Changing the Kindergarten Cutoff Date: Effects on California Students and Schools

Technical Appendix

Jill S. Cannon
Stephen Lipscomb

Description

In this appendix to our Occasional Paper, we review 14 recent rigorous studies on how entrance age affects student outcomes in the short and long term, paying particular attention to aspects that are most relevant to state-level policy decisions. We summarize findings related to elementary and secondary academic achievement, grade retention, educational attainment, adult wages, and other relevant outcomes.

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Kindergarten Entrance Age Policies and Debate

When should children start kindergarten? This question has long been the subject of debate among early childhood education experts, policymakers, and parents alike. For many, the issue is one of school readiness – that students should begin formal schooling when they have accumulated the skills necessary to meet the academic rigors ahead of them. In practice, readiness is difficult to measure and schools typically rely on the child's age in relation to a cutoff for kindergarten entrance specified by the state or a local education agency (LEA). Children reaching the age of five before the cutoff are allowed to enter, while others must wait an additional year.

Enrolling children when they first become eligible exposes them to a kindergarten environment as soon as possible. The benefits of starting students when they become eligible are often viewed from two perspectives. The first is that for many children, time spent in school settings more effectively fosters learning and development than time spent outside them. Whatever age-based performance differences exist at the beginning of schooling will narrow over time as younger children learn faster and catch up to their older peers. Further, entering "on time" at a younger age allows children to complete all of their schooling earlier, resulting in more time to be productive in the labor market.

The second view is that starting children when they are eligible but before they are truly ready is less productive than giving them additional time to mature. The practice of voluntarily delaying school entry, or "academic redshirting," is presumably done to avoid setting children up to perform poorly and fail grades.[1] Entering one year older potentially carries long-run benefits that exceed the costs of delaying entry in terms of grade-level academic achievement, degree attainment, and labor market outcomes

Research on the effects of school entry age can inform these conflicting perspectives and guide policymakers in decisions about state cutoff dates. This technical appendix summarizes recent rigorous research findings on how entrance age affects student outcomes in the short and long term, paying particular attention to aspects that are most relevant to state-level policy decisions.

Kindergarten Entrance Cutoff Dates

The kindergarten entrance age debate takes on a particular importance in California because the state has one of the latest entry cutoffs. In California, all children turning five years old by December 2 are eligible to enroll in kindergarten in a given school year. This means that the expected entry age for students born throughout the year ranges from four years and nine months to five years and nine months. In contrast, most states have adopted cutoff dates that

[1] Dobkin and Ferreira (2007, Table 3A) estimate that 24 percent of children born up to 30 days prior to December 2 in California voluntarily delayed entry in 1999. These children were most likely to be male, white, and have parents with college degrees. Among summer births, Lincove and Painter (2006) estimate that 9 percent of U.S. kindergartners in 1979 delayed school entry. Work cited by Stipek (2002) estimates that 6 to 12 percent of eligible students delayed entry nationwide during the 1990s.

fall in August or September. States with earlier cutoff dates have older entering classes of students, on average, than comparable classes in California.

Table 1 categorizes entry cutoff dates by month over the past 40 years. California is among four states to have a winter cutoff.[2] Table 1 reveals that entry cutoffs have not always been concentrated around the start of the school year. Thirty years ago, winter was the most common period for states to have their entry cutoffs. California's comparatively late cutoff is the product of a steady trend in policy changes in other states over time.

Table 1
Number of States by Kindergarten Entry Cutoff Dates, 1965-2006

	1965	1975	1985	1995	2006
Jun - Jul	0	0	0	2	1
Aug - Sept	10	12	22	29	35
Oct - Nov	13	15	11	5	4
Dec - Feb	18	17	12	9	3
LEA / none *	9	6	5	5	7

SOURCES: 1965-1995 data collected by Kelly Bedard (University of California, Santa Barbara) and Elizabeth Dhuey (University of Toronto); 2006 data from the Education Commission of the States, available at www.ecs.org, and personal communications with staff in several state departments of education.
*NOTE: Several states do not have a uniform cutoff date for all school districts. Some state laws give local education agencies (LEAs) discretion over specifying the cutoff. Other states do not have kindergarten entrance age legislation.

Concerns about school entry before age five remain an issue in California. Like most entrance age reforms enacted in other states, proposals in California have focused on moving the cutoff date earlier in the year. Most recently, the Governor's Committee on Education Excellence (2008) recommended that California change its cutoff date to September 1. State lawmakers have considered changing the date several times over the past decade. [3] Most of this legislation has failed in the Assembly or Senate appropriations committees. The exception is the Kindergarten Readiness Pilot Program created by AB 25 (2000) that allows school districts to elect and test the effectiveness of a September 1 cutoff. Although enacted, this program has never been funded.

Policy Motivation and Tradeoffs

Why states would select earlier cutoffs is a multifaceted question. Proponents of an earlier cutoff argue that it helps to solve school readiness issues. Many kindergarten curricula, and specifically those in California, currently place a heavier emphasis on academics than in previous years. This is largely in consideration of the increased focus on improved test scores in later years and the push for accountability through the No Child Left Behind Act of 2001. At the

[2] See Addendum A for a complete list of current cutoff dates by state.
[3] For example, see AB 1236 (2008); AB 683 (2007); AB 2596 and SB 1764 (2006); AB 2970 (2004); AB 810 (2003); AB 25 (2000); AB 513 (1999); and AB 85 (1997).

same time, many schools are moving toward a full-day kindergarten schedule that requires children to be in a structured environment for longer periods of time. By forcing some children to wait an extra year before entering, later entry helps the youngest students mature socially, emotionally, physically, and cognitively, so that they can succeed in the academic environment. This may boost some children's academic achievement as well as their potential for post-secondary education attainment. If students learn more from having older peers in the classroom, forcing the youngest students to delay kindergarten entry by moving the cutoff date could benefit the other children in the class as well.

Fiscal concerns also motivate moving the cutoff date earlier. The policy change creates a one-time reduction in cohort size in the year the change is implemented. When district funding is determined by average daily attendance, as it is in California, the smaller cohort reduces the state's financial commitment to school districts. The potential savings would be realized for 13 years, as the cohort moves through the K-12 system. According to the recent report by the Governor's Committee on Education Excellence (2008), moving California's cutoff date from December 2 to September 1 would save the state $700 million per year during this 13-year period.[4] The actual fiscal impact would depend on how much of these savings are reinvested into the schools in the form of readiness or pre-kindergarten programs.

Other important tradeoffs are associated with entrance age policy decisions. One is the reported test score benefit of starting children older. If valid, older entry becomes important in relation to state and federal accountability systems. Increasing the minimum entry age makes some children older when they take grade-level assessments. This may be advantageous for California on tests that compare children across states (such as the National Assessment of Educational Progress) or countries. But are children actually learning more in school? Students may perform better – given the same amount of schooling – entirely because of their greater age, especially in elementary grades where age differences are more significant.

The potential test score benefit is countered by an important interaction between entry age policy and compulsory schooling laws. California's current compulsory schooling law prohibits children from dropping out before they turn 18. This requirement is more stringent than in many states and applies to some students until they graduate high school. Nevertheless, policies that start children at older ages accept the fact that students will reach the end of compulsory education having attained less total schooling.[5] In California, students would become eligible to drop out around the time they are facing increased pressure to pass the California High School Exit Examination (CAHSEE). The coupling of these factors, along with California's sizable at-risk population, makes the effect of entry age on the probability of dropping out especially relevant for policy debates.

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[4] The California Department of Education (CDE) and the Legislative Analyst's Office (LAO) recently estimated the fiscal impact of moving the cutoff date to September 1 as well. According to the Assembly Committee bill analysis for A.B. 1236 (April 23, 2007, available through www.leginfo.ca.gov), the 2004 CDE estimate is $391.8 million per year, while the 2003 LAO estimate is up to $600 million per year.

[5] Angrist and Krueger (1991, 1992) and Bound and Jaeger (2000) agree that compulsory schooling laws influence the relationship between quarter of birth and educational attainment.

Perhaps most importantly, there is the possibility that policy change would lead to greater widening of achievement gaps between advantaged and disadvantaged children. Would being older affect subgroups differently, and what would children who are no longer eligible to start kindergarten do while they wait? The concern is that children from relatively advantaged backgrounds have greater access to high-quality early education environments that promote learning prior to entry. Given evidence that differences in school performance between economically disadvantaged and advantaged students are present at school entry and in the early grades, previous research suggests the need to address pre-kindergarten and child care policy along with kindergarten entrance age policy (Cannon and Karoly, 2007; Datar, 2006b; Duncan et al., 2007; Magnuson and Waldfogel, 2005; Reardon, 2003; Reardon and Galindo, 2006, 2007; Rumberger and Anguiano, 2004).

Synthesizing the Evidence

Given the high degree of policy interest in this issue, this paper seeks to summarize the recent evidence on the effects of kindergarten entrance age policy on student outcomes. Stipek (2002) and de Cos (1997) provide thorough reviews of the early literature on age effects. The findings they cite provide some support for the position that relatively older entry is related to modest academic gains in the first few years of schooling. Stipek (2002) concludes, based on her review of existing research, that the evidence does not support a change in cutoff date. Many of the studies she reviews involve methodological issues that limit the ability to make policy inferences. The main limitations with the earlier research are the use of small, non-representative samples and the difficulty in disentangling entry age policy and the non-school factors associated with decisions to delay intentionally kindergarten entry.

By comparison, recent studies from the economics literature attempt to overcome these important limitations. The studies from this newer literature typically use large, nationally representative samples. All use research designs that adjust for potential bias due to factors related to delaying kindergarten entry versus entering school "on time." The evidence comes from both U.S. and international data. This is important because entry age and compulsory schooling policies differ considerably. In some European countries, compliance with entry cutoff dates is greater in practice than in this country, and compulsory schooling laws require students to reach a certain grade level rather than a specific age. Thus, international evidence may provide cleaner estimates of the effect of entry age on educational attainment. Finally, the studies we examine investigate both long-term education and non-education outcomes. Altogether, these studies shed more light on what is currently known and unknown about the effects of kindergarten entrance age policy on student outcomes.

No ideal study exists to date to answer the questions most relevant for policymakers. Thus, we draw upon a number of recent rigorous studies to describe what is currently known. In some cases the message is consistent across several studies, while at other times it remains inconclusive. The studies we reference vary across time, some studying children attending school in the 1950s and others in the 1990s, making some possibly more relevant to today's education context. We also include international studies to allow us to examine specific issues relevant to the policy debate and, at times, to compare to U.S. findings. We are cognizant that

international education systems differ in important ways from ours. We identify where appropriate the findings that seem more pertinent in the policy context in California.

Each of the studies we cite meets specific criteria. First, studies must use appropriate research methods to analyze the research questions they pose. Second, they must apply their empirical framework to a sufficiently large sample size. Third, studies must have an adequate comparison group. Fourth, studies should be conducted after 2002. Finally, each study must measure the effect of entry age on student outcomes.

Fourteen studies satisfied our selection criteria.[6] In the next section, we discuss the findings from each based on the outcomes they examine. These include elementary and secondary academic achievement, grade retention, educational attainment, adult wages, and other relevant outcomes. In each subsection, we also discuss several differences in methods that may make particular studies more relevant for entry age policy debates than others. We conclude in the following section by summarizing the evidence, describing areas for future research, and discussing the implications of various policy tradeoffs for California.

[6] We include both published papers and working papers that are publicly available. We note that there may be a publication bias that results in papers with significant findings being more likely to be published than papers that find no significant differences. This may result in some studies being overlooked because they are not publicly available.

What Does Current Research Tell Us About the Effects of Being Older at School Entry?

Ideally, to determine the benefits of entering kindergarten at a particular age, we would conduct an experiment in which children who are the same age are randomly assigned to start kindergarten at different dates and their outcomes observed. Random assignment would allow us to isolate the effect of entry age because we could assume that all other things are equal, with the exception of the random selection of entry age. However, for ethical and practical reasons, schools are not willing to assign children to start school at different times randomly. Researchers of this topic must therefore use other methods to try to distill the causal effect of starting age on student outcomes.

The primary complication is the fact that parental decisions to enroll their children on time or to delay entry for a year are motivated by numerous factors, such as parental perceptions about student maturity, that are not always directly observable in the data available. These factors may be strongly related to student performance. By not accounting for them, we may erroneously attribute student performance to entry age rather than these other factors. The earlier research on this topic exhibited methodological limitations that reduce our confidence that effects found are a direct result of entry age. Research since 2002 uses statistical techniques that attempt to overcome the previous limitations and give us greater confidence that findings are a result of entry age.

A quasi-experimental approach is the next best alternative to a random assignment study. The studies we review use one of two related research designs. The intention of the first is to address whether biologically older students at kindergarten entry perform better in school. Studies using this design calculate the age at which students become eligible to start kindergarten based on their birthday and the entrance cutoff date. These studies also calculate the expected average age of each student's classroom peers. The findings have implications for California's cutoff policy because they address whether starting at an older age improves student outcomes.

The second main research design compares the outcomes of children born just prior to the state cutoff date to those born just after it. The cutoff requires that some students enter school a year older than others. Findings from these studies are informative about whether relative age differences within a class affect student outcomes. Relative age studies do not inform the decision about whether to adopt an earlier state cutoff because no matter what school entry age policy is adopted there will always be relatively older and younger children in any class. However, these studies are useful for educational purposes because teachers face students of differing ages in the classroom.

Both designs share common features. They typically use large, representative datasets that include the exact date of student birth. Researchers find that parents do not purposefully time births to fall on one side or the other of a school entry cutoff date. Thus, a student's

position relative to the cutoff date depends on the randomness of birthdates. Finally, each study focuses on determining when students are eligible to begin formal schooling rather than when they actually enroll. Age of eligibility is better methodologically because it is unaffected by decisions to accelerate or delay entry, choices that likely differ considerably across subpopulations in the state.

We summarize below the weight of the evidence of the 14 research studies we identified for six outcome areas: elementary academic achievement, middle and high school academic achievement, grade retention, educational attainment, labor market, and other relevant outcomes.[7] We present our interpretation of the evidence and discuss differences for subgroup populations where applicable. Our reading of the evidence is that adopting an earlier state cutoff is likely to boost average scores on grade-level assessments. At the same time, it is not likely to sizably affect overall retention, special education enrollment, or high school completion, and may increase adult wages.

Academic Achievement—Elementary Grades

Section Highlights:

- An earlier cutoff date is likely to improve average test scores.
- Relatively older children perform better on math, reading, and science tests.
- Boys benefit more than girls from being relatively older, especially for reading.
- Being biologically older may benefit advantaged students more than disadvantaged students. The current evidence is inconclusive whether advantaged students benefit more from relative age than do disadvantaged students.

Most of the research on elementary achievement discusses the relative age effects of being among the oldest or youngest in kindergarten without separating that from the biological age of the student. Six of the seven studies examining achievement in kindergarten through sixth grade found that students who are older at school entry outperform students who are younger (Bedard and Dhuey, 2006; Datar, 2006a; Elder and Lubotsky, 2007; Fredriksson and Öckert, 2006; McEwan and Shapiro, 2008; Puhani and Weber, 2007a). Math and reading scores were most often measured in these studies, although science, IQ, and subject grades were also found to be affected by age. The size of effects on test scores ranges from about 0.1 to 0.8 standard deviations, which translate to about 3–27 percent higher than the average score. The larger estimates tend to be for earlier grades. Results of these magnitudes are considered educationally meaningful.

Most of these studies compare students born just before and after state cutoff dates. This does not allow us to examine the effects of an incremental increase in age by moving a state

[7] Addenda B and C provide summaries of study designs and findings in both table and narrative form for these 14 studies.

cutoff date by a few months, but it does contribute to our understanding of longer-term achievement benefits of being older at school entry. In part of their analyses, Elder and Lubotsky (2007) try isolating the effects of biological and relative age. Their evidence indicates that biological age effects are the larger of the two. The results suggest that an increase in biological age can significantly improve test scores, but having older peers on average does not seem to affect scores.

Similarly, Cascio and Schanzenbach (2007) find that biologically older children perform better on achievement tests at the end of kindergarten. Their study attempts to isolate the separate effects of biological age, relative age, and the average age of classroom peers. The research design exploits the fact that students in some Tennessee schools were randomly assigned to kindergarten classes; this helps reduce bias from administrative and parental decisions that pair students with certain classmates and teachers. Cascio and Schanzenbach (2007) also find suggestive evidence that having older classmates increases a student's kindergarten test performance. In contrast with other research, they find no evidence of relative age effects. However, their research design tries to identify much smaller differences in relative age than other studies do. The finding of no significant differences is not altogether surprising in this context. Another potential limitation is whether results from Tennessee 20 years ago apply to California today.

Four studies also examined differences in outcomes by gender. There is reason to suspect that boys and girls will differ in early outcomes based on differences in maturity levels at young ages. The evidence suggests that boys benefit more than girls from being relatively older at school entry, especially for reading scores through fourth grade (Datar, 2006a; McEwan and Shapiro, 2008; Puhani and Weber, 2007a). Cascio and Schanzenbach (2007) find no significant differences by gender throughout their analysis.

Several studies compared age effects between disadvantaged and advantaged students. Cascio and Schanzenbach (2007), for instance, examine kindergarten outcomes by student eligibility for a subsidized school lunch, meaning that household income is at or below 185 percent of federal poverty level. Students who are not eligible for subsidized lunch and who are biologically older at school entry have higher test scores at the end of kindergarten than peers who are also biologically older but eligible for subsidies. By comparison, students eligible for subsidized lunch benefit more from having older classmates, in terms of kindergarten test performance.

While the evidence in Cascio and Schanzenbach (2007) suggests that biological age effects differ by economic status, it is evidence based on only one study. The remaining evidence comparing disadvantaged and advantaged students is based on relative age comparisons. The results are inconclusive across these studies. Elder and Lubotsky (2007) find a larger and more persistent benefit through fifth grade for advantaged students than disadvantaged students, especially in reading. Datar (2006a), in contrast, finds that relatively older students below the poverty line benefited more in test score gains from kindergarten

through first grade than relatively older non-poor students.[8] McEwan and Shapiro (2008) find no significant relative age differences in fourth grade scores between Chilean students whose mothers have low education levels and those with more maternal education. Cascio and Schanzenbach (2007) find no significant effects between groups for relative age differences.

Academic Achievement—Middle and High School Grades

Section Highlights:

- An earlier cutoff date is likely to improve average test scores in middle school.
- Relatively older children perform better on math, reading, and science tests.
- Older students in Germany and Sweden may benefit up through 10th by placement in higher academic tracks
- The evidence is inconclusive whether relatively older students, on average, are more likely to take the SAT or ACT. There is some evidence that biologically older advantaged students are more likely to take the SAT or ACT than biologically older disadvantaged students.
- No differences are found between boys and girls. Mixed findings are found for differences by socioeconomic status.

As children grow older, the conventional wisdom is that age differences of less than a year become less significant and less likely to affect outcomes. The story would be different if children who start at a higher academic level maintain that advantage over subsequent years in school. Thus, the question is whether the suggested benefits for elementary academic achievement of being older, discussed above, hold for students in later grades as well. If not, one interpretation is that the earlier benefits are largely a function of being older at the time of testing rather than a lasting benefit.

Eight studies we examined include indicators of academic achievement measured in middle or high school. Studies measured outcomes at eighth through 11th grades. Our interpretation of the evidence is that students who entered kindergarten at a relatively older age (generally one year older than comparison children) tend to perform about 0.10 – 0.35 standard deviations better in math, reading, and science tests (Bedard and Dhuey, 2006; Elder and Lubotsky, 2007; Fredriksson and Öckert, 2006; McEwan and Shapiro, 2008; Strøm, 2004).[9] [10]

[8] The study also found that disabled children benefited more from relatively older entry in test score gains between kindergarten and first grade. Relatively older non-poor and nondisabled children had higher kindergarten entry test scores than their poor and disabled peers, perhaps due to better preschool opportunities.

[9] Fredriksson and Öckert (2006) examined ninth-grade grade point average and subject grades in Sweden.

[10] Lincove and Painter (2006) find that students with summer birthdates who enroll on time (i.e., younger) perform better in math and reading than similar students who purposefully delay school entry for a year (i.e., redshirt). This comparison is somewhat different than in the other studies where students delay

Estimates of these magnitudes are considered educationally meaningful. Elder and Lubotsky (2007) and Fredriksson and Öckert (2006) attribute most of these effects to differences in biological age rather than differences in relative age. Similarly, Cascio and Schanzenbach (2007) find evidence that biologically older children have higher eighth-grade math and reading scores, but no evidence that the same is true for relatively older children in a classroom.

The general persistence of age effects into secondary school suggests that they are not simply a short-run result of age differences at the time of test taking (i.e., age-at-test) when children are very young. It is interesting to note that there is disagreement around this interpretation despite the common empirical findings. Elder and Lubotsky (2007), for instance, argue that entrance age effects are due to differences in skill accumulation prior to entry. They are led to this conclusion in part because age effects diminish in size between kindergarten and eighth grade. In contrast, Bedard and Dhuey (2006) and McEwan and Shapiro (2008) find more persistent effects and argue that age-at-test cannot fully explain the results. Regardless of the interpretation, the weight of evidence appears to indicate that the benefits of being older extend into high school with regard to achievement tests in math, reading, and science.

In addition to test scores, a few studies investigate other high school outcomes. Two studies examine a student's likelihood of taking the SAT or ACT as an indicator of intention to attend college. Bedard and Dhuey (2006) find that relatively older students are more likely to take the SAT. Cascio and Schanzenbach (2007), on the other hand, find no meaningful differences overall and note that although they use a different sample of students than Bedard and Dhuey, their methods would allow them to find similar effects if they existed in their data. As noted earlier, a possible limitation of the Cascio and Schanzenbach study is that the relative age differences examined are likely to be very small. Because the only studies produce conflicting overall results, interpretation is inconclusive to date.

Four international studies examine a form of tracking in high school through either a high academic track placement in German schools (Puhani and Weber, 2007a, 2007b), the enrollment in advanced classes in Sweden (Fredriksson and Öckert, 2006), or successful completion of pre-university coursework in British Columbia (Bedard and Dhuey, 2006). Findings suggest that relatively older entry leads to high tracking through ninth and 10th grades in Germany and Sweden, and through 12th grade in British Columbia. Fredriksson and Öckert (2006) attribute at least some of the effect in Sweden to biological age.

An interesting recent addition to the evidence on tracking is a study under way by Puhani and Weber (2007b). In Germany, decisions that stream students into academic and non-academic tracks can be revised in 11th grade. The current results suggest that relative age effects disappear when institutional systems allow for an adjustment to student tracking based on school decisions in mid-secondary school. This is only suggestive evidence at present, but it may indicate that institutional factors play an important role in explaining age-based

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entry primarily because they miss the cutoff date. Lincove and Painter (2006) suggest from their study of effects for redshirted children that redshirting on average does not appear to be beneficial.

differences in student outcomes. Tracking decisions made early based on factors plausibly related to biological age differences may need to be revisited periodically.

Of the four studies that examined middle- and high-school academic outcomes by gender, none found evidence that effects differ between boys and girls (Cascio and Schanzenbach, 2007; Fredriksson and Öckert, 2006; Puhani and Weber, 2007a; Strøm, 2004). Significant differences were found by socioeconomic status, although the findings are mixed. Fredriksson and Öckert (2006) find that Swedish students who have less educated parents benefit more in ninth grade, in terms of grade levels on subject tests and the likelihood of taking advanced classes, from delayed entry. Strøm (2004) finds no differences for secondary reading scores by parent education status or family resources in Norway. On the contrary, Elder and Lubotsky (2007) find that for eighth grade test scores, as with elementary grade scores, the effects of relatively older entry age for socioeconomically advantaged students are larger and more persistent over time compared to the most disadvantaged students, especially for reading. Cascio and Schanzenbach (2007) find no relative or biological age effects for eighth grade test scores between students eligible for subsidized lunch or not. They do find, however, that subsidy-eligible students who are relatively young or biologically older at kindergarten entry are less likely to take the ACT or SAT in high school. Students not eligible for subsidy and who are biologically older at school entry are more likely to take the ACT or SAT. That is, with regard to taking the ACT or SAT in high school, being biologically older at school entry appears to benefit economically advantaged students and have a negative effect for disadvantaged students.

Grade Retention

Section Highlights:

- An earlier cutoff is unlikely to change greatly the overall retention rate.
- Students whose entrance is delayed due to a cutoff date change may be less likely to be retained, but students whose entrance is not delayed by a date change may be more likely to be retained.
- Boys are more affected than girls.
- Findings related to socioeconomic status are inconclusive.

A common reason given for holding eligible children out of school for an additional year (i.e., redshirting), especially if their birthdays are close to the cutoff date, is that parents fear their children are not yet mature enough or have enough skills to manage the academic environment. This would put them at increased risk of failing to master class material and being retained a grade. Several of the studies we examine investigate the effect of being older on the likelihood of being retained.

Supporting the notion that being relatively younger may be a risk factor for later retention, five studies found a significantly decreased likelihood of being retained for children

entering school older (Cascio and Schanzenbach, 2007; Dobkin and Ferreira, 2007; Elder and Lubotsky, 2007; Lincove and Painter, 2006; McEwan and Shapiro, 2008). Lincove and Painter (2006) found this effect for young children compared to both redshirted children of similar ages but in different grades, and older children within the same grade.

Cascio and Schanzenbach (2007) also find evidence that being biologically older and having older peers in a classroom reduces the probability of retention. This is especially interesting in light of their finding that having older peers does not significantly boost eighth grade test scores. Our reading of their evidence is that older peers must benefit students in subjective ways not measured by test scores. In contrast, Elder and Lubotsky (2007) present suggestive evidence that having older peers increases the probability of retention. They argue that retention decisions are partly made by judging students relative to their peers. Significantly for California, Elder and Lubotsky conclude that changing a state cutoff from December 2 to September 1 would result in a 2.8 percentage point increase in the likelihood of retention by eighth grade for those children in the grade whose own entrance age is unaffected by the policy change. That said, Elder and Lubotsky also find that biologically older children at school entry are less likely to be retained, suggesting that a change in cutoff date policy might decrease retention for children whose entrance age is affected. A better understanding of the effect of older peers and biological age will have implications for a policy to move the cutoff date earlier.

In general, these studies indicate that entry-age effects on grade retention may differ by gender and socioeconomic group. For example, younger boys are more likely to be retained than younger girls (Dobkin and Ferreira, 2007; Lincove and Painter, 2006; McEwan and Shapiro, 2008). Researchers also suggest there may be differential effects depending on socioeconomic status, although the results are inconclusive. Older students with less educated mothers have larger decreases in retention than those with more educated mothers (McEwan and Shapiro, 2008). In contrast, the Elder and Lubotsky study finds that the effect of older entry on retention is stronger for students from higher socioeconomic backgrounds than for students from lower such backgrounds. Cascio and Schanzenbach find no evidence that age effects in grade retention are different by gender or socioeconomic group. More research on entry age differences by subpopulation in this area is certainly warranted.

Educational Attainment

Section Highlights:

- Negative effects of an earlier cutoff date on high school graduation are likely to be small if they exist at all.
- Evidence is inconclusive on the likelihood of college attendance and graduation – studies find no effects or find that older students are more likely to pursue post-secondary education.
- Limited evidence suggests effects do not differ by gender, but studies have not examined differences by race or socioeconomic status.

Compulsory schooling laws in the United States require students to stay in school until they reach a state-specified age. Because of these laws, older children at kindergarten entry become eligible to drop out having attained less schooling than their younger classmates. Compulsory schooling rules therefore complicate the relationship between entry age and educational attainment. Currently, there is less agreement among studies than there is with regard to test performance and grade retention. Some studies find no effects. Among the studies that do find effects, the evidence suggests that older students may be less likely to complete high school but possibly more likely to enroll in college.

Dobkin and Ferreira (2007) investigate the effect of entry age on high school completion in California and Texas. They present evidence that relatively younger students are a percentage point more likely to complete high school. These findings corroborate Angrist and Krueger (1991, 1992) and Bound and Jaeger (2000). In contrast to Dobkin and Ferreira (2007), Bedard and Dhuey (2007) find no effects of entry age on high school completion using the same data nationwide. The latter study examines how changes to state entry cutoff dates over 20 years affected the educational attainment of students. This makes it especially important for California's entry age debate because its research design specifically addresses changes in student outcomes that are due to changes in state entry policies.

Not all countries determine compulsory education by age. Sweden, for example, requires students to complete nine years of schooling. The distinction is important if compulsory school laws are what make older students drop out more frequently. Fredriksson and Öckert (2006) examine age effects in Sweden and find that the oldest students complete slightly more schooling and are more likely to complete two years of college.

Most of the studies we examined that looked at post-secondary enrollment and completion in the U.S. found no evidence of age effects (Bedard and Dhuey, 2007; Dobkin & Ferreira, 2006; Lincove and Painter, 2006). An exception is Bedard and Dhuey (2006). Although this appears to contradict the results in their 2007 study, the two papers measure different effects. The 2006 study examines differences in relative maturity across individuals in the same grade level. It focuses on the 12-month age difference between students who are expected to be the oldest and the youngest in each class and documents that the relatively oldest students are 12 percent more likely to enroll in college. The 2007 study analyzes the effect on post-secondary student enrollment decisions of a state policy change that moves the entry cutoff from January to September. This specifically attempts to estimate the net effects of a change in biological age and average age of peers, which is a research design more closely related to California's entry age debate.

Labor Market Outcomes

Section Highlights:

- Evidence suggests that adopting an earlier cutoff raises adult wages, but the evidence is inconclusive that relatively older students within a class have higher adult wages and earnings.

- There is suggestive evidence that relative entry age does not affect employment, home ownership, housing prices, and household income in one study.

A key role of the education system is preparing students for the labor force. Performance in school is closely linked to later job performance and adult wages. In addition to studies that have examined student outcomes in the K-12 system, recent research has also explored post-education outcomes as a measure of long-term benefits of entry age. This research aims to help us understand if the academic benefits we see for older entry translate into success in the labor market.

Several studies have examined the effect of older entry age on adult wages and earnings. One study in particular, Bedard and Dhuey (2007), has the advantage of measuring actual labor market responses to the specific policy intervention California is considering. The researchers examine state changes in entry cutoff dates and whether those changes affected the wages for U.S. men aged 25–44. The results indicate that moving the cutoff date one month earlier in the year increases wages by 0.7 percent.

Other studies examining labor market outcomes compare relatively older and younger students in the same class. Fredriksson and Öckert (2006) study Swedish citizens aged 16–65 in 2000 and also find that relatively older school entrants have higher earnings, but only for the eldest individuals in their sample. Among those who are aged 16–26, relatively older school entrants have lower earnings, possibly because many in this age range have not yet completed their schooling. This finding highlights the opportunity cost of starting kindergarten later, in terms of delayed entry into the labor market (i.e., one less year of work experience). The authors conclude that, although older entrants earn more money later in life, the loss of a year of work experience reduces earnings over the entire lifecycle. Similarly, Lincove and Painter (2006) find that U.S. wages at 25 years of age are higher for relatively younger students at school entry, but the sample does not include those in college at age 25. Dobkin and Ferreira (2007) find no significant differences by relative entry age in wages for adults in California and Texas ages 30–79. Dobkin and Ferreira (2007) also study additional long-term outcomes and find no differences by entry age in terms of employment, home ownership, and household income. Although these results are informative for California, further research to corroborate the results is needed.

Most of the studies in this section are still in progress. A potential improvement for these studies and for related future research on labor market outcomes is to confine samples to people who are at least 30 years old. Studies that measure labor market outcomes at younger ages may be affected by the fact that many young adults are in college and not full-time wage earners. The short-term opportunity cost of going to school is likely to pay off long-term in higher earnings, so earnings should be studied when these benefits have had a chance to accumulate. A potential concern with this approach is a byproduct of measuring long-term outcomes—the effective date of school entry must be several decades previous. If education or labor force circumstances have changed dramatically in the intervening years, then the results might not be as applicable to today's context as we would like.

Other Relevant Outcomes

Section Highlights:

- Limited evidence suggests that relatively oldest students have more high school leadership experience.
- Limited evidence suggests that relatively oldest students have fewer learning disability diagnoses. A three-month change in cutoff date may increase learning disability diagnoses among children who become relatively younger due to the policy change.
- Limited evidence suggests that younger students have more schooling at motherhood and have older, more educated mates. Entry age does not affect age at first birth, infant health, or the likelihood of an out-of-wedlock birth.

Four studies have examined outcomes that affect quality of student life and long-term outcomes and differ from the academic achievement and labor market outcomes noted above. Each of these has been measured only in one study to date, so no firm conclusions can be drawn yet. However, they are important to consider in evaluating the overall benefits of older age at school entry.

Dhuey and Lipscomb (2008) find that the relatively oldest students are 4–11 percent more likely to hold high school leadership roles as either a varsity team captain or club president. Similarly, Fredriksson and Öckert (2006) present evidence that older entrants are more likely to participate in sports in Sweden. Extracurricular activities such as these can influence social capital and social skill development and are considered increasingly important for college applications. The available research indicates that the effects of entry age for these outcomes are in the same direction as the findings for academic achievement.

Elder and Lubotsky (2007) present evidence that biological age and average cohort age affect the likelihood that a student is diagnosed with a learning disability (e.g. attention-deficit disorder). They find that an additional year of biological age at school entry substantially reduces the probability of a learning disability diagnosis. At the same time, unlike for test performance but as with retention, they find some evidence that having older peers increases the chances of a learning disability diagnosis. Both results have significant implications for special education placement decisions. They conclude that referrals to behavioral specialists reflect comparisons of students' performance to that of their classmates. In this case, moving the entry cutoff will inevitably change which students are most likely to be diagnosed with learning disabilities—regardless of whether the policy changes the timing of their kindergarten entry. According to their estimates, moving the cutoff date from December 2 to September 1 would increase the probability of a learning disability diagnosis by about 25 percent of the baseline rate for children whose own entrance age was unaffected by the policy change. The authors do not note whether a cutoff policy change would lead to greater or fewer diagnoses in the aggregate.

A different story is found when looking at non-school-related outcomes such as childbearing. One study finds that girls who enter school at a relatively older age complete fewer years of schooling by the time of motherhood. In addition, the fathers of their children tend to be younger and less educated (McCrary and Royer, 2006). At the same time, researchers found no differences by school entry age for the probability of becoming a mother, age at first birth, or the health of their infants. Lincove and Painter (2006) also found no differences by relative entry age for out-of-wedlock births. These two studies suggest that younger school entry may be better than—or no different from—older entry for out-of-school social and health outcomes studied to date. Our interpretation of the limited evidence for non-educational outcomes is that a relatively older entrance age is likely beneficial for school-related outcomes such as leadership and disability diagnoses, but it is not necessarily beneficial for out-of-school outcomes such as those related to childbearing.

Discussion and Policy Implications

The studies we review shed new light on the effects of entering school at an older age. Below we discuss the overall weight of the evidence to date, any issues that we feel should be considered, and what remains to be studied on the issue. In sum, we find that moving the cutoff date earlier is likely to boost achievement test scores. While this achievement test benefit is not likely to come at the expense of other educational outcomes, we note that policymakers should be aware that an indirect result of widening the achievement gap is a concern.

Assuming that everyone complies with school entry rules, moving the current cutoff date to September 1 ensures that all children are at least five years old when they start kindergarten. This policy change would force a quarter of all children currently eligible to start school (i.e., those whose birth dates fall from September 2 through December 2) to start school the following year. This would make them one biological year older at school entry. It would also switch them from being among the relatively youngest to among the relatively oldest children in their class. In contrast, children with summer birthdates would not have their entrance age eligibility changed. They are nevertheless affected by the policy because they would become the relatively youngest in their class. In fact, moving the cutoff date changes the relative age of everyone in a kindergarten class. Although relative age effects are clearly important, the issue washes out from the perspective of entrance age cutoff policy. A minimum 12-month age span still exists within grades regardless of which cutoff date is chosen. The cutoff only determines where children fall in the relative age span.

From a policy perspective, the key factors in selecting the entrance cutoff date are the effects of increasing the biological age of students as well as the average age of their classmates. We find no evidence in current research of a threshold age for school entry, similar to Stipek's (2002) review of earlier research. In other words, research is not able at this time to inform us whether there is an optimal biological entry age. That said, several studies attempt to draw inferences about effects due to biological age and average age of peers, separate from relative age effects.

The weight of evidence to date suggests there is likely to be a test score advantage in being biologically older at school entry. This benefit means that moving the entry age in California up by three months will have some effect on improving test scores in later grades and is likely to be most pronounced in elementary school. This is important in the context of accountability and an increased focus on test results. However, it is unclear how large the effect of a three-month change will be for test scores overall. For example, it is uncertain if the magnitude of effects we see will move children up one proficiency level on state exams. At least in the short-term, as the entry age policy change effect works its way through the K-12 grades, it would likely improve school achievement growth measures, such as the Academic Performance Index, that are related to accountability.

From an education perspective, the issue of relative age is important because the research we review predicts differences in outcomes between students who are the oldest and the youngest in a class. The youngest students are less likely to perform well on elementary and secondary tests, to be on a track for college attendance, and to hold high school leadership positions. The persistence of test score effects into middle and high school suggest that they are due at least in part to age differences at kindergarten entry rather than solely due to age differences at the time of test taking. Further, the youngest students are more likely to be retained a grade and diagnosed with a learning disability. For elementary test scores and grade retention, older boys appear to benefit more from relative age than older girls.

Several of the studies we reviewed found evidence that relative youth is beneficial for a separate set of outcomes. Relatively young girls appear to have more schooling at the time of motherhood, and the father of their child tends to be older and more educated. There is some evidence that younger students have a slightly higher chance of completing high school, perhaps due to the role of compulsory schooling laws.

Policy Issues for California

An important caveat to the positive effects on test scores is that some groups of students, especially disadvantaged students, may not gain as much as other groups. One study finds that economically advantaged students benefit more from the increase in biological age at school entry than do disadvantaged students (Cascio and Schanzenbach, 2007). The support for this finding at this point seems to be stronger for elementary scores than for secondary scores. The authors note that this difference in economic status could result in an increase in the achievement gap between these groups of students, a gap that is already sizable in California. Policymakers should consider interventions for students from economically disadvantaged families along with any change in the cutoff date. Moreover, studies such as Datar's (2006a) suggest that gaps are present at kindergarten entry, and the quality of pre-kindergarten learning opportunities varies greatly. Thus, targeted interventions could be considered for children before school entry as well as during their academic careers. Significantly for California, no studies to date have specifically examined entry age effects for English learners, which may be a group that benefits differently from early school entry.

As mentioned in the Governor's Committee report, an earlier cutoff may reduce the occurrence of redshirting. If true, this would result in a more even distribution of students by age and so help to reduce achievement gaps. Though redshirting may decline, the studies we review provide no direct evidence about its extent. It remains to be seen whether students who would become the youngest students because of a date change—students with July and August birthdates—will enter on time or will themselves delay entry at higher rates than occurs now. In relation to the achievement gap, what ultimately matters is whether any reductions in redshirting would mitigate the additional differences between groups in pre-kindergarten learning opportunities.

An educational benefit related to academic achievement is shown in the evidence from one study (Elder and Lubotsky, 2007) that being biologically older upon school entry decreases the likelihood of being retained and diagnosed with a learning disability. This study also provides a thought-provoking conclusion that although the students who are directly affected by a change in the cutoff date (i.e., autumn birthdates) benefit, the remaining students unaffected by the policy change are more likely to be retained and diagnosed with a learning disability. Cascio and Schanzenbach (2007), however, conclude that students will be less likely to repeat a grade if the average age of their kindergarten classmates increases. The conflicting evidence at this point does not allow a firm interpretation on this issue. If the Elder and Lubotsky (2007) findings are confirmed with further research, they would imply that grade retention and diagnosis decisions are informed by subjective judgments of children relative to their peers.

Although the weight of current evidence indicates that test score gains may result from moving the cutoff date earlier, another important policy tradeoff is the extent to which these gains come at the expense of high school graduation rates. Several current and previous studies raise the possibility that older students will drop out in greater numbers because they reach the end of compulsory education with less schooling attained. We interpret the evidence to date as indicating that entry age effects on high school graduation in California are likely to be small if they exist at all. Part of the reason is that California already requires students to stay in school for longer than most states. Nevertheless, we believe there are important reasons why California policymakers should consider this possible outcome seriously. First, increasing the minimum entry age does affect the grade level at which students become eligible to drop out. Second, the timing of the end of compulsory schooling overlaps with administration of the CAHSEE. Older students at risk for failing the exit exam may choose to drop out legally because their age makes dropping out an option. Third, there is not much current evidence in terms of subgroup-specific effects for policymakers to include in their decisionmaking. One way to mitigate the potential dropout problem would be to mandate a specified number of years of schooling, as is found in some other countries, in place of the age-based system now in use.

A final policy issue is the extent to which older entry is rewarded in the labor market. Although the research in this area is currently inconclusive, the research by Bedard and Dhuey (2007) is specifically designed to address this policy question. Their preliminary finding is that moving the cutoff date one month earlier leads to an increase in adult wages. This result is indicative of both the importance of entry age policy and the duration of entry age effects. However, we stress that because all studies examining wage outcomes are still in progress, it is premature to make generalizations. In developing possible reforms, policymakers will have to weigh the possibility of wage gains against the loss of up to a year of work. Since an ultimate goal of education systems is to build a skilled work force, labor market outcomes are both important for policymakers to consider and promising areas for additional research.

Conclusions

The research to date highlights important policy tradeoffs and provides no clear evidence of what the best entry age cutoff date should be. Ultimately the decision to move the cutoff date to September 1 depends on the goals of state policymakers. If the primary goal is that California students achieve success in the K-12 academic environment, moving the cutoff is likely to prove beneficial on the whole. Policymakers would still have to consider whether the potential positive effects for many students outweigh the potential negative effects for other students, especially disadvantaged students. If a policy change in entry age cutoff date is made, policymakers should follow how entering students are affected, paying special attention to disadvantaged children and English learners. State legislators should also be prepared to enact further policy refinements as needed. Furthermore, additional evidence on the effects of biological age, the existence of a threshold age for learning in the current kindergarten environment, and long-term or non-academic outcomes that are relevant to children's lifetime success would make important contributions to the policy debate.

Ultimately, entry age policies return to the issue of school readiness. Early childhood education practitioners and scholars commonly discuss the issues of children entering school when they are ready and concurrently, of schools being ready for the children who are allowed to enter. The importance of early childhood education is mentioned in at least three of the studies we review (Cascio and Schanzenbach, 2007; Datar, 2006b; Elder and Lubotsky, 2007) in addition to Stipek (2002). Considering the possible links between entry age, child care costs, and achievement gaps, it seems natural to coordinate entry age policies with other policies that focus on early education as well as disadvantaged children. Given California's diverse population, further research along these lines will be valuable.

Addendum A: State Kindergarten Entrance Cutoff Dates, 2006-07

Table A.1

State	Cutoff	State	Cutoff
Alabama	Sept. 1	Montana	Sept. 10
Alaska	Aug. 15	Nebraska	Oct. 15
Arizona	Sept. 1	Nevada	Sept. 30
Arkansas	Sept. 15	New Hampshire	LEA option
California	Dec. 2	New Jersey	LEA option
Colorado	LEA option	New Mexico	Sept. 1
Connecticut	Jan. 1	New York	LEA option
Delaware	Aug. 31	North Carolina	Oct. 16
Florida	Sept. 1	North Dakota	Sept. 1
Georgia	Sept. 1	Ohio	LEA may choose Aug. 1 or Sept. 30
Hawaii	Aug. 1	Oklahoma	Sept. 1
Idaho	Sept. 1	Oregon	Sept. 1
Illinois	Sept. 1	Pennsylvania	LEA option
Indiana	July 1	Rhode Island	Sept. 1
Iowa	Sept. 15	South Carolina	Sept. 1
Kansas	Aug. 31	South Dakota	Sept. 1
Kentucky	Oct. 1	Tennessee	Sept. 30
Louisiana	Sept. 30	Texas	Sept. 1
Maine	Oct. 15	Utah	Sept. 2
Maryland	Sept. 1	Vermont	Jan. 1 or LEA option Aug. 31 to Jan. 1
Massachusetts	LEA option	Virginia	Sept. 30
Michigan	Dec. 1	Washington	Aug. 30
Minnesota	Sept. 1	West Virginia	Sept. 1
Mississippi	Sept. 1	Wisconsin	Sept. 1
Missouri	Aug. 1, or Aug. 1 to Oct. 1 for metropolitan districts	Wyoming	Sept. 15

SOURCES: Colasanti (2007); Data updated by incorporating information for 2006-07 from the Education Commission of the States, available at www.ecs.org, and personal communications with staff in several state departments of education.
NOTES: LEA = local education agency; In practice, most Colorado districts have an October 1 cutoff date, and most New Hampshire districts have a September 30 cutoff date.

Addendum B: Study Samples and Designs

Table B.1

Authors	Data Sources and Sample	Sample Size	Sample Geography	Methods and Research Interest	Examines Biological Age and/or Older Avg. Peer Effects	Outcomes Examined
Bedard & Dhuey (2006)	1995/1999 TIMSS (ECLS-K & NELS for U.S.); 3rd & 4th graders (10 OECD countries & U.S.); 8th graders (18 OECD countries & U.S.); 1995-2003 British Columbia student data	225,722 (TIMSS/ECLS); 106,917 (BC); 10,200 (NELS)	United States, 18 OECD countries	Methods: Instrumental variables and reduced form Instrument/ Key explanatory variable: Expected relative age Topic: Effect of early relative maturity on later outcomes	No	1. Math/Science test scores 2. Pre-university preparation 3. University enrollment 4. Taking the SAT
Bedard & Dhuey (2007)	2000 U.S. Census; 2001-2005 American Community Survey, 25-44 year old men, born 1959-80	907,091	United States	Method: Reduced form Key explanatory variable: Minimum entry age Topic: Effect of changing minimum entry age laws on later outcomes	Yes	1. Educational attainment 2. Adult wages

Authors	Data Sources and Sample	Sample Size	Sample Geography	Methods and Research Interest	Examines Biological Age and/or Older Avg. Peer Effects	Outcomes Examined
Cascio & Schanzenbach (2007)	1985 Project STAR, kindergartners in 79 schools	6,248	Tennessee	Method: Instrumental variables Instruments: Expected entry age, expected relative age in K class, and average expected age of K class peers Topic: Effect of biological age, relative age, and average class age on later outcomes	Yes	1. Math/reading test scores at end of K and at end of school year child is expected to be in 8th grade 2. Below 8th grade in 1994 3. Taking the ACT / SAT
Datar (2006a)	1998-2000 ECLS-K, kindergartners followed through 1st grade	13,818	United States	Method: Instrumental variables Instrument: Expected entry age Topic: Effect of entering school a year older on test scores in first two years	No	1. Math and reading scores
Dhuey & Lipscomb (2008)	1960 Project Talent 10th - 12th graders; NLS-72 12th graders; High School and Beyond (HS&B) 12th grade classes of 1980,1982	260,000 (Talent); 16,000 (NLS-72); 18,000 (HS&B)	United States	Method: Reduced form Key explanatory variable: Expected relative age Topic: Effect of early relative maturity on high school leadership experience	No	1. Varsity team captain 2. Club president

Authors	Data Sources and Sample	Sample Size	Sample Geography	Methods and Research Interest	Examines Biological Age and/or Older Avg. Peer Effects	Outcomes Examined
Dobkin & Ferreira (2007)	2000 Census	15% of population	California, Texas	Method: Regression discontinuity Key explanatory variable: Born just after the cutoff Topic: The effect of a one-year delay in entry on later outcomes	No	1. Timing of school entry 2. Grade retention 3. Educational attainment 4. Adult wages
Elder & Lubotsky (2007)	1998-2004 ECLS-K, kindergartners followed through 5th grade; 1988 NELS, 8th graders	12,000 (ECLS-K); 16,000 (NELS)	United States	Method: Instrumental variables Instruments: Expected entry age and expected average age of peers Topic: The effect of individual and class average kindergarten entrance age on later outcomes	Yes	1. Reading & math scores 2. Grade retention 3. Disability identification
Fredriksson & Öckert (2006)	Statistics Sweden (SS), population. born from 1935-1984; Swedish Level of Living Survey of 2000 (SLLS)	4,800,000 (SS); 5,000 (SLLS)	Sweden	Method: Instrumental variables Instruments: Expected entry age and percentile rank of expected entry age Topic: Effect of school entry age and relative entry age on school and labor market performance	Yes	1. GPA and subject grades 2. IQ test scores 3. Achievement test scores 4. Educational attainment 5. College attendance 6. Earnings

Authors	Data Sources and Sample	Sample Size	Sample Geography	Methods and Research Interest	Examines Biological Age and/or Older Avg. Peer Effects	Outcomes Examined
Lincove & Painter (2006)	1988 NELS, 8th graders followed through 12th grade	5,556	United States	Method: Propensity score matching of summer and winter birthdates (young at entry, older at entry, and redshirted) Topic: Effect of delaying school entry (redshirting) on educational attainment and social outcomes	No	1. Math/Reading test scores 2. Childbirth out of wedlock during HS 3. HS dropout 4. Entering college by age 20 5. Wages
McCrary & Royer (2006)	California (1989-2002) and Texas (1989-2001) state natality data	7,515,248 (CA) 4,003,275 (TX)	California Texas	Methods: Instrumental variables and reduced form Instrument/Key explanatory variable: Expected entry age Topic: Effect of amount of female education on fertility and infant health	No	1. Years of schooling at motherhood 2. Fertility 3. Infant health (LBW, prematurity) 4. Risk factors for poor infant health (prenatal care, quality of father)
McEwan & Shapiro (2008)	1998-2003 National School Assistance and Scholarship Board (NSASB), 1st graders; 2002 National System of Education Quality Measurement (NSEQM), 4th graders; 1999 TIMSS, 8th graders	1,013,081 (NSASB) 144,047 (NSEQM) 5,582 (TIMSS)	Chile	Methods: Instrumental variables and regression discontinuity Instrument/Key explanatory variable: Born just after entry cutoff Topic: Effect of a one-year delay in school enrollment on later outcomes	No	1. Retention in 1st grade 2. Test scores in 4th and 8th grade

Authors	Data Sources and Sample	Sample Size	Sample Geography	Methods and Research Interest	Examines Biological Age and/or Older Avg. Peer Effects	Outcomes Examined
Puhani & Weber (2007a)	Progress in International Reading Literacy Study of 2001 (PIRLS); 2004-05 pupil-level data of the Statistics of General Schools (SGS) for the state of Hessen	6,591 (PIRLS) 182,676 (SGS)	Germany	Method: Instrumental variables Instrument: Expected entry age Topic: Effect on educational outcomes of age at school entry (age 7 vs. age 6)	No	1. Reading scores in 4th grade 2. Probability in the high track in secondary school
Puhani & Weber (2007b)	2002-2007 Hessen state administrative data, 1993-1998 kindergarten cohorts	60,000 per cohort-year	Germany	Method: Instrumental variables Instrument: Expected entry age Topic: Effect on educational outcomes of age at school entry (age 7 vs. age 6)	No	1. Probability of attending high track by cohort and year 2. Probability of changing to high track by cohort and year
Strøm (2004)	2000 Programme for International Student Assessment (PISA), 15-16 year olds	2,795	Norway	Method: Reduced form Key explanatory variable: Quarter of birth Topic: Effect on educational outcomes of age at school entry	No	1. Reading scores

NOTES: ECLS-K = Early Childhood Longitudinal Survey, Kindergarten Class of 1998-99; GPA = grade point average; HS = high school; LBW = low birth weight; NELS = National Education Longitudinal Study of 1988; NLS = National Longitudinal Study of 1972; OECD = Organisation for Economic Cooperation and Development; TIMSS = Trends in Mathematics and Science Study.

Addendum C: Summary of Studies and Findings

Bedard & Dhuey (2006) study the effect of relative maturity on student outcomes across 18 OECD countries and the United States. They examine math and science test scores in third, fourth and eighth grades, the probability of taking the SAT, being university bound, and enrolling in college. U.S. data comes from the nationally representative Early Childhood Longitudinal Study – Kindergarten Class of 1998-1999 (ECLS-K) and the National Educational Longitudinal Survey (NELS). Data for other OECD countries come from the Trends in Mathematics and Science Study (TIMSS 1995/1999). They also use 1995-2003 data on British Columbia students to examine the probability of being university bound. All together, they have 225,722 student observations for all OECD countries and grades.

The researchers find that the oldest students outperform their youngest peers by 4–12 percentiles in fourth grade and by 2–9 percentiles in eighth grade. In British Columbia, older students are more likely to be university bound. In the United States, the youngest students are 7.7 percent less likely to take the SAT and 11.6 percent less likely to enroll in college.

Bedard & Dhuey (2007) study the effect of state policies that changed kindergarten entry cutoff dates on student educational attainment and adult wages. They use the 2000 U.S. Census and the 2001-2005 American Community Survey to examine the experiences of 907,091 men ages 25–44 years old born between 1959 and 1980.

The researchers find that moving the entry cutoff by one month increases adult hourly wages by almost 1 percent. The effects are largest for men with no post-secondary education. Moving the cutoff by one month does not affect educational attainment. The evidence suggests that almost all students in a class have higher wages as a result of moving the entry cutoff, not just the ones whose entry is delayed by the policy change.

Cascio & Schanzenbach (2007) study the separate effects of relative age, biological age, and average class age. They examine math and reading scores at the end of kindergarten and eighth grade, whether students are below eighth grade in 1994, and whether they take the ACT or SAT. The researchers follow 6,248 kindergartners in 1985 from 79 Tennessee schools that are part of the Project STAR experiment. In this experiment, children who were all eligible to enter school were randomly assigned to different classrooms at entry.

The researchers find no evidence of relative age effects on test scores or the probability of taking the ACT/SAT for the population as a whole. Most specifications show that relatively older students are less likely to be retained by eighth grade. There is also evidence that biologically older students perform better on tests up to eighth grade. This study highlights important socioeconomic differences as well. Among those students eligible for free or reduced-price lunch, both the relatively young and the biologically old in class at kindergarten entry are less likely to take either the ACT or SAT. In contrast, biologically older students at kindergarten entry who are not eligible for free or reduced-price lunch may be more likely to take the SAT or ACT. They find reasonably consistent evidence that having older peers in the classroom has a positive effect on a student's test scores and reduces the probability of grade retention.

Datar (2006a) studies the effect of later school entry on kindergarten math and reading test scores, as well as test score gains between the beginning of kindergarten and the end of first grade. The sample includes the 13,818 first-time kindergartners in the fall of 1998 that are part of the ECLS-K, a nationally representative study.

Datar finds that children who start kindergarten one year older score 0.6 to 0.8 standard deviations higher on kindergarten math and reading tests soon after school entry. Because this may entirely represent an age-at-test effect, the researcher examines the effect of older entry on test score gains. The results indicate that older entrants have steeper score trajectories as well (0.07-0.10 standard deviations). This study also examines the effect of later entry on student outcomes by several subgroups. With respect to test score gains, the entry age effect is larger for boys – especially in reading – as well as for the poor and the disabled. With respect to fall kindergarten scores, the entry age effect is larger for the non-poor and the non-disabled. The Datar study suggests that initial test score gaps in kindergarten reflect differences in the home/child care environments prior to school entry.

Dhuey & Lipscomb (2008) study the effect of relative maturity on the likelihood that students become varsity team captains or club presidents in high school. The data come from three nationally representative surveys. The first sample is approximately 260,000 10th–12th graders in 1960 from Project Talent. The data also includes 16,000 12th graders from the National Longitudinal Survey of the High School Class of 1972 (NLS-72) and about 18,000 12th graders from the High School & Beyond survey (HS&B 1980/82).

They find that students who are expected to be the oldest are 4 –11 percent more likely to become high school leaders. This study also finds that those expected to be the oldest self-report possessing more "leadership skill" than their younger peers. These effects do not appear to reflect differences in physical development in high school. The researchers suggest that relative maturity affects the acquisition of soft skills such as leadership as much as it affects measures of cognitive development that are measured by test scores.

Dobkin & Ferreira (2007) study the effect having a birth date close to the kindergarten entry cutoff on the timing of school entry, the likelihood of grade retention, educational attainment in secondary school, and adult wages in California and Texas. The data consist of a 15-percent population sample from the 2000 U.S. Census for each of these two states. When examining later outcomes such as educational attainment, the sample is restricted to individuals who are at least 30 years old.

They find that kindergarten cutoff dates have a considerable effect on the timing of school entry. In California, five-year-olds born just before the cutoff are 53 percent more likely to enter during the current academic year than five-year-olds born just after the cutoff. Researchers infer that they are also more likely to be retained a grade. Girls, minorities, and children whose parents have not attained a bachelor's degree are most likely to enter "on time." The researchers find that minorities and children whose parents do not hold a bachelor's degree are least likely to be retained. Thus, they are disproportionately the youngest in each class. Children born just before the cutoff, however, are about 1 percentage point more likely to complete high school than children born just after the cutoff (and 0.5 percentage points more

likely to complete earlier high school grades. This study finds no evidence that school entry laws lead to differences in employment rates, wages, family income, home ownership, home values, or marital status. The researchers conclude that school entry laws introduce an important tradeoff between test performance and educational attainment: Relatively older children have been shown to perform better on math and reading tests but also have a slightly lower probability of graduating from high school.

Elder & Lubotsky (2007) study the effect of kindergarten entrance age on math and reading scores up to eighth grade, grade retention, and the probability being diagnosed with a learning disability. They also study the separate effect on each of these outcomes of having older peers. The data come from about 12,000 kindergartners in 1998 from the ECLS-K who were followed through eighth grade, as well as approximately 16,000 NELS eighth graders in 1988.

The researchers find that older kindergarten entrants score better on math and reading tests up to eighth grade. Entering school a year older reduces the probability of grade retention and learning disability diagnosis. Older classmates increase test scores but also the likelihood of grade retention and disability diagnosis. Entry age effects are larger and more persistent for children from advantaged backgrounds. Because the entry age effect on test scores diminishes by eighth grade (from 24 percentiles when most surveyed children begin kindergarten, to 4 percentiles in eighth grade), the researchers conclude that the relationship between entry age and academic performance is due to skill acquisition prior to school entry. Finally, they suggest that moving the entry cutoff will increase disability identification among children who become the youngest in their class as a result of the policy change.

Fredriksson & Öckert (2006) study the effect of school entry age on academic and labor market performance in Sweden. They examine sixth grade IQ scores, math and reading test scores, and subject grades, ninth grade GPA, subject grades, and the likelihood of taking an advanced class, educational attainment, college attendance, and adult earnings. Statistics Sweden is the primary dataset and includes the entire population born between 1935 and 1984, approximately 4.8 million observations. The data is augmented with a representative sample of 5,000 18–75-year-olds in 2000 from the Swedish Level of Living Survey for examining post-secondary experiences and earnings.

The researchers find that children who begin school at age seven rather than age six perform better in all subjects and in tests through ninth grade, and are more likely to participate in sports. They attribute most of these effects to differences in biological age rather than relative age. The researchers consider only relative age effects on educational attainment and labor market outcomes. They find that relatively older students at entry attain 0.08–0.19 additional years of schooling and are more likely to complete two years of college. The school entry effect on earnings is negative for younger cohorts but positive for older cohorts. The researchers conclude that the net lifecycle earnings effect is negative. Because compulsory education laws in Sweden require children to complete nine years of schooling, rather than setting an age after which school is no longer compulsory, they do not complicate the possible relationship between school entry and educational attainment as compulsory schooling laws do in the United States.

The researchers do not find differences by gender except that age effects are larger for boys than girls in sports. In terms of grades and attending advanced classes, children with less educated parents benefit more from being older. The researchers conclude that there appears to be a tradeoff between academic achievement and lifetime earnings with respect to school entry policies.

Lincove & Painter (2006) study the effect on educational attainment and social outcomes of intentionally delaying school entry until age six (i.e., redshirting). They examine eighth, 10th , and 12th grade math and reading test scores, high school dropout rates, high school behavioral indicators, whether students enter college by age 20, whether women have children out of wedlock by age 25, and earnings at age 25. The study follows 5,556 NELS eighth graders from 1988 to 2000.

They find that children who enter "on time" and are relatively young have slightly higher eighth and 10th grade test scores than children who redshirt. They are also more likely to be retained. There are no differences for earnings or behavioral outcomes. Among children who enter "on time," the relatively young are more likely to be retained than older children in their same grade but they also appear to have higher earnings by age 25. The researchers find that young boys are more likely than young girls to be retained. Overall, the researchers conclude that redshirting is not an effective way of improving long-term student outcomes.

McCrary & Royer (2006) study how school entry policies influence the effect of female education on fertility and infant health. They examine years of schooling at motherhood and several measures of infant health: low birth weight, prematurity, prenatal care, and the age and education level of the father. The study uses state health department natality data from California (1989-2002), 7,515,248 mothers, and Texas (1989-2001), 4,003,275 mothers.

They find that mothers born just after the school entry cutoff have less schooling at the time of their first childbirth. In California, 15 percent of these mothers have one less year of schooling than they would have had they been born before the entry cutoff. In Texas, the negative schooling effect is larger for whites than blacks. Similarly, mothers who are born just after the entry cutoff mate with younger, less educated men. The researchers find no effects of school entry age on fertility, infant health, maternal risk factors, or prenatal care in the overall samples. In California, however, later school entry reduces the likelihood that non-Hispanic white mothers have children with low birth weight. The researchers conclude that entrance age policies have the largest effect on the education levels of women who are at risk for dropping out.

McEwan & Shapiro (2008) study the effect of a one-year delay in school enrollment on first grade retention, and on fourth- and eighth-grade test scores in Chile. The first data source is the entire first grade population from 1997-2004 as collected by the Chilean National School Assistance and Scholarship Board. Additional data comes from the National System of Education Quality Measurement's census of fourth graders in 2002, and the 1999 eighth grade sample from TIMSS. The sample sizes total 1,013,081, 144,047, and 5,582, respectively.

The researchers find that entering at an older age reduces grade retention 71 percent among children born near the entry cutoff. Later entry also increases math, reading, and science test scores in fourth and eighth grade by 0.3–0.4 standard deviations. Entering school later has larger effects for boys than girls in terms of both retention and test scores. A one-year entry delay leads to larger decreases in retention among children with less-educated mothers. Because eighth grade test score effects are at least as large as they are in fourth grade, the researchers conclude that the effects are stable over time and that age differences at the time students take the tests do not entirely explain their findings.

Puhani & Weber (2007a) study the effect of entering school in Germany at age seven rather than age six on fourth-grade reading scores and the probability of attending the highest secondary school track. They use data on 6,591 fourth graders from the Progress in International Reading Literacy Study of 2001 as well as administrative data on all 182,676 pupils in the state of Hessen in 2004-05 who began school between 1997 and 1999, inclusive.

The researchers find that a one-year delay in school entry increases fourth grade reading scores by 0.4 standard deviations and increases the likelihood of attending the highest secondary track by 12 percent. Age effects in reading are larger for boys than girls but there are no gender differences in terms of high tracking status. There are no differences in age effects on either outcome for immigrant populations.

Puhani & Weber (2007b) study the effect in Germany of entering school at age seven rather than age six on the probability of attending the highest secondary school track from fifth to 11th grade Tracking decisions are made at the beginning of fifth grade and can be revised at 11th grade. The study uses administrative data from the state of Hessen. The sample includes students in the 2002-03 school year who began school between 1993 and 1998. There are about 60,000 student observations from each cohort-school year.

The researchers find that school entry age policies increase by 12 percent the likelihood that older entrants attend the highest track secondary school, when tracking decisions are made in fifth grade. Age effects are consistent over time until 11th grade, at which point school entry age effects disappear. The researchers conclude that the institutional design of the education system in Germany both generates and eliminates school entry age effects on tracking. Based on the estimated wage returns to the highest quality secondary school degree, the researchers conclude that delaying entry—and thereby forgoing a year in the labor market—has more costs than benefits from a pure lifetime earnings perspective.

Strøm (2004) studies the effect of age at school entry on mid-secondary school reading scores in Norway. The data includes observations of 2,795 students ages 15 and 16 in 2000 who were part of the Programme for International Student Assessment.

Strøm finds that the youngest entrants score 0.25 standard deviations lower in reading compared to the relatively older students. The study does not find any significant differences by gender, parental education, or family resources as measured by the number of books in the home.

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