mean | 48.30 | 48.08 |
| | SD | 10.07 | 10.04 |
| | 10th Percentile | 38.36 | 38.36 |
| | 90th Percentile | 60.41 | 60.08 |

Column 1 shows descriptive statistics for developmental outcomes within the synthetic kindergarten entry cohort. Column 2 shows similar descriptive statistics except that all redshirting students are assigned their test score at age 5 to simulate a scenario where all redshirters begin school when they are legally eligible.

Table 7: Achievement gaps at Kindergarten entry, with and without Redshirting

| | Math | | Reading | |
|---|---|---|---|---|
| | *Synthetic kindergarten cohort (observed)* | *Hypothetical kindergarten cohort with no redshirting* | *Synthetic kindergarten cohort (observed)* | *Hypothetical kindergarten cohort with no redshirting* |
| **Race** | | | | |
| Black | -0.599*** | -0.567*** | -0.391*** | -0.365*** |
| | (0.054) | (0.054) | (0.052) | (0.052) |
| Hispanic | -0.758*** | -0.740*** | -0.640*** | -0.624*** |
| | (0.050) | (0.049) | (0.053) | (0.053) |
| Asian | 0.108 | 0.132+ | 0.262*** | 0.286*** |
| | (0.067) | (0.068) | (0.066) | (0.068) |
| **Gender** | | | | |
| Female | 0.025 | 0.050 | 0.113** | 0.135*** |
| | (0.039) | (0.039) | (0.039) | (0.039) |
| **SES** | | | | |
| SES Q1 | -1.237*** | -1.202*** | -1.251*** | -1.235*** |
| | (0.057) | (0.056) | (0.060) | (0.060) |
| SES Q2 | -0.941*** | -0.917*** | -0.886*** | -0.869*** |
| | (0.057) | (0.057) | (0.057) | (0.057) |
| SES Q3 | -0.668*** | -0.635*** | -0.648*** | -0.625*** |
| | (0.056) | (0.055) | (0.054) | (0.053) |
| SES Q4 | -0.468*** | -0.461*** | -0.467*** | -0.472*** |
| | -1.237*** | -1.202*** | (0.055) | (0.055) |
| **N** | 5200 | 5200 | 5200 | 5200 |

Note: + 0.10 * 0.05 ** 0.01 *** 0.001; Columns 1 & 3 show results for the synthetic kindergarten entry cohort. Column 2 & 4 show similar results except that all redshirting students are assigned their test score at age 5 to simulate a scenario where all redshirters begin school when they are legally eligible. Excluded groups, by model, are: white children , males, and children whose family place in highest SES quintile. The race model includes children who are multiple and other races, but due to small sample sizes, these groups are not shown. All analyses are weighted and (as per NCES requirements) sample sizes are rounded to the nearest 50. Models are adjusted for month of assessment and sampling weights.

[1] The sample for the bulk of our analysis includes approximately 5,300 children. This drop in sample size from the Wave 1 sample size of nearly 10,700 stems primarily from attrition over time. Approximately 6,550 children have data available at kindergarten entry as well as cognitive scores from Wave 3. We lose about 1,250 additional children by dropping children residing in states without a set kindergarten entry law in 2005.

[2] Because not all children have a regular non-parental care arrangement at Wave 3, this provider-reported measure of social development is only available for a subsample of the data (~3,350 children).

[3] Recall that the ECLS-B provides information on each child's month of birth but not on their *day* of birth. Ideally, we would like to know each child's actual day of birth to precisely calculate the distance between their exact age and their state's kindergarten cut-off. Instead, we assign each child a birth date at the middle date of the month in which they were born. We then calculate the difference between the assigned birth date and the state cutoff date (in months). In states where the state cut-off is in the middle of the month, we drop children who were born during the cut-off month. For example, in North Carolina the kindergarten cut-off date is October 16th. We drop children from North Carolina born in October, because we cannot distinguish whether their birth date put them just below or just above their state cut-off.

[4] All models are weighted to account for attrition in sample selection probabilities as well as survey non-response. We use ECLS-B weight variable WK1CO which is designed for combining data on kindergarten entry across 2006 and 2007. Children born towards the beginning of 2001 are over-represented in the ECLS-B sample relative to children born later in the year. We inverse-weight our analysis (or upweight the sample towards children born towards the end of the year) to account for this imbalance in month of birth.

[5] We also explored models including interactions between demographic covariates with $D_i$ and $D_i^2$ to test whether the probability of enrollment is proportional across birthdates; an interaction with $D_i$ indicates a differential sensitivity to the proximity of the birth date to the cutoff date. These models, available from the authors upon request, show no evidence of significant interactions.

[6] Unfortunately, the ECLS-B does not have the data to assign early entrants a 2007 score in order to estimate how their outcomes would have differed had they not "greenshirted." However, the number of greenshirters is very small so is unlikely to affect our results substantially.

[7] Note that at Wave 3 when the children were age four, approximately 2 percent of parents indicated that their children were already enrolled in Kindergarten. The bulk of these children (70 percent) were born in the first half of 2001, with 15 percent born in January. Despite this, at Wave 4, nearly all these children (86 percent) are coded as first time kindergarteners and only 5 children are coded as first graders.

[8] Calculations are available from authors upon request.

[9] We exclude states without a state cut-off from this calculation. In those states, approximately 14 percent of six year olds are enrolled in kindergarten or preschool.

[10] We present findings from OLS regressions for ease of interpretation. Findings from logit models are quite similar. Results are also robust to narrowing and expanding the distance from the cut-off.

[11] We also examined whether redshirting and early entrance were related to family structure or maternal employment and did not find significant relationships.

[12] None of the multivariate results are sensitive to changes in model specification. For instance, it may be the case that the likelihood of redshirting (or early entrance) also differs depending on *when* the cut-off occurs. Accounting for cut-off month does not influence our estimates, however. We also run models that include state fixed effects. Estimates from these models describe within-state associations between child characteristics and entry practices. Including the fixed effects ensures that our results are not driven by cross-state variations either in timing of the cut-off or in any other characteristics that differ across states and may influence kindergarten entry decisions. The same patterns persist in the "within-state" framework.