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DISCUSSION PAPER SERIES

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Born Under a Lucky Star: Financial Aid, College Completion, Labor Supply, and Credit Constraints

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ABSTRACT

Born Under a Lucky Star: Financial Aid, College Completion, Labor Supply, and Credit Constraints*

Financial aid has been shown to affect student outcomes from enrollment to graduation. However, effects on graduation can be driven either by marginal students induced to enroll by financial aid, or by inframarginal students who would have enrolled anyway but received additional financial aid. This paper identifies the effect of financial aid on inframarginal students rather than the combined effect on marginal and inframarginal students by examining a change in financial aid that did not change enrollment. I find that additional financial aid accelerates graduation for university seniors and increases persistence for sophomores and juniors. To do this, I examine a discrete change in the amount of federal financial aid available to financially independent students. I find that financial aid received by needier students is more likely to positively affect educational outcomes.

JEL Classification: I22, I23
Keywords: financial aid, graduation

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1 Introduction

Attending college can have large impacts on students' earnings as well as many other dimensions of students' lives.[1] Moreover, students who *complete* college have substantially higher wages than those who do not (Oreopoulos and Petronijevic, 2013; Ost et al., 2016). The price of college may play a key role in determining college completion due to credit constraints and time costs of employment during college. I show that college graduation is sensitive to the amount of financial aid students receive. I also examine the effect of the financial aid on earnings and credit constraints while in college.

Additional financial aid may increase college completion for two groups of students. First, additional financial aid may induce new students to enroll in college, some of whom go on to complete college. Second, additional financial aid may help students to graduate whose decision to enroll in college does not change as a result of the additional financial aid. This second group of inframarginal students will be the focus of this paper.

This study makes two main contributions. The first contribution is that I examine the effect of additional financial aid on graduation for inframarginal students whose enrollment was not affected by financial aid. Most existing estimates of the effect of financial aid on college completion are a combination of the effects for students induced to enroll in college and inframarginal students. Several studies find increases in graduation associated with additional financial aid. In the extreme, the observed increases in graduation could come entirely from inframarginal students who did not change their initial enrollment while all students who were induced to enroll failed to graduate. Most existing estimates cannot rule out this extreme situation. I am able to separately identify the effect of financial aid on inframarginal students, and I find that financial aid has a modest effect on time to degree overall but a larger effect for lower-income students. In order to examine already enrolled students, I study an increase in financial aid that did not change

[1] See Hoekstra (2009); Oreopoulos and Salvanes (2011); Zimmerman (2014) for evidence on the effects of college on earnings and other outcomes.

student enrollment decisions.[2] Because most students do not change their enrollment as a result of financial aid, the effects of financial aid on inframarginal students are the most commonly experienced effect of financial aid.

For the second contribution, this study documents some of the mechanisms associated with decreasing time to degree. I show that financial aid increases credits attempted. I also present evidence that financial aid eases binding credit constraints, and suggestive evidence that financial aid reduces earning.

I estimate the effect on already-enrolled students by examining a large change in the amount of financial aid available to students who are declared financially independent from their parents. Students must typically report their parents' income for determining eligibility for need-based financial aid. However, if students are declared financially independent, parents' assets are not included in the calculation of financial aid which increases eligibility for financial aid. Students may become independent for a number of reasons but this paper focuses on the age cutoff for financial independence. All students who are 24 years old before January 1 are financially independent for the entire school year whereas students who turn 24 on or after January 1 are mostly not independent.[3] The change in status induced by this age cutoff generates a change of over $900 in grants and $400 in loans. This change in financial aid induces 1.8 percent of students to graduate a year earlier, though there is heterogeneity by family resources.

The findings of this paper are relevant for financial independence policy. Financial independence has heterogeneous impacts on student financial aid packages and educational outcomes that vary by family income. The additional financial aid arising from financial independence is poorly targeted. The largest increases in aid occur for students with wealthier parents. Students from wealthier backgrounds see larger changes in financial aid but experience smaller changes in time to degree. This finding suggests that

[2]The reasons for the null result of financial aid on enrollment will be discussed in Section 4.

[3]18.6 percent of students who are 23 to 24 years old are financially independent, authors calculations 2011-12 National Postsecondary Student Aid Survey (National Center for Education Statsitics, 2012)

the rules surrounding financial independence could be reworked to improve student outcomes at no cost simply by improving the targeting of resources to poorer students.

I next consider two mechanisms for the change in educational outcomes: decreases in student labor supply and easing of binding credit constraints. Financial aid is likely to reduce student labor supply while enrolled, and this paper estimates the effect of financial aid on student earnings. Most undergraduates are employed while in college—from 1989 to 2008, roughly 60 percent of undergraduates were employed.[4] In fact, roughly 14 million people, or 8 percent of the United States' total labor force, are both enrolled in formal postsecondary training and active in the labor market (Carnevale et al., 2015). I present suggestive evidence that financial aid decreases earnings during college. I also demonstrate that some students face binding credit constraints.

The change in financial aid studied in this paper occurs for older students, who are sometimes called "nontraditional" students. However, this label may be misleading. Older students constitute a large fraction of the college-going population. In the nationally representative 2012 National Postsecondary Student Aid Survey, 51.3 percent of all undergraduate students were classified as financially independent and 43.8 percent were 24 years or older (U.S. Department of Education, 2013a). Older student are an increasing share of college students. In 1970, students 25 and older constituted 27.7 percent of all undergraduate enrollment, and by 2010 they accounted for 42.6 percent (National Center for Education Statistics, 2013). Despite their growing prominence, the response of older students to financial aid has rarely been studied. Importantly for policy, financially independent students feature prominently among federal aid recipients and made up nearly 60 percent of Pell Grant recipients in 2010–11. (U.S. Department of Education, 2013b). This paper examines what has increasingly become the "typical" college student by focusing on older students.

Financial independence has previously been studied in Seftor and Turner (2002). They

[4] In the estimating sample of this paper, 78 percent of students are employed in the year they are enrolled in college.

use the Current Population Survey and find that the additional financial aid arising from financial independence increases student enrollment. Seftor and Turner (2002) use a differences-in-differences framework to examine the impact of a change in the age at which students were classified as independent. They use a single policy change which requires assumptions that outcomes followed parallel trends and no other contemporaneous shock was experienced. Moreover, they cannot directly link aid receipt to student performance. The current paper advances this line of research by using student-level administrative data that links student financial aid receipt, educational outcomes including graduation, and earnings records with a regression discontinuity design. Additionally, the policy change examined in (Seftor and Turner, 2002) occurs in 1986 and the current paper examines a more recent cohort.[5] Barr (2015) also examines nontraditional students by studying the Post 9/11 GI Bill and finds that additional aid increases enrollment.

Several papers have examined the effect of financial aid on graduation for new students.[6] However, far fewer papers have examined the effect of financial aid on enrolled students. Goldrick-Rab et al. (2016) use a randomized controlled trial to examine the effect of privately financed aid for freshman in Wisconsin and find that additional financial aid increased persistence and graduation within four years.[7] Murphy and Wyness (2016) examine financial aid in the United Kingdom that did not affect enrollment and find that additional financial aid increases the chances of earning a "good" degree. Barr (2016) examines veteran students enrolled at the time of the expansion of education benefits for veterans due to the Post 9/11 GI Bill and finds increased persistence. Relative to these studies, the current paper has the advantage of examining the U.S. federal financial aid system.[8] There is also some evidence that higher expected prices of an additional year of

[5] Seftor and Turner (2002) also examine the effect on students aged 21 to 23, where the present study focuses on students aged 23 and 24.

[6] See Angrist et al. (2014); Bettinger et al. (2016); Castleman and Long (2016); Cohodes and Goodman (2014); Dynarski (2008); Scott-Clayton (2011); Scott-Clayton and Zafar (2016); Sjoquist and Winters (2012).

[7] Anderson and Goldrick-Rab (2016) find that additional aid at community colleges did not help enrolled students persist or graudate.

[8] Additionally, Bettinger (2015) discusses the effect of financial aid on enrolled students by making assumptions about the behavior of marginal versus inframarginal students.

college can decrease time to graduation, which suggests that students may value additional years in college (Garibaldi et al., 2012).[9]

This paper lies at the intersection of three trends in higher education in the United States. The first is a substantial increase in the price students pay for college.[10] Second, while college enrollment rates have grown since 1970, college completion rates have declined and time to degree has increased (Bound et al., 2010, 2012). Last, student employment has increased over this same time frame.[11] While these trends would appear to be related, there is a paucity of evidence that causally ties them together. I find that the price of college enrollment causally affects time to degree and suggestive evidence that it affects student labor supply. The results from this paper suggest that some of the growth in time to degree and student labor supply is likely a result of increases in the price of college.

The rest of the paper will proceed as follows. Section 2 will discuss the institutional details of financial independence. Section 3 will introduce the data used, and Section 4 will discuss how the effect of financial aid on already-enrolled students is identified. Section 5 will present the results of estimation and Section 6 will conclude.

2 Background

The U.S. federal government has several financial programs that are designed to help students pay for college. A host of factors determine students' eligibility for these programs, including income, assets, and family structure. A primary consideration is whether

[9] Garibaldi et al. (2012) examine Bocconi University in Italy, which is notably a different setting from public universities in the United States or, specifically, Texas. Moreover, the policies are different, as Garibaldi et al. (2012) examine anticipated discontinuities in tuition and the present study examines changes in financial aid that are likely to be unanticipated. The differences in these settings may lead to different graduation responses to college price.

[10] Since 1982, the average amount for total tuition, fees, and room and board has increased by over 350 percent after adjusting for inflation (National Center for Education Statistics, 2013).

[11] The rise in student work has been examined in Scott-Clayton (2012), and the author concludes that different factors have driven the growth at different times.

students' income and assets are considered separately from their parents—that is, whether they are financially independent. This distinction between dependent and independent students does not need to reflect actual financial dependence but rather deals with statutes governing the amount of financial aid disbursed. There are two broad categories of federal aid that are affected by financial independence. The first set of programs is administered by the U.S. Department of Education, which I will refer to as "federal financial aid." The second set of programs is a part of the U.S. tax code, and I will refer to that as "tax aid."

Federal financial aid consists of federal grants, student loans, and work study. The largest federal grant program is the Pell Grant, which is targeted toward low-income students. In order to be eligible for need-based financial aid, students must file a Free Application for Federal Student Aid (FAFSA). The FAFSA requires information about student income and assets as well as family income and assets and demographic information (such as the number of siblings in college). This information is then fed into a complex formula to compute eligibility for need-based federal financial aid programs. In general, the federal financial aid awards are calculated yearly and use information from the prior year.[12]

Students must include parental information on their FAFSA if they are considered financially dependent. Undergraduate students may be classified as financially independent for several reasons, including being over 24 years old as of January 1 of the school year, being married, having dependent children, or a few other reasons.[13] All else being equal, independent students qualify for larger amounts of need-based financial aid (both grants and subsidized loans) than dependent students. Independent students are eligible for higher annual (and aggregate) federal loan limits.

[12]This will change in the 2016–2017 school year, when students can use income data for the "prior-prior-year." If a life event occurs that would change a student's Expected Family Contribution (EFC), students can amend their FAFSA to reflect the new information and possibly change their eligibility for Pell Grants.

[13]See http://studentaid.ed.gov/fafsa/filling-out/dependency for all conditions that determine independent status.

The United States tax code gives special treatment to dependent children. Children can be claimed as dependents as long as they are younger than 19 at the end of the year. If a child is a full-time student, that child may be claimed as a dependent if she is younger than 24 at the end of the year and meets certain conditions. [14] If students are dependent for tax purposes, parents may claim their student children as dependents and receive exemptions and tax credits that reduce taxable income. Additionally, dependent students may qualify the taxpayer for tax credits like the American Opportunity Credit, the Lifetime Learning Credit, and the Earned Income Tax Credit. During the time period studied in this paper, the Hope Tax Credit and Tuition Deduction could also be used.[15]

Changes in tax aid occur at the same January 1 threshold for some students. Ultimately this paper will be able to identify the reduced-form effect of changes in tax aid and financial aid resulting from financial independence. However, I argue that the changes in federal financial aid are likely to dominate changes in tax aid for several reasons which are discussed in Appendix A.1.

3 Data

The primary data for this project come from the Texas Higher Education Coordinating Board and contain the universe of students who were enrolled in public universities in the state of Texas from 2002–2003 to 2013–2014. The data contain demographic information about the students including race, gender, and birth date. They also contain records on student enrollment and credits attempted. Importantly, financial aid disbursed by the university is included.[16] Many of the fields from the FAFSA are available, including

[14] Those conditions are that the child must be a full-time student for at least five months in a year, must live with her parents for at least six months of the year, and must receive more than half of her financial support from her parents.

[15] See Dynarski and Scott-Clayton (2015) for a discussion on tax benefits for college.

[16] From 2003-2006 the data include financial aid for students who received any need-based aid, from 2007 to 2009 it includes all students who filed a FAFSA, and from 2010 to present it includes students who received only merit-based or performance based aid are also included.

dependency status and Expected Family Contribution (EFC).

Student outcome variables will be defined by academic year. For instance, graduation in the current year means graduation in the year that a student turns 24. Graduation in the next year means graduation by the next academic year (the year a student turns 25). Similarly, yearly earnings are defined as Quarter 4 in year $t-1$ and Quarters 1, 2, and 3 in year t which roughly corresponds to the academic year.

I adjust all financial aid and earnings data to be in constant 2013 dollars for comparability. Data from the Texas Workforce Commission's (TWC) Unemployment Insurance system are linked to individual student records and contain quarterly earnings.[17] Importantly for this study, students employed by their college or university are not included in reporting for the Unemployment Insurance system. However, the financial aid data include total Federal Work-Study compensation, which is added to the UI earnings data. Furthermore, I winsorize the wages at the ninety-ninth percentile to avoid issues with outliers. I will discuss the implications of the unavailability of non-work-study earnings at colleges in Section 5 and in the Appendix A.4.

The primary sample consists of seniors who were enrolled at a public university in Texas in the year they turned 24. However, students may respond to additional financial aid in the year they turn 24 by changing enrollment. This is checked in Section 4 and found not be a concern. The sample is restricted to seniors because graduation within a given time frame is a key outcome considered, and students with different classifications would have different relevant time frames for graduation. However, this restriction keeps the majority of university students turning 24 during the school year, as 71.5 percent are classified as seniors.[18] Section 5.1 considers freshman, sophomores, and juniors

[17]The unemployment insurance records only include employers who pay at least $1,500 in gross wages to employees in a quarter. Alternatively employers are included if the employer has at least one employee during 20 different weeks in a calendar year, regardless of the wages.

[18]The restriction to seniors is akin to the standard practice of examining rising freshman. It ensures that the outcomes considered have a similar meaning. For example graduation within one year is a relevant outcome for seniors but is not for freshman. Moreover, since over 70 percent of students are seniors it is the most natural group of students to examine. However, examining all students yields very similar results. The effects on graduation are attenuated but still are marginally statistically significant. These results can

separately.

Table 1 contains summary statistics for university seniors. University seniors receive a substantial amount of financial aid, receiving over $2,100 in grant money and taking out over $4,100 in loans. Graduation is relatively common for these students, as 44 percent of seniors who turn 24 graduate in that year and 70 percent graduate by the end of the following year. Also, 30 percent of students received a Pell Grant in the previous year, and students attempted an average of 22 credits hours within the current year.

I focus on university students in this paper because they see much larger changes in financial aid resulting from financial independence than do community college students. This is likely because community college students file the FAFSA at lower rates than university students. Results for community college students find no effect on persistence, graduation, GPA, or earnings in college.[19]

4 Identification

I leverage the discrete change in the probability of being financially independent arising due to the January 1 cutoff to examine the effect of additional financial aid on student outcomes in a regression discontinuity framework. The outcomes considered include reenrollment, graduation within a certain number of years, credits attempted, financial aid, any employment, and earnings.

The basic intuition is to compare otherwise similar students, who differ in whether they are classified as financially independent. Specifically, it is to compare students born just before January 1 to students just after January 1 in the year they turn 24. In order to

be obtained from the author upon request.

[19]These results are not presented but are available upon request. Detecting economically meaningful changes in outcomes for community college students is difficult due to the relatively small change in financial aid arising from financial independence.

accomplish this the estimating equation is:

$$Y_i = f(\widetilde{age}_i) + \theta \cdot 1(Ind > 0) + X_i + \mu_t + \epsilon_{it}, \ for \ |\widetilde{age}_i| < j, \tag{1}$$

where i indexes students and t indexes school year. Y_i is a student outcome. $\widetilde{age}_i$ is the running variable and is a student's age in days. $\widetilde{age}_i$ is recentered so that a student who turns 24 on January 1 is 0. $f(\widetilde{age}_i)$ is a flexible function of a student's recentered age that will be estimated nonparametrically using a rectangular kernel.[20] $1(Ind > 0)$ is an indicator for being 24 as of January 1, and θ is the parameter of interest and is the effect of the additional financial aid arising from students being declared financially independent because of their age.[21] X_{it} contains indicators for race and gender and μ_t represents year fixed effects. Finally, ϵ_{it} is an idiosyncratic error term. Standard errors are clustered on $\widetilde{age}$ to account for correlation within date of birth. (Lee and Card, 2008).

This equation is estimated on a subset of the data to compare students who are similar ages. Specifically, restriticting to students with $|\widetilde{age}_i| < j$ means that students whose birthday falls within j days of January 1 are included in estimation. j is chosen using the procedure outlined in Imbens and Kalyanaraman (2012) for local linear regression discontinuity frameworks though results are robust to the choice of bandwidth.[22]

Assumptions for Identification

There are two assumptions that must be made for the estimates of Equation 1 to yield unbiased estimates of the effect of age-based financial independence. First, because the sample is conditioned on students turning 24 years old during the school year, students must not respond to additional financial aid in the year they turn 24 by changing their decision to enroll in that year. Second, birth date cannot be manipulated to gain access to

[20] In practice, this will be estimated using Ordinary Least Squares with allowing the slope of the running variable to change at the discontinuity. (Imbens and Lemieux, 2008).

[21] Some students who are less than 24 will be independent for other reasons, as previously discussed.

[22] Tests for sensitivity to bandwidth will be presented in Section 5.

treatment. If either birth date manipulation or differential enrollment occurs, this would appear as additional students who are 24 years or older as of January 1.

If students anticipate the additional financial aid available to independent students, they may change their enrollment or reenrollment in response to additional financial aid. If this occurs and enrollment is affected, then conditioning the sample on students who turn 24 will yield biased estimates that conflate the effect of additional financial aid on enrolled students and the change in sample composition arising from additional financial aid.

Students do not appear to alter their enrollment decisions in the year they turn 24 based on financial independence. To check for this, in Figure 2 and Table 2 I examine the re-enrollment probabilities of 23-year-old students. Because I focus on seniors, re-enrollment is how enrollment-induced changes in financial aid would manifest themselves. If financial independence altered enrollment decisions, it would appear as a discrete change in the re-enrollment probabilities of 23–year–old students. The estimated change in re-enrollment probability for students who will receive additional aid financial is 0.0027 with a standard error of 0.0038. The robustness of this estimate to various bandwidths can be seen in Figure 6 where estimates and 95% confidence intervals are plotted for bandwidths from 50 days to 150 days. The lack of an enrollment effect is seen in Figure 2. This can also be seen in Figure 1, Panel B, in which there is no discontinuity in the density of students enrolling in the year they turn 24.

The lack of a response may be because the age rule governing independent status and the consequence of financial independence are not widely known. It may also be that older students who have typically accumulated substantial credits do not change their reenrollment based on financial aid. Given that there is no measured effect on reenrollment, I continue to condition the sample on enrollment in the year a student turns 24. This lack of an (re)enrollment effect allows an examination of the effect of financial aid on student outcomes apart from enrollment effects.

A second assumption for identification is that birth date is not manipulated to gain access to the financial independence. Obviously, a student's true birth date is not manipulable by the student. Students do have incentives to misreport their birth date to gain additional dollars, but the reported birth date is verified by comparison with Social Security Administration records. Students cannot manipulate their birth date, but parents may manipulate their child's birth date. There is evidence that birth dates are manipulated around January 1 by parents in response to tax incentives (LaLumia et al., 2015; Schulkind and Shapiro, 2014). This issue is discussed in Appendix Section A.2 and found to likely affect only a very small number of students born within a few days of January 1.

To avoid any issues associated with potential retiming of births, the preferred specification will be a regression discontinuity "donut" estimator (Almond and Doyle, 2011), in which the three days on either side of January 1 are omitted. The results are quantitatively and qualitatively very similar if those three days are included; these results are presented in Appendix Table A2. A formal McCrary test, after excluding 3 days around January 1st, yields a point estimate of -.015 with a standard error of .013. [23]

Section A.3 in the Appendix and Table A3 confirm that predetermined student characteristics do not change discontinuously at the threshold.

Because of three qualifying conditions—1) there is no change in reenrollment probabilities for 23-year-olds, 2) students are unable to manipulate their date of birth, and 3) observed covariates do not vary discretely by eligibility status—the testable assumptions of the regression discontinuity estimator are met and the results can be interpreted as the causal impact of age-based financial independence on student outcomes.

[23]The inclusion of students just in the 3 day window yields an estimate of .054 with a standard error of .010. This discontinuity is clearly seen in Figure 1 but is notably absent when excluding 3 days around January 1.

5 Results

Educational Outcomes

University students see substantial changes in financial aid arising from financial independence. This is documented in Figure 3 and Table 3. Students who are financially independent appear on the right of the figures and receive an additional $966 in grant dollars, the bulk of which comes in the form of increased Pell Grants ($806). They also take out an additional $486 in loans. Between grants and loans, this represents a significant change to student finances totaling over $1,452. One important caveat is that the data do not contain private loans but do contain state loans such as the College Access Loan (CAL Loan). Federal loans typically offer better interest rates than private loans and offer access to a variety of repayment plans generally unavailable in the private market, including income-based repayment, income-contingent repayment, graduated repayment, or extended repayment. As a result, some of the increase in the amount of federal and state loans could be students switching from private loans to federal and state loans. Federal loans are by far the most common type of loans, and private student loans make up about 10 percent of student debt issued since 2009 (College Board , 2015). If financial independence induced switching from private loans to federal and state loans, the estimated increase in loan aid would overstate the degree to which students borrowed additional money. Because the increase in federal loans ($864) is smaller than the increase in both state and federal loans ($485) federal loans do appear to crowd out state loans, but not completely.

This large change in financial aid allows an examination of whether student outcomes are affected by financial aid. The effect on student outcomes are presented in Figure 4 and Table 3. Financial independence increases student credit hours attempted by 0.39. In attempting more credits, students could see their GPA decrease if they do not change the time devoted to studying. However, despite the larger class load, the student GPAs are

unaffected, with an estimated discontinuity of 0.001 and a 95 percent confidence interval of –0.022 to 0.025. The additional financial aid increased student credits attempted but did not reduce performance in those credits.

Because seniors are attempting more credits and GPA is unaffected, graduation has the potential to be affected. This is seen in Figure 4 and in Table 3. Students are 1.8 percentage points more likely to graduate in the year they turn 24 (in the tables this is designated "Grad 4yr this year") as a result of additional financial aid. This discontinuity is clearly visible in the figure and is statistically different from zero at the 1 percent level. There is an accompanying dip in the probability of enrolling in the next year, which provides evidence that financial aid causes some students to graduate and not enroll in the next year.

The increased graduation in the year of financial aid receipt could either be a result of retiming graduation by encouraging students to graduate earlier than they otherwise would have, or it could arise from students graduating who otherwise would not. To investigate this graduation in either the year students turn 24 or the year afterward is considered. The estimated coefficient ("Grad 4yr Next Year" in the table) is 0.002, which suggests that additional financial aid retimed graduations rather than induced graduation among students who not otherwise have graduated.

While there is a positive effect on graduation in the year the money is received, it is relatively small. The 1.8 percentage point increase represents a 4 percent increase in the graduation rate during the school year a student turns 24. The increase comes at a cost of $966 in grants. Assuming that all of the graduation effects are driven by grants, it costs $55,234 in grants for one student to graduate one year earlier. The cost would be even higher after accounting for additional subsidies received for loans. College enrollees in the sample earn $12,219, and students who graduate in the year they turn 24 earn $26,923 in the year they turn 25. This means that graduating a year earlier corresponds to roughly a $14,704 difference in earnings. However, for the sample taken as a whole the benefits of

an additional year in the labor market do not exceed the costs associated with one student graduating a year earlier. I will explore whether additional financial aid is cost effective by exploring students with different levels of income in Section 5.

Mechanisms

I now investigate mechanisms for the increased credits attempted and reduced time to degree, including reduced time spent working during college and binding credit constraints.

Labor Supply during College

Despite the large number of students in the labor force and the large amount of federal financial aid available, very few studies have attempted to identify the effects of financial aid on student earnings. Broton et al. (2016) use random assignment of a state need-based grant to examine student responses to survey questions about work. They find that students receiving financial aid reduced hours worked by about 14 percent. Scott-Clayton (2011) examines the effect of a merit scholarship in West Virginia that affected enrollment and finds that scholarships reduce earnings in some specifications but not in others.[24]

Additional financial aid may allow students to reduce time spent working. Using Unemployment Insurance earnings data, in Figure 5 I explore whether students who are

[24]The sensitivity Scott-Clayton (2011) to specificaiton may be because the identification strategies measure different local average treatment effects or because there is a bias in one or both of the estimates arising from those strategies. Also, Scott-Clayton and Park (2015) use a regression discontinuity to examine the effect of replacing federal loans with the Pell grants for community college students and find that grants reduce earnings and increase full-time enrollment. However, there is a discontinuity in the density of the running variable, which suggests the results may be biased.

In related work, many studies have tried to quantify the effect of working on educational outcomes. The general finding has been that working in college decreases GPA (Kalenkoski and Pabilonia, 2010; Stinebrickner and Stinebrickner, 2003) and credits accumulated (Darolia, 2014; Triventi, 2014). These studies motivate studying the effect of financial aid on labor supply. The financial aid-induced reductions in earnings and accelerated graduation results in this paper are consistent with the aforementioned prior studies on the effects of employment on student outcomes.

declared financially independent based on age change their earnings in response to the additional grants and loans they receive. Financially independent university students do not adjust the probability of positive earnings. The coefficient on whether students have positive earnings is –0.5 percentage points with a standard error of 0.5 percentage points. This rules out reasonably small reductions in the probability of earnings up to –1.5 percentage points. Despite no change in the probability of working, there is significant change in earnings during college seen in Figure 5, Panel B. Students who are financially independent by age 24 see their earnings decrease by $511. This represents about 35 percent of the increase in grants and loans, or 55 percent of the increase in grants. Financial aid appears to crowd out earning by reducing labor supply on the intensive margin but does not seem to affect extensive margin labor supply.

Interpreting the change in earnings requires some caution. In Table A4, I perform a placebo exercise where I use the same specifications except I examine students turning 21, 22, or 23 during the school year. For the 22 and 23 year old subset, there are discontinuities of $162 and $220 respectively that are significant at the 5% level. These two placebo exercises are the only two that are significant at the 5% level and 21-year-old students do not see reduced earnings at the threshold. Because this occurs for both 22 and 23-year-old students this is likely to not be the result of gaming eligibility to insure additional grant aid. This could be the result of chance as there are 18 placebo outcomes considered and 2 significant discontinuities at the 5% level. Moreover, the effects on earnings are somewhat sensitive to the choice of bandwidth as can be seen in Figure 6, with smaller bandwidths yielding smaller, insignificant effects on earnings. Given the sensitivity to bandwidth and the issues in the placebo test, I interpret the evidence on earnings as being suggestive but not definitive of earnings declines due to additional aid.[25]

[25]Interpreting the estimates of the effect of additional financial aid on earnings requires additional caution, because earnings for students employed by the university they attend are not included in UI earnings records unless the student is employed as part of the federal work-study program. There is further discussion of on-campus employment in Appendix Section A.4, but if anything, the lack of on-campus, non-work-study earnings likely results in an underestimate of the effect of financial aid on earnings.

Unfortunately, in this setting, it is impossible to completely disentangle the effect of additional eligibility for student loans from the effect of additional grant money on earnings. In the section on heterogeneous effects by family income, I will examine groups of students who saw small (or no) increases in grants and larger increases in loans to see if there are differences by the type of aid received. Given the earlier results on completion, the suggestive findings on earnings support the idea that working during college slows down time to degree.

Credit Constraints

Financial aid may reduce time to degree because it eases binding credit constraints. This paper estimates to what degree increased financial aid eases these constraints. Many studies have attempted to identify whether binding credit constraints affect college enrollment and graduation. Early studies tended to find that credit constraints were not prevalent (Cameron and Heckman, 1998; Cameron and Taber, 2004; Carneiro and Heckman, 2002; Keane and Wolpin, 2001). However, recent studies have shown borrowing constraints matter for educational investment (Belley and Lochner, 2007; Brown et al., 2012; Cowan, 2016; Lovenheim, 2011; Stinebrickner and Stinebrickner, 2008).

Independent students have access to higher yearly and aggregate federal student loan limits than do dependent students. This provides an opportunity to test for credit constraints among enrolled college students. Specifically, how does financial independence affect the number of students borrowing above the amount that would be allowed had they been born a few days later? Any student, regardless of assessed financial need, may borrow the maximum amount of federal unsubsidized loans as long as the amount of loans does not exceed unmet financial need.

Figure 3 and Table 3 investigate this question. Panel C shows that there is a 15% increase in the number of students borrowing more federal loans than the dependent maximum. This suggests that 15% of students face binding credit constraints and financial

independence eases their credit constraints by raising their borrowing limit. This esimate is similar in magnitude to Stinebrickner and Stinebrickner (2008).

There are three important caveats for the estimation of the number of students who are credit constrained– private loans, changes in grant aid, and behavioral factors. As previously discussed, federal loans are the bulk of the market for student loans and are more attractive. As a result, students are likely to exhaust their federal loan eligibility before turning to the private loan market. In the 2012 National Postsecondary Student Aid Study (NPSAS), 9.6 percent of students who reported taking out less than the statutory maximum of federal student loans reported having taken out private loans, which suggests that nearly all students will exhaust federal student loan eligibility before taking out private loans.

Financial independence not only changes the maximum amount of loans students have access to but increases grants and eligibility for subsidized loans. To partially address this issue, I will examine students who had received a Pell Grant or a zero EFC in the previous year in the section on heterogeneity. These students see smaller (or no) changes in grants and subsidized loans, and as a result, looking at them can be more informative of what might happen if subsidized loans and grants were unchanged. The results are not substantively different for this group of students.

Loan take up has been shown to depend on the amount of loan offer. In the present setting, the default loan offer increases for students who are independent. Marx and Turner (2016) use a randomized controlled trial and demonstrate that the default of packaging loan amounts at their maximum affects loan take up. They also show that offering students their maximum loan they are eligible for affects the number of students taking the maximum loan for which they are eligible. The results from Marx and Turner (2016) suggest that the measure of credit constraints in this paper may be imperfect due to behavioral responses to loan offers.

Heterogeneity

I examine heterogeneity by a measure of parental income, which affects the size of the change in financial aid. In Table 4, separate discontinuities are estimated for three groups of students: 1) students who had a zero EFC when they were 23 years old, 2) students who received a Pell grant when they were 23 years old, and 3) students who did not receive a Pell Grant when they were 23 years old. These groups are examined separately because changes in financial aid arising from age-induced financial independence are quite different based on family income.

Students who previously received a zero EFC are examined in Column 1 of Table 4 and see no change in grants or subsidized loans. These are the neediest students in the sample, and so the exclusion of parental income and assets does not affect their eligibility for grants or subsidized loans. However, these students do increase borrowing by $723. Despite only seeing an increase in student loans, age-induced financial independence causes 4 percent of students to speed up graduation by one year. Students who previously received a zero EFC appear to reduce earnings by roughly the same amount as the sample as a whole at $495, but this is imprecisely estimated. The reduction in earnings is approximately 65 percent of the increase in loans. The larger effects on educational outcomes is somewhat surprising given the lack of a change in grants. However, the increased loans are likely to help these students most, as they are the neediest in the sample. These estimates demonstrate the academic benefits of increased access to student loans for the poorest students.

Students who previously received a zero EFC can be helpful in understanding how many students are credit constrained because they experience no change in grants or subsidized loans as a result of age-induced financial independence. Among these students, age-induced financial independence increases borrowing above the dependent maximum by 16.2 percentage points which is larger than the sample as a whole

The second column examines students who received a Pell Grant when they were 23.[26] These students see a $374 increase in grants, a $727 increase in total loans for age-induced changes in financial independence. They are slightly more likely to graduate than the full sample as a result of financial aid, with 2.85 percent graduating one year earlier. They also reduce earnings and appear to be credit constrained at slightly higher rates to the sample as a whole.

The third column of Table 4 examines students who did not receive a Pell Grant when they were 23 years old. These students are wealthier, so excluding parental income induces larger changes in need-based financial aid. They see a $1232 increase in grants and a $370 increase in loans. Despite a much larger change in financial aid, the effect on time to degree is smaller, with 1.3 percent reducing time to degree by one year though this is not significant at the 5% level. They reduce earnings by $520 and have a smaller number of credit constrained students at 13.7 percentage points.

The estimate for the fraction of students constrained does not vary substantially across student income. However, students who previously did not receive the Pell have a smaller estimate for the number of constrained students than students who previously had received a Pell Grant (13.7 versus 17.4 percentage points).

The heterogeneity analysis shows that the cost of reducing time to degree by one year varies substantially by family income. For students who had previously received an EFC of zero, there is no direct cost from grants. The increase in loans for independent students reduces time to graduation. Essentially, this decreased time to degree (and increased time in the labor market) comes at cost of administering student loans. For students who had previously received a Pell Grant, an additional $13,108 in grants decreases time to degree by one year.[27] This is very similar to how much more graduates in the sample make as compared to students enrolled in college. For students who had previously received a Pell Grant, additional grant aid is likely to be efficient, as its cost is roughly equal to the

[26] Students with a zero EFC in the year they turned 23 are a subset of this sample.
[27] This abstracts from the costs of subsidized loans or program administration costs.

gain in earnings that a student sees from an additional year in the labor market. For students who had not previously received a Pell Grant, reducing time to degree costs $98,536 which is substantially more costly than the benefit of an additional year in the labor market.

Taken together, the results on heterogeneity by previous Pell receipt suggest a few things: Financial independence gives more resources to relatively wealthier students. Despite this, the reduced time to graduation seems to be larger for needier students. In fact, aid to students who qualified for the Pell Grant in the year they turned 23 is likely to be efficient, as the benefits to the students are less than or equal to the costs. These results on heterogeneity highlight the educational attainment benefits of targeting financial aid to the neediest students.

5.1 Other Classifications

The focus of this paper is on seniors turning during an academic year. However, the same change in dependent status occurs for students who are not seniors. These students are considered in Table 5. There are very few students turning 24 as freshman and the results presented are imprecise as a result. However, the point estimates for freshman are positive for hours attempted and reenrollment.

However, sophomores and juniors have more students and there is some increased precision. In both cases, students are more likely to persist to the next year. Sophomores are 7.9 percentage points more likely and juniors are 2.6 percentage points more likely. Juniors also attempt .51 more credit hours. Student earnings are not affected for Freshman, Sophomores, and Juniors.

These students provide further evidence that additional financial aid provide benefits to students before their senior year. Although 24 year old students are a particular sample this shows that financial aid affects older students who are not as far along in their schooling.

Robustness

Two additional robustness checks are performed to make sure the results are not spurious. The first is to check the choice of bandwidth and is presented in Figure 6. This figure considers a main result of the paper, which finds that students who are financially independent and receive additional financial aid are more likely to graduate in the year they receive the aid and reduce their earnings. Each of the dots represents an estimated discontinuity, along with 95 percent confidence intervals for different bandwidth choices. For graduation in the year students turn 24, the estimate is stable across bandwidths and is statistically different from zero starting with the bandwidth of 80 days.

For earnings, smaller bandwidths tend to deliver smaller estimates, but once the bandwidth includes 90 days it is statistically different from zero. This figure shows that the effect on earnings is somewhat sensitive to the choice of bandwidth

I also use students turning 21, 22, and 23 as placebo exercises to see if student outcomes systematically vary at January 1. These results are presented in Table A4 and are discussed in Appendix Section A.5. If students anticipated the change in financial aid, we would likely see changes in student outcomes for these students. However, student outcomes do not significantly differ at this same threshold for other ages with the exception of earnings as previously discussed.

6 Discussion and Conclusion

This paper links three trends in higher education: 1) higher tuition, 2) increasing time to degree, and 3) increased earnings in college. In particular, the price of college causally increases time to degree and I present suggestive evidence that it increases student labor supply. The effects of college price on inframarginal students are important because they affect many students and are implicitly included in every financial aid and tuition policy considered but are rarely measured.

Several policy lessons emerge from this paper. First, proposals to change tuition or financial aid should consider the implications of their decisions on time to degree. In fact, this may be the bulk of the effect, as changes in price are likely to induce relatively small changes in enrollment while affecting all enrolled students.

Second, the change in financial aid associated with financial independence is poorly targeted. The largest increases in aid go to students who come from the most affluent backgrounds. As a result, the benefits from the change in independence (namely one additional year in the labor market) do not outweigh the costs for the sample as a whole. However, for poorer students who see smaller changes in aid, the effects on time to degree are comparatively larger. For students who had previously had a zero EFC, time to degree is reduced simply by allowing additional borrowing of unsubsidized loans.

The heterogeneous effects of financial aid by family income underscore how targeting financial aid to needier students improves student outcomes relative to aid for wealthier students. This is particularly important for evaluating policy that reduces the price of college for all students.

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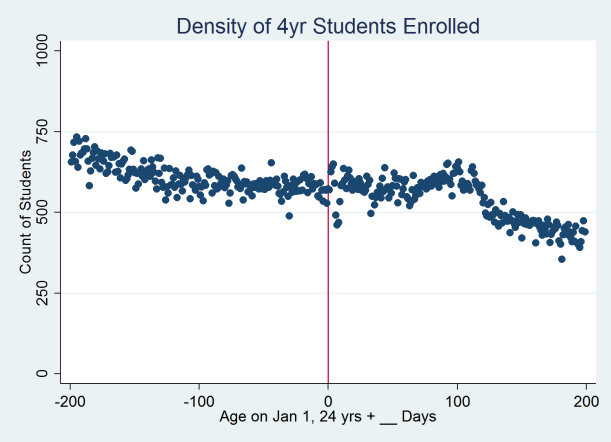
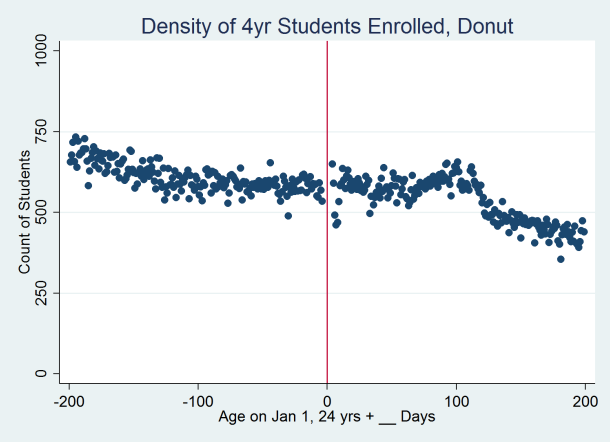
7 Figures and Tables

Figure 1: Density of Birth Dates

(a) 4yr

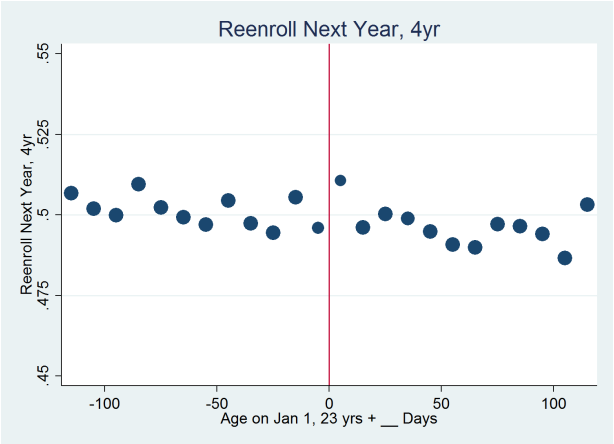


(b) 4yr Donut



NOTE: Panel A plots the number of students born on each day of the year, and Panel B replicates that plot but removes students born within three days of January 1. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. and The data come from administrative records of the THECB and include the 2002–2003 to 2013–2014 school years.

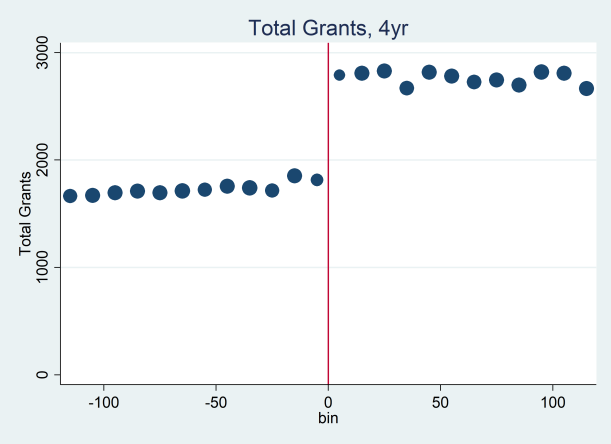
Figure 2: Reenrollment of 23-year-olds



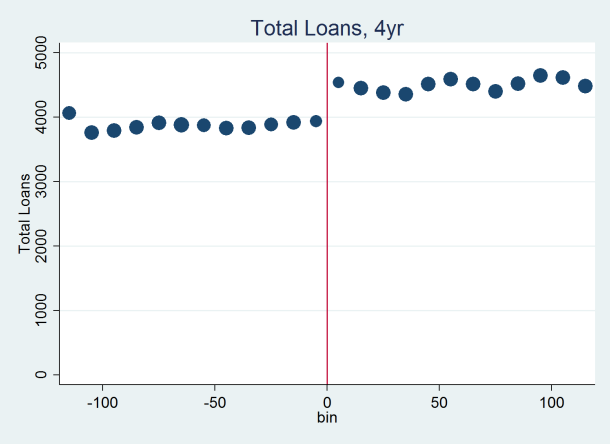
NOTE: This figure plots the fraction of 23-year-olds who re-enroll in the year they turn 24 by their recentered birth date. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. The data come from administrative records of the THECB and include the 2002–2003 to 2013–2014 school years.

Figure 3: Four-Year Colleges, Financial Aid

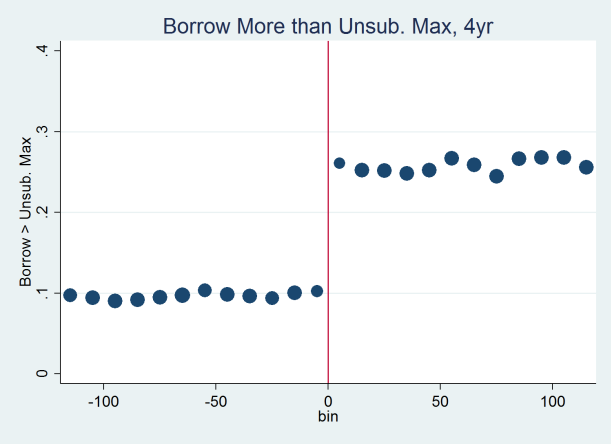
(a) Grants



(b) Loans



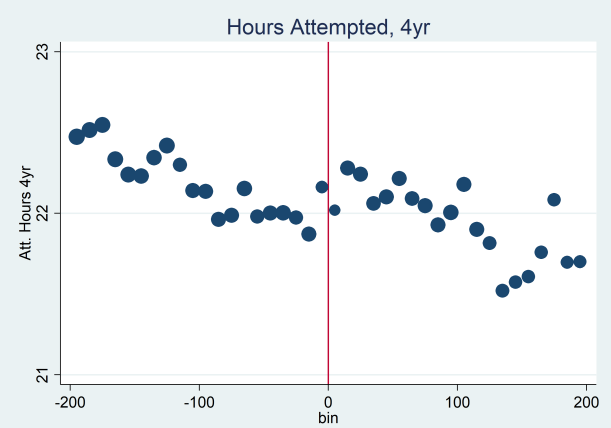
(c) Borrow More than Unsub. Max



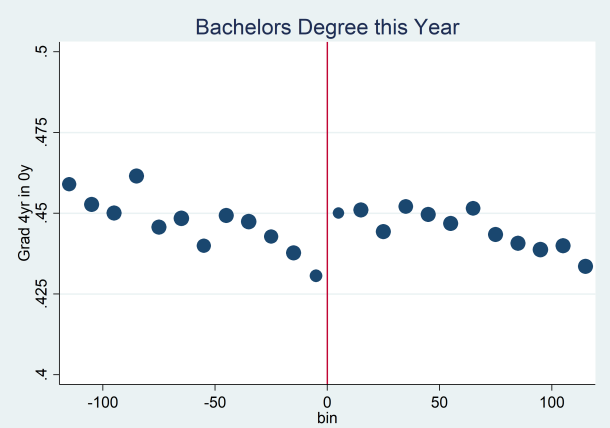
NOTE: Panel A plots the average amount of grants received by students by their age as of January 1. Panel B plots the amount of loans taken out by the students by their age as of January 1 and Panel C plots the fraction of students who borrow above the annual federal maximum for dependent students. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. Each dot represents the average for a group of 10 birth dates. The size of the dot is proportional to the number of students for which the average is computed. The data are from administrative records of the THECB and include the 2002–2003 to 2013–2014 school years.

Figure 4: Four-Year Colleges, Educational Outcomes

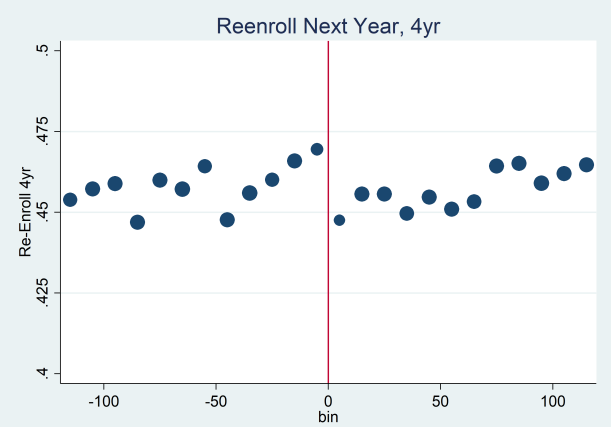
(a) Hours Attempted



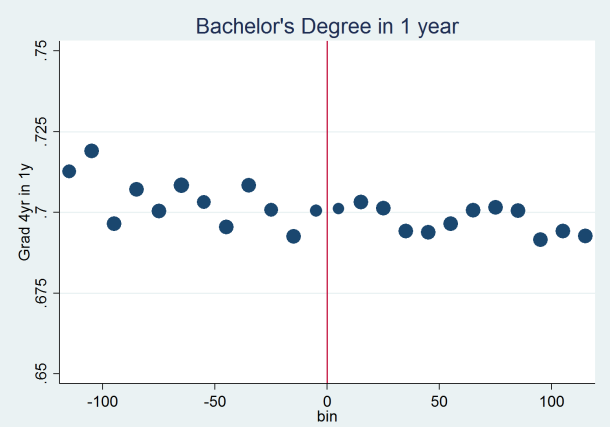
(b) Grad this Year



(c) Re Enroll Next Year



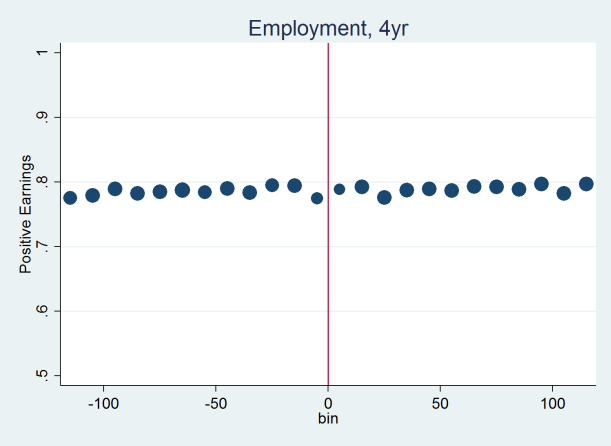
(d) Grad Next Year



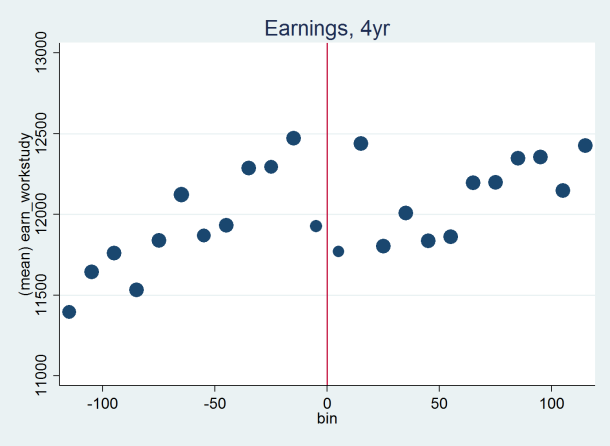
NOTE: Panel A plots the number of credit hours attempted by student age as of January 1. Panel B plots the probability of graduating in the year a student turns 24 by birth date. Panel C plots the probability of reenrolling in the year after a student turns 24 by birth date. Panel D plots the probability of graduating by the year after a student turns 24 by birth date. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. Each dot represents the average for a group of 10 birth dates. The size of the dot is proportional to the number of students for which the average is computed. The data are from administrative records of the THECB and include the 2002–2004 to 2013–2014 school years.

Figure 5: Four-Year Colleges, Earnings Outcomes

(a) Employment



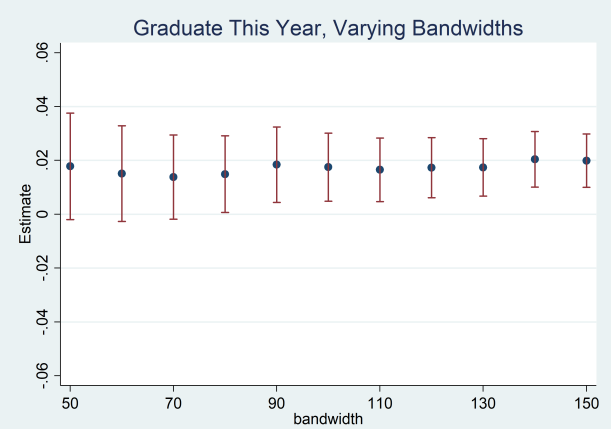
(b) Earnings



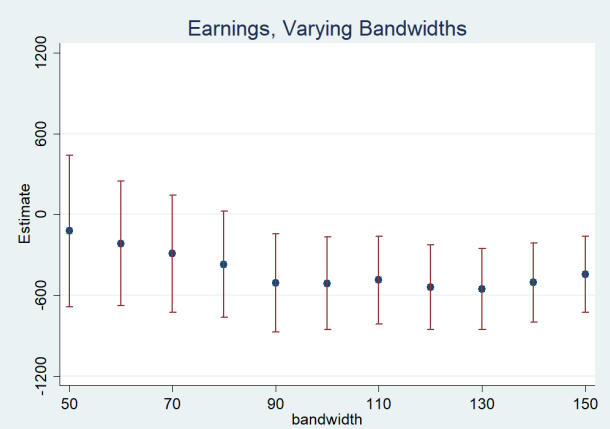
NOTE: Panel A plots the fraction of students with nonzero earnings in the year they turn 24 by their age as of January 1. Panel B plots earnings by birth date. The size of the dot is proportional to the number of students for which the average is computed. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. The data come from administrative records of the TWC and include the 2002–2003 to 2013–2014 school years.

Figure 6: Bandwidth Sensitivity, University Students

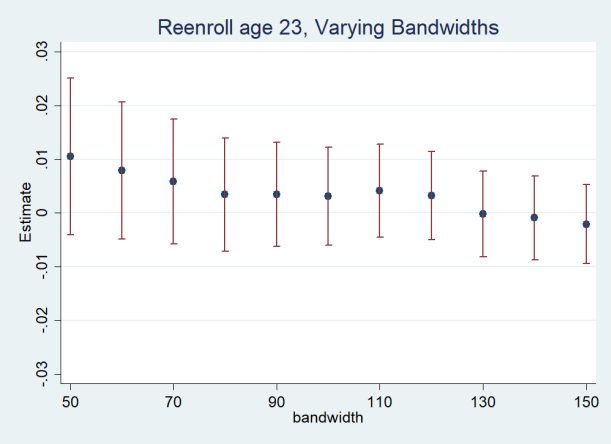
(a) Graduation



(b) Earnings



(c) ReEnroll when 23



NOTE: The estimated discontinuity is plotted with 95% confidence intervals when estimated with different bandwidths. Panel A plots the effect of independence on graduation in the year students turn 24. Panel B plots the estimate of independence on earnings. The horizontal axis is recentered age in days such that 0 is 24 years old on January 1. The data are from administrative records of the TWC and THECB and include the 2002–2003 to 2013–2014 school years.

Table 1: Summary Stats

Variable	Obs	Mean	Std. Dev.
Male	227,848	0.49	0.50
White	227,848	0.49	0.50
Black	227,848	0.10	0.30
Hispanic	227,848	0.30	0.46
Asian	227,848	0.05	0.21
Hours attempted	227,848	22.09	10.36
Enroll next year	227,848	0.46	0.50
Graduate current year	227,848	0.44	0.50
Graduate next year	227,848	0.70	0.46
GPA	227,848	2.70	0.97
Borrow at unsub Max	227,848	0.06	0.24
Borrow at sub max	227,848	0.12	0.32
Borrow more than unsub max	227,848	0.17	0.38
Total grants	227,848	2,168.59	3,125.50
Pell	227,848	1,449.67	2,111.72
Total loans	227,848	4,155.84	5,421.51
Received Pell last year	227,848	0.30	0.46
Earnings	227,848	12061.83	12424.1
Positive earnings	227,848	0.79	0.41

NOTE: Summary statistics for the sample of seniors at Texas public universities from 2002-2003 to 2013-2014 who are within 200 days of turning 24 during the school year. The data are from administrative records of the THECB and TWC and include the 2003–2004 to 2013–2014 school years. Variables that refere to the current year refer to the academic year in which students turn 24. Variables that refer to ”next year” refer to the academic year in which students turn 24. Earnings correspond to earnings for the academic year (Q4 in year t-1 and Q1,Q2, and Q3 in year t.

Table 2: Reenrollment Probability of 23-Year-Old Students

	Re-Enroll 4yr
Discontinuity	0.0027
	(0.0038)
Mean | Ineligible	0.5
Observations	257,723

NOTE: This table estimates the change in the probability of reenrolling in the next school year for students who turn 23 during the current school year. Students born December 29 through January 3, are excluded as discussed in the text. The discontinuity is estimated using a window of birth dates of 100 days from January 1. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. The regressions also include controls for gender and race. Standard errors are clustered on recentered birth date and are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table 3: Estimated Discontinuities

	Total Grants	Unsub. Loans	Sub. Loans	Pell Amount	Total Loans	Borrow > Unsub. Max
Discontinuity	966.6***	303.6***	560.7***	806.0***	485.8***	0.149***
	(37.77)	(36.53)	(27.80)	(20.64)	(71.42)	(0.00484)
Mean | Ineligible	1812.2	1296.8	1568.9	1139.4	3908.5	0.101
Observations	111,795	111,795	111,795	111,795	111,795	111,795
	Att. Hours	Re-Enroll 4yr	Grad 4yr This Year	Grad 4yr Next Year	GPA	
Discontinuity	0.391***	-0.0147**	0.0175***	0.00187	0.00126	
	(0.0883)	(0.00617)	(0.00646)	(0.00579)	(0.0119)	
Mean | Ineligible	21.87	0.464	0.435	0.699	0.2695	
Observations	223,772	111,795	111,795	111,795	111,795	
	Earnings	Next Year Earnings	Positive Earnings			
Discontinuity	-511.3***	-437.7	-0.00531			
	(175.6)	(269.6)	(0.00506)			
Mean | Ineligible	12369.5	20634	0.551			
Observations	111,795	111,795	111,795			

NOTE: Each column has an estimate of the discontinuity in student outcomes for students born before January 1. The estimates arise from estimating Equation 1. The regressions also include controls for gender and race. Each discontinuity is estimated using a window of birth dates of 100 days around January 1. This bandwidth corresponds to the IK bandwidth except in the case of attempted hours, where a bandwidth of 200 days is used. Students born December 29 through January 3 are excluded, as discussed in the text. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. The data are administrative records of the THECB and TWC and include the 2002–2003 to 2013–2014 school years. Standard errors are clustered on recentered birth date and are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$

Table 4: Heterogeneity Analysis

	Previous 0 EFC	Previous pell	Previous No Pell
Total Grants	-129.0	373.6***	1231.7***
	(101.5)	(71.31)	(33.45)
Mean | Ineligible	4975.2	4411.2	659.1
Total Loans	723.3***	727.7***	370.9***
	(155.1)	(121.2)	(83.73)
Mean | Ineligible	5256.6	5486.7	3208.4
Grad 4yr in 0y	0.0396***	0.0285***	0.0125
	(0.0137)	(0.0108)	(0.00762)
Mean | Ineligible	0.406	0.433	0.437
Grad 4yr in 1y	0.0135	0.00871	-0.00122
	(0.0145)	(0.0105)	(0.00644)
Mean | Ineligible	0.694	0.712	-0.00122
Earnings	-495.0	-507.1*	-520.1**
	(352.9)	(261.1)	(204.2)
Mean | Ineligible	11368.9	11539	12737.6
Borrow >Unsub. Max	0.162***	0.174***	0.137***
	(0.0129)	(0.00997)	(0.00481)
Mean | Ineligible	0.19	0.184	0.0643
Observations	18,995	33,844	77,951

NOTE: Each entry is an estimate of the discontinuity in student outcomes for students born before January 1. The estimates arise from estimating Equation 1. The rows represent different outcomes and the columns represent different estimating samples based on student characteristics in the year they turn 23. The regressions also include controls for gender and race. Each discontinuity is estimated using a window of birth dates of 100 days from January 1. Students born December 29 through January 3 are excluded as discussed in the text. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. The data are administrative records of the THECB and TWC and include the 2002–2003 to 2013–2014 school years. Standard errors are clustered on recentered birth date and are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table 5: Other Classifications

Freshman	Grants	Loans	Hours	Enroll Next Year	Earn
Discontinuity	157.3	303.9	0.280	0.0132	356.2
	(145.5)	(192.0)	(0.349)	(0.0306)	(757.0)
Mean | Ineligible	1134.1	1741.2	13.94	0.439	10657
Observations	4,687	4,687	9,354	4,687	4,687
Sophomore	Grants	Loans	Hours	Enroll Next Year	Earn
Discontinuity	364.6***	721.1***	0.186	0.0794***	104.4
	(103.3)	(161.2)	(0.242)	(0.0191)	(491.1)
Mean | Ineligible	1577.3	2664.6	16.22	0.58	11953
Observations	11,216	11,216	22,759	11,216	11,216
Junior	Grants	Loans	Hours	Enroll Next Year	Earn
Discontinuity	510.9***	609.7***	0.510***	0.0264**	-116.8
	(68.95)	(121.8)	(0.164)	(0.0108)	(309.1)
Mean | Ineligible	1688.2	3551	18.94	0.739	12265.3
Observations	28,590	28,590	57,809	28,590	28,590

A Appendix

A.1 Changes resulting from Tax Aid

There are several reasons that the effects found in this paper are likely driven by financial aid rather than tax aid. The first is that tax aid is disbursed for the prior financial tax year no earlier than February. This date falls after students have made extensive and intensive margin enrollment decisions for both semesters, which likely limits the extent to which tax aid can influence student outcomes. Furthermore, a student's tax liability is likely to decrease as a result of the change, whereas family tax liability is likely to decrease making the effect on student finances ambiguous. Last, federal tax aid more than doubled in 2009. As a robustness check, I show that the results are not substantively different in the years before or after this increase in tax aid in Table A1. For these reasons, the results of this study will largely be interpreted as the effects of financial aid rather than of tax aid.

Dependent status for tax purposes changes for a minority of students. In particular, students must live at home for at least six months and provide less than half of their own support. An upper bound on the number of students experiencing a change in dependency status for tax purposes can be gleaned from the 2007–2008 National Postsecondary Student Aid Study. The NPSAS contains information students' residence with parents while they are enrolled. Students at four-year schools in Texas who are from 23.5 to 24.5 years old on January 1 live with their parents 15.0 percent of the time (U.S. Department of Education, 2013a). This number is an upper bound on the number of students affected by the change in tax status, because some of those who live at home may receive less than half of their support from their parents.

If a student is declared independent, all else being equal, the parent's tax liability will increase, as they no longer can claim a dependent exemption or any of the education tax credits. If parents were eligible for the Earned Income Tax Credit (EITC), they are

likely to see EITC benefits decrease, as the number of eligible children will be reduced. The students will have their personal tax liability decrease, as they will be able to use the education tax credits on their tax return instead of their parents' using the education tax credits. In general, the family's total tax liability will weakly increase as credits or deductions are shifted from parents with relatively high marginal tax rates to students with relatively low marginal tax rates.[28]

Financial independence is associated with (weakly) reduced family tax aid but increased student tax aid. How this affects total resources toward college depends on how parents and older students split changes in wealth from marginal tax changes. I am not aware of any studies that examine how families split such tax changes, and data on within-family transfers would be required to answer the question. Tax aid is never "disbursed" per se, and households may differ in the timing of realizing tax benefits.

One test for the impact of tax credits for college is to consider the time before the large expansion of tax credits that occurred in 2009. Tax expenditures increased by 140 percent in 2009. Results from 2002–2003 to 2007–2008 are presented in Table A1 and do not vary substantially from the results presented for all years, except for the expected loss for precision. While imperfect, this test shows that more than doubling the generosity of the tax credits for college does not substantially effect the interpretation of the results.

A.2 Birth Retiming

LaLumia et al. (2015) and Schulkind and Shapiro (2014) find that there is a small amount of manipulation in response to tax incentives that is less than half the amount of retiming of births that is typically seen on a weekend. A $1,000 change in taxes leads to about 1 percent of births being retimed.[29] This may be a concern for identification if

[28] For very high income families who are not eligible for education tax credits, the total tax burden may decrease, as students will become eligible for tax credits.

[29] Schulkind and Shapiro (2014) find that the manipulation is due to increased cesarean rates before January 1.

children of parents who retime their births in response to tax incentives produce children who systematically respond differently to financial independence 24 years later. It is not obvious how these students would differ systematically, but it is a possibility.

To explore the amount of retiming of births or differential reenrollment that occurs, Figure 1 plots the number of students with each birthday among students turning 24 in a given school year for community college students and university seniors. The panels on the left include all students. Panels on the right remove students who were born within three days of January 1, and the distribution is much more smooth through the cutoff. There is some retiming of births evident, but the distribution appears to be smooth after removing the three days surrounding January 1.[30]

A.3 Student Characteristics

If either differential (re)enrollment or birth retiming were an issue, student observed and unobserved characteristics may discretely vary across the threshold.[31] I test for observable differences by looking for discontinuities in predetermined characteristics like race, gender, grant aid received in the previous year, and EFC for students who had filed a FAFSA in the previous year. Results from these checks for balance of the covariates are found in Table A3. In these regressions there are thirteen discontinuities considered; one is statistically significant at the 5 percent level, and the estimated discontinuities are small.

Data on student performance prior to college is also included for students who have it. This data was obtained through college applications after 2000. Of the analysis sample,

[30] There does appear to be a decrease in births associated with Christmas, though that is unlikely to be problematic for the identification strategy.

[31] There may be unobserved variables that also differ on each side of the age cutoff. One example that may be relevant is insurance coverage. In the state of Texas during this time frame employers were required to cover dependent children with health insurance until age 25, so insurance status is not likely to vary discretely at this threshold (Dillender, 2014). Starting in 2011, the Affordable Care Act mandated that all children under the age of 26 be eligible for inclusion on their parents' plans, which would not affect the identification strategy of this paper.

76% have some information via application data. This includes indicators for students being in the top 10 percent of their high school class and being in the top 11-25. Some students did not provide testing information such as SAT or ACT which explains the smaller sample size for those outcomes. Similarly, prior AGI for students and parents have a smaller sample because that data began being collected in 2007-2008 and is only available for students who were enrolled and filed a FAFSA in the previous year.

A joint test for significance reveals that the discontinuities in characteristics available for all students are not jointly different from zero. Overall, the lack of discontinuities in predetermined covariates suggests that students on either side of the age discontinuity are similar in observable characteristics.

A.4 On-Campus Employment

Work-study is a need-based federal program in which wage subsidies are offered to universities to employ students, typically on campus (Scott-Clayton and Minaya, 2014). Financial independence increases a student's eligibility for work-study because parents' income and assets are excluded from need calculations. However, the earnings measure in this study includes student earnings from work-study, which eliminates this as a concern.[32] There is still the issue of non-work-study employment at universities and colleges. Employment on campus is a small fraction of employment for students age 23.5 to 24.5. In fact, only 8.1 percent of students at public four-year universities work on campus or both on and off campus.[33]

If financial aid displaces non-work-study employment at colleges and universities in the same way that it does for employment observed in the UI data, then the UI earnings will understate the true effect of financial aid on earnings. This is because there are additional reductions in earnings for students who turn 24 that are not captured by UI and

[32] There is a very small, positive estimated discontinuity in student earnings from work study.

[33] Author's calculations based on the 2012 NPSAS. Additionally, 5.4 percent of students work exclusively on campus, and 2.7 percent work both on an off campus.

work-study data. If non-work-study employment by universities is insensitive to financial aid, then the estimates in the UI data will be accurate. For the estimates presented to overestimate the effect of financial aid on earnings, an unusual result is required in which students respond to additional financial aid from turning 24 by reducing hours worked off campus and increasing non-work-study hours worked on campus. However, this unusual situation seems less plausible, since work-study earnings are accounted for and there is no other clear mechanism that would drive student behavior in this way.

A.5 Placebo—21, 22, and 23 years old

One concern is that students born before and after January 1 are unobservably different and have differential outcomes as a result of these differences rather than differences in financial aid. One way to test this is to perform a placebo test with students turning 21, 22, and 23. I perform the same analysis as before, but instead use students who are turning 21, 22, and 23 in a school year. These students do not experience any differential change in financial aid if they are 21, 22, or 23 by January 1 and so the students should have the same outcomes irrespective of where their birthday falls relative to January 1 unless there are some unobserved underlying differences. Table A4 examines 18 different placebo outcomes and finds 2 to be significant at the 5% level–earnings for 22 and 23 year olds. These discontinuities are discussed in the main body of the text and I discuss issues in interpretting earnings results in light of these estimates.

Table A1: Results Pre 08

	Total Grants	Unsub. Loans	Sub. Loans	
Discontinuity	837.3***	274.7***	614.0***	
	(47.88)	(37.00)	(39.13)	
Mean | Ineligible	1445.3	940.2	1485.7	
Observations	57,613	57,613	57,613	
	Att. Hours 4yr	Grad 4yr in 0y	Grad 4yr in 1y	Re-Enroll 4yr
Discontinuity	0.210	0.0156*	-0.00747	-0.0155*
	(0.137)	(0.00869)	(0.00780)	(0.00881)
Mean | Ineligible	22.27	0.44	0.704	0.459
Observations	114,819	57,613	57,613	57,613
	Earnings	Positive Earnings	Borrow > Unsub. Max	
Discontinuity	-492.6**	-0.00960	0.139***	
	(243.4)	(0.00729)	(0.00651)	
Mean | Ineligible	13199.9	0.815	0.1	
Observations	57,613	57,613	57,613	

NOTE: Each column has an estimate of the discontinuity for a student outcome for students born before January 1. The sample only includes students in 2003–2004 to 2006–2007, in order to focus on a time with smaller available tax aid. The estimates arise from estimating Equation 1. The regressions also include controls for gender and race. Students born December 29 through January 3 are excluded, as discussed in the text. Each discontinuity is estimated using a window of birth dates of 100 days from January 1, which corresponds to the IK bandwidth. The data are administrative records of the THECB and TWC and include the 2002-2003 to 2007-2008 school years. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. Standard errors are clustered on recentered birthdate and are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table A2: Estimated Discontinuities, no donut

	Grants	Pell	Unsub	Sub	
Discontinuity	964.1***	798.8***	305.5***	558.5***	
	(43.90)	(30.31)	(37.99)	(31.37)	
Mean | Ineligible	1804.8	1568.4	1303.3	1568.4	
Observations	115,871	115,871	115,871	115,871	
	Hours Attempted	ReEnroll	Grad in Current Year	GPA	Grad Next Year
Discontinuity	0.386***	-0.0140**	0.0146**	-0.000978	-0.00298
	(0.0859)	(0.00549)	(0.00596)	(0.0112)	(0.00560)
Mean | Ineligible	21.9	0.464	0.436	2.7	0.701
Observations	227,848	115,871	115,871	115,871	115,871
	Earnings	Positive Earnings	Borrow > Unsub Max		
Discontinuity	-472.3***	-0.00208	0.146***		
	(160.9)	(0.00500)	(0.00699)		
Mean | Ineligible	12340.4	0.786	0.102		
Observations	115,871	115,871	115,871		

NOTE: Each column has an estimate of the discontinuity in student outcomes for students born before January 1. The estimates arise from estimating Equation 1. The regressions also include controls for gender and race. Each discontinuity is estimated using a window of birth dates of 100 days from January 1, which corresponds to the IK bandwidth except in the case of attempted hours, which uses a bandwidth of 200 days. The data are administrative records of the THECB and TWC and include the 2003–2004 to 2013–2014 school years. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. Standard errors are clustered on recentered birth date and are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table A3: Covariate Balance

	Male	White	Black	Hispanic	Asian	Previous Grants	
Discontinuity	-0.00104	-0.00154	0.000446	0.00938	-0.00552**	16.80	
	(0.00667)	(0.00706)	(0.00384)	(0.00613)	(0.00280)	36.04	
Mean | Ineligible	0.484	0.483	0.107	0.3	0.0494	1828.8	
Observations	111,795	111,795	111,795	111,795	111,795	111,795	
	SAT	ACT	Top 10	Top 11-25	Previous EFC	Previous Student AGI	Previous Parent AGI
Discontinuity	1.242	-0.0572	0.00609	-0.00492	-51.13	-15.70	-62.62
	(5.259)	(0.173)	(0.00423)	(0.00412)	(194.5)	(247.1)	(3694.1)
Mean | Ineligible	1005.9	20.45	0.0926	0.0935	7095.5	7841.8	66088.5
Observations	21,017	10,332	85,413	85,413	64,134	34,892	35,614

NOTE: This tests for discontinuities in covariates for students who were born before January 1. Each discontinuity is estimated using a window of birth dates of 100 days from January 1 which corresponds to the IK bandwith. Students born December 29 through January 3 are excluded as discussed in the text. The data are administrative records of the THECB and include the 2002–2003 to 2013–2014 school years. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. Standard errors are clustered on birthdate are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table A4: Placebo Check

Age 23, All Classifications	Total Grants	Hours Attempted	Loans	Enroll University Next Year	Grad this year	Earnings
Discontinuity	-10.18	0.0707	70.29*	0.00286	0.000337	-220.4**
	(25.27)	(0.0819)	(38.48)	(0.00382)	(0.00367)	(95.50)
Mean | Ineligible	1912.6	22.28	3746	0.499	0.377	10789.7
Observations	257,723	257,723	257,723	257,723	257,723	257,723
Age 22 Classifications	Total Grants	Hours Attempted	Loans	Enroll University Next Year	Grad this year	Earnings
Discontinuity	-0.113	0.0569	50.13	-0.000712	0.00426	-161.9**
	(26.19)	(0.0636)	(39.45)	(0.00325)	(0.00303)	(65.62)
Mean | Ineligible	2349.7	25.83	3787.7	0.625	0.263	8047.3
Observations	358,409	358,409	358,409	358,409	358,409	358,409
Age 21, All Classifications	Total Grants	Hours Attempted	Loans	Enroll University Next Year	Grad this year	Earnings
Discontinuity	7.948	0.0534	-32.46	0.00126	0.00172	-54.28
	(28.69)	(0.0612)	(44.92)	(0.00246)	(0.00133)	(50.52)
Mean | Ineligible	2646.1	26.78	3630.7	0.844	0.0335	6041.6
Observations	371,100	371,100	371,100	371,100	371,100	371,100

NOTE: This placebo exercise tests for discontinuities in outcomes for students who were born before January 1 using students who turn 21, 22, and 23 years old during the school year. Each discontinuity is estimated using a window of birth dates of 100 days from January 1 which corresponds to the IK bandwith. Students born December 29 through January 3 are excluded as discussed in the text. The data are administrative records of the THECB and include the 2002–2003 to 2013–2014 school years. Mean | Ineligible is the estimated value of the dependent variable at the discontinuity for ineligible students. Standard errors are clustered on birthdate are in parentheses, with * $p<0.1$ ** $p<0.05$ *** $p<0.01$.