Can Financial Aid (Re)Connect Students To College? Evidence From Tennessee Colleges Of Applied Technology[1]

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EXECUTIVE SUMMARY

State and federal agencies invested $51.5 billion in grant aid for college students in 2016-17,[2] and we know from decades of research that financial aid can help traditional students access or complete college. We know much less about how aid interacts with non-traditional students, however, and ours is the first study we know of to examine the take-up and effects of financial aid for students attending non-degree technical colleges. We do so using state administrative data describing the enrollment, financial aid, and earnings for students entering Tennessee Colleges of Applied Technology (TCATs) between 2005 and 2016.

Key findings are as follows:

- Most TCAT students do not access financial aid through the Free Application for Federal Student Aid (FAFSA) process, although they may have access to subsidies from state or federal labor departments.
- Among those TCAT students who do file FAFSAs prior to enrolling, 9 in 10 (and even more in recent years) are eligible for federal Pell grants, state TSAA or Wilder-Naifeh grants, Tennessee Reconnect or Promise, or the merit-based HOPE scholarship.
- Students with grant aid from the FAFSA enroll for 87% more contact hours than other students, and they are almost twice as likely to complete a diploma within two years (47 versus 25%).
- Tennessee Reconnect and Promise were available to incoming students beginning in 2015-16. We find that 2 in 5 TCAT students in that cohort had either Reconnect or Promise, and over the two years following their initial enrollment, they typically earned more contact hours and completed more diplomas than other FAFSA-filing new students. We caution not to interpret these differences as causal effects of Reconnect or Promise, since student decisions to pursue those programs may be driven by unobserved factors that also affect persistence and completion.
- Eligibility rules for Pell and TSAA grants include natural experiments in financial aid that separate a narrow group of aid recipients and non-recipients as good as randomly. We use these circumstances to test for the causal effect of each grant on TCAT student outcomes. Results are limited to students who just met or just fell short of specific rules for grant eligibility.
    - We see little to no effect of qualifying for the minimum Pell grant or the TSAA grant on contact hours or receipt of a certificate or diploma within two years. Results are very imprecise, however, and do not rule out large positive effects.
    - Students with adjusted gross income below a certain threshold qualify for a simplified federal aid process known as "Automatic Zero EFC," which also provides slightly more aid ($208, on average). We find that students whose income is just low enough to meet this rule do not complete significantly more contact hours than students on the other side of the Automatic Zero EFC rule, and that they are not more or less likely to attain a certificate or diploma.
    - The simplified aid formula is tied to higher earnings while enrolled, but this unexpected finding is likely not causal. Students who are marginally eligible for simplification also have significantly higher earnings prior to enrolling.

Our mixed findings are consistent with the limited amount of prior research on financial aid for non-traditional students, which have likewise detected a mix of positive and inconclusive student responses to aid.

Students tend to benefit from transparent and generous financial aid, but it is possible that the natural experiments we study here do not change the cost of college enough to elicit a big change in college persistence and completion among non-traditional technical students.

I. BACKGROUND, MOTIVATION, AND RELATED RESEARCH

In 2014, Tennessee passed the first statewide legislation since California's Master Plan devoting public resources toward making college tuition-free for a broad swath of state residents. While the Tennessee Promise grant for traditional-aged students attending associate, certificate, or diploma programs received much of the attention, a parallel initiative known as Tennessee Reconnect provided tuition-free technical training for older students enrolling in Tennessee Colleges of Applied Technology (TCATs). Both Tennessee Promise and Tennessee Reconnect are rooted in the state's efforts to "Drive to 55," that is, to have 55% of working-age adults hold a postsecondary credential by 2025. The Lumina Foundation estimates the attainment figure to be 43% as of 2018.[3]

TCAT students figure prominently into the state's accounting of how to move toward 55% college attainment, for a few reasons. Foremost, TCATs have high completion rates. A recent state report boasts that 81% of students in a TCAT cohort completed their programs.[4] This compares very favorably to completion percentages of 28% in the state's community colleges and 58% across Tennessee public universities, although caution should be exercised when making direct comparisons across these sectors because of different definitions of completion.[5] Second, the technical, career-focused nature of TCAT programs are attractive to adults, who are much greater in number than traditional-aged college entrants and much less likely than younger generations to have a postsecondary credential. Attainment goals like the Drive to 55 are motivated by analyses projecting that a majority of jobs in the coming decade will require some college training (not necessarily a college credential, it should be noted).[6] If so, adults without college training are at risk of being shut out of a growing number of jobs, endangering their own financial security as well as that of their children. And third, TCATs are thought to be very successful in connecting students to jobs. According to the 2014-15 Tennessee Higher Education Commission Fact Book, 86% of TCAT completers available for job placement were placed in their field. In a recent study, Carruthers and Sanford (2018) find significant labor market returns to enrolling in a TCAT, and furthermore, that these returns are not limited to TCAT students who attain a certificate or diploma.[7]

Tennessee Promise and Reconnect have refocused attention on TCATs, but also on the broader effect of financial aid on student success. College is expensive, and given that students typically have less time to work while enrolled, the true cost of a postsecondary education well exceeds the sticker price of tuition and fees. According to the U.S. Department of Education, the cost of attendance for full-time enrollment at TCAT-Nashville was $14,908 in 2017-18, inclusive of tuition, fees, books, materials, and housing expenses for those not living with family.[8]

Against the growing importance of financial aid and TCAT enrollment in Tennessee, we seek to understand the take-up of aid among recent TCAT cohorts as well as the effect of financial aid on a number of outcomes: contact hours, outside work while enrolled, and the likelihood of attaining a certificate or diploma. We know of no other study reporting on the effect of financial

aid within technical programs like those offered by TCATs, although our methods and findings speak to a large literature on financial aid more broadly, as well as smaller literatures on technical postsecondary education and non-traditional students. Financial aid can help students enroll in and complete college, more so if the requirements to obtain aid are transparent and timely.[9] This is not universally true of all financial aid programs, some of which are quite complex to navigate. Several recent experiments have shown that providing students with information about college costs, aid opportunities, and college choices can reduce barriers to enrolling.[10] Among TCAT students who file for financial aid, one of the most common forms of aid they receive is the federal Pell grant. The Pell grant's design is not well suited to influence student choices about college, as eligibility and award notification are part of an opaque process that most students begin once they have already decided to go to college. Indeed, in an earlier study we found that Pell eligibility has little to no effect on whether or where students go to college.[11] Of course, aid can benefit students after they enroll in college, and others have shown that additional grant aid from Pell led to faster graduation for university students in Texas, as well as higher post-college earnings that more than recoup the federal investment.[12]

But much of this research, including our own, has focused on traditional-aged students enrolling in community colleges or four-year universities, not technical colleges that attract all ages. The effects of financial aid for non-traditional students – older enrollees, veterans, technical college students, or for-profit students – have been mixed.[13] It is this smaller literature that we add to with this study.

We begin with an in-depth descriptive analysis of financial aid take-up and opportunities for TCAT students, up to and including Tennessee Promise and Reconnect. We then turn to three natural experiments in financial aid that pertain to a small subset of students applying for federal aid, testing whether more aid affects contact hours, completion, or the intensity of working while enrolled.

II. FINANCIAL AID FOR TCAT STUDENTS

We focus on five sources of financial aid available to TCAT students. All five require students to file a Free Application for Federal Student Aid (FAFSA) and to verify their financial information if requested by institutions or the federal government.

- **Tennessee Promise:** Building from the state's privately funded models of free community college dating back to 1999, statewide Tennessee Promise legislation was passed in 2014, and the graduating high school class of 2015 was the first eligible cohort. High school students sign up for Tennessee Promise in the fall of their senior year, file a FAFSA, meet with volunteer mentors, complete community service projects, graduate, and seamlessly enroll full-time in an associate or certificate/diploma program at one of the state's community colleges or TCATs.[14]

For students meeting these benchmarks, the state pays any tuition and fees not covered by federal, state, or institutional grants. The funding stream comes from an endowment of excess lottery reserves and is guaranteed for full-time students making satisfactory academic progress for up to 2.5 academic years. The vast majority of high school seniors signed up to—at least—learn more about Tennessee Promise in its first year (and each year since), contributing to a 12% increase in high school graduates' enrollment in in-state public colleges and universities between 2014 and 2015.[15]

- **Tennessee Reconnect:** There are two programs going by this name, and we are focusing on the first one, which was introduced in 2015. At the same time that Tennessee Promise was implemented for new high school graduates, Tennessee Reconnect was introduced to support non-traditional aged students enrolling in TCATs. Beginning with the fall 2015 entering class, adult learners (typically age 25 or older) could enroll in a TCAT tuition-free if they qualified for Reconnect. Eligible students had to file a FAFSA, enroll full time, and make satisfactory academic progress. The state would pay any tuition and required fees not covered by other federal or state grants. The broad outlines of this program were extended beginning with fall 2018 entrants to include any independent student according to FAFSA definitions, community college programs, and part-time enrollment.

- **Federal Pell grants:** Named for U.S. Senator Claiborne Pell (D-RI), this is the farthest-reaching need-based aid program in the U.S. Nationwide, students received $27.4 billion in Pell grants for 2016-17 according to the College Board. Eligibility is determined from income, asset, and family information that students input into their FAFSAs. The form is typically more complex and lengthier than an income tax return, but the most critical inputs for aid determination are a family's adjusted gross income and the number of household members in college.[16] Lower-income families and families with more individuals in college are eligible for more aid. These and other inputs are factored into formulas that determine each student's "expected family contribution" (EFC) toward college expenses. Pell eligibility is strictly determined by whether a student's expected family contribution is below a specific value, and this value changes each year depending

on appropriations. Students enrolled full-time in 2018-19 with EFC equal to $5,486 are entitled to a Pell grant worth $652. The grant grows as EFC falls, such that the maximum grant for 2018-19 is $6,095 for students with zero EFC.

- **State TSAA grants:** Tennessee Student Assistance Awards are worth up to $1,000 for full-time enrollees in TCATs and are awarded based primarily on two factors: An EFC less than a set amount (currently $2,100, identifying much needier students than the minimum Pell award), and when a student's FAFSA was filed. The grant is allocated first-come, first-served until appropriated funds run out.

- **State Wilder-Naifeh Technical Skills grants:** These grants are worth up to $2,000 for students pursuing certificate or diploma programs in TCATs. Eligibility requirements include filing a FAFSA and state residency of at least one year.

We also observe whether a student was eligible for the state merit-based HOPE scholarship, available to students with an ACT score of at least 21 or a high school GPA of at least 3.0. As we will show, very few TCAT students are HOPE-eligible.

An uncertain but potentially large number of TCAT students are eligible for aid through state or federal labor departments. Individuals who are out of work can participate in labor redevelopment or assistance initiatives such as the Trade Adjustment Assistance or Workforce Innovation and Opportunity Act programs. The Trade Adjustment Assistance program supports retraining for workers who have lost employment due to trade. The Workforce Innovation and Opportunity Act also supports job seekers. Both programs can subsidize a student's TCAT expenses. Prospective students may be eligible for grant aid through FAFSA processing or through labor assistance programs, but potentially not all of the above. We do not observe eligibility or receipt of grant aid from labor redevelopment. We discuss how to interpret descriptive information on financial aid take-up in light of this omission in Sections IV and V. Our section VI analysis on the causal effects of financial aid for TCAT students focuses on those who seek aid by filing a FAFSA.

III. DATA[17]

Data used in this study begins with enrollment records for all students who attended any of the 27 TCATs between 2005 and 2016. These were provided by THEC and include a limited amount of information on student background (gender, race, ethnicity, and in some cases, age) as well as indicators for when and where students were enrolled, how many contact hours they accumulated each term, and when any certificates or diplomas were awarded. A small number of students in non-credit programs were excluded from the data available to us.[18] We merged enrollment and completion records with additional information provided by THEC describing financial aid information from FAFSA records.

Most critical for this analysis, the data include indicators of eligibility for Pell, Wilder-Naifeh, TSAA, and Reconnect grants, as well as adjusted gross income and the federally computed amount that students and their parents were expected to contribute toward their education. These "expected contribution" figures usually sum to an EFC that determines eligibility for Pell and TSAA grants. We were not provided final EFC values, however, which has implications for our analysis and results as described below.

For students working in occupations and for employers covered by Unemployment Insurance, we were provided quarterly earnings from the Tennessee Department of Labor and Workforce Development (TLWD). We converted quarterly earnings to trimesterly, 4-month earnings to align with TCAT fall, spring, and summer terms.[19]

We build a large 2005-2016 analytical dataset by merging individual information on enrollment, background, institutional characteristics, awarded degrees and certificates, financial aid, and earnings while enrolled. We exclude individuals who appeared to be dual enrolled high school students.

These data allow us to construct descriptive statistics for take-up of the different types of financial aid programs offered at TCATs in addition to creating student outcomes measuring persistence, completion, and working during enrollment. The Section VI statistical analyses also rely on these data, however, there the analytic sample is restricted to students who filed a FAFSA and enrolled in a TCAT for the first time between academic years 2005-2006 and 2016-2017. Restricting the analytic sample to FAFSA filers is necessary in evaluating the effect of financial aid programs such as Pell or TSAA. Eligibility for these programs is based on students' EFC, which serves as the critical component in our analytical design (see Section VI for details). EFC information is not available for students who choose not to, or were not able to, file a FAFSA.

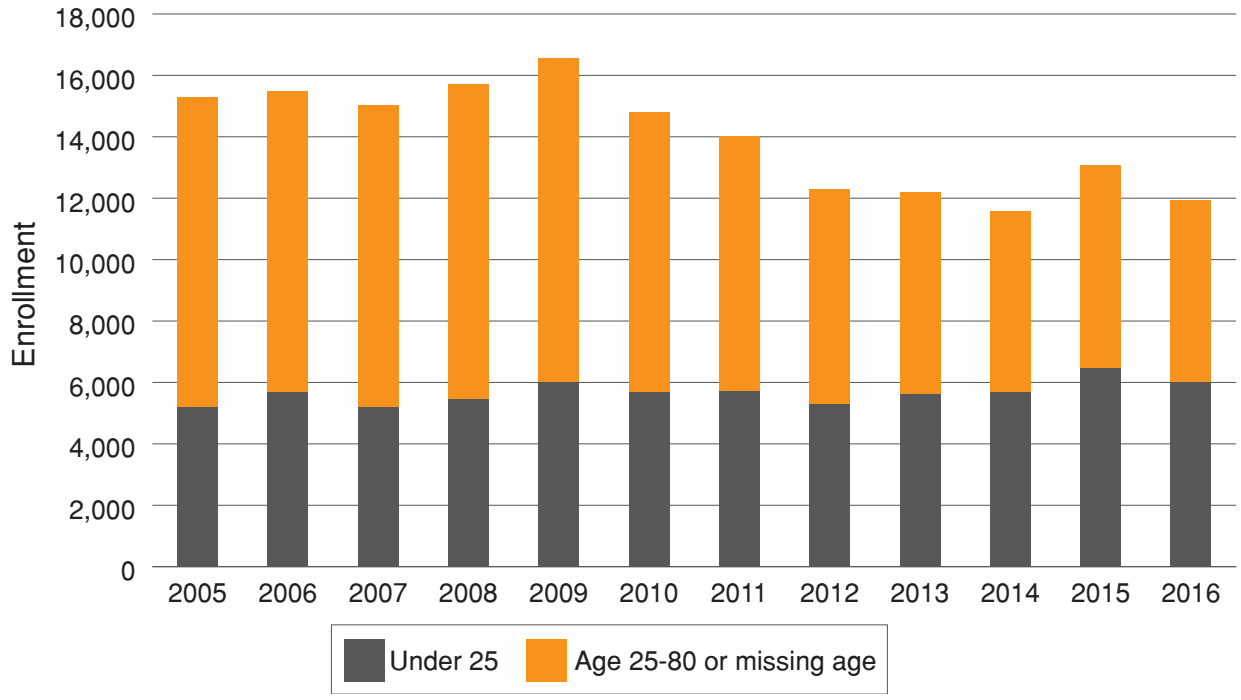
IV. TCAT STUDENT TAKE-UP OF FINANCIAL AID

Figure 1 illustrates the count of new students enrolling in a TCAT by academic year (where 2016, for example, references the 2016-2017 academic year covering the fall 2016 term, the spring 2017 term, and the summer 2017 term).

There are three standout patterns to note from Figure 1. First, a bump in enrollment can be observed beginning in the 2008 school year, immediately following the onset of the Great Recession. This is a time period during which the opportunity cost of schooling – that is, the availability of well-paying work – was limited and more students of all ages chose to enroll in college. A similar dynamic is typically observed in community colleges, so much so that they have been referred to as "safe ports" during economic downturns.[20] Enrollment declined each year following 2010 as job prospects improved. Second, another bump in enrollment is observed in 2015 with the beginning of Tennessee Promise and Reconnect, despite continued economic growth that would normally push more students into the workforce rather than college. The volume of students under 25 increased by 14% between 2014 and 2015, while students over 25 increased in number by 12%. This was likely a consequence of Tennessee Promise, which would have benefited some of the younger group of students, as well as Tennessee Reconnect, which was targeted at students over 25.

Figure 2 illustrates the percent of TCAT students who filed a FAFSA seeking aid to support

Figure 1: TCAT Entrants by Age Groups



their first TCAT term, by year and age group. Panel 2A shows that it is fairly unlikely for adults to file for financial aid prior to entering a TCAT. Part of this may be due to ineligibility for financial aid, such as the case where an employer pays for tuition.

Students may also be ineligible if their expenses are covered by labor redevelopment initiatives described in Section III. We do not observe indicators for employer-sponsored enrollment or labor redevelopment eligibility, but summary statistics on earnings described shortly suggest that students without FAFSA-processed grant aid are unlikely to be working while enrolled.

Younger students depicted in Panel 2B are much more likely to have a FAFSA on record when they enter a TCAT. Another part of the shortfall in FAFSA filing among older, non-traditional students may be due to less awareness of financial aid options. Following the adoption of Tennessee Promise, the state touts one of the highest rates of FAFSA filing in the nation among high school students preparing for college,[21] but it is not clear if this has spilled over into substantially higher rates of aid applications for non-traditional students.

Next, we examine trends in aid eligibility over time for the five FAFSA-dependent grants under study. Figure 3 traces aid eligibility for Pell, TSAA, Wilder-Naifeh, Reconnect, Promise, as well as the likelihood of having a FAFSA and having any of the five grants, for cohorts entering in 2005-2016. The likelihood of filing a FAFSA prior to entering a TCAT has risen remarkably over time, from 11% among 2005 entrants to 36% in 2016. The percent of new TCAT students who are eligible for any of the five grants has risen in step with FAFSA filing.

FAFSA filing rarely does not lead to aid for TCAT students, a point which is even clearer in Figure 4. There, we focus on FAFSA filers and plot the percent with each of the five grants over time. Over 9 in 10 filing a FAFSA to enroll in 2005 were eligible for either a Pell, Wilder-Naifeh, or TSAA. Eleven years later, among 2016 entrants with FAFSAs, less than 1% were ineligible for all five grants. There is no strong pattern over time in eligibility for Pell or Wilder-Naifeh, but TSAA grants have become increasingly more common among the most recent TCAT entrants. The most recent two years of available data show that about 1 in 5 new TCAT students were eligible for Reconnect, and up to 1 in 4 were eligible for Promise.

Focusing on the 2016 cohort of new TCAT students, the percent who sought aid through the FAFSA varies considerably across campuses, as shown in Figure 5. This has a close correspondence with the percent of students at each campus with grant aid. Almost 7 in 10 students starting at TCAT McKenzie are eligible for aid processed through the FAFSA, whereas less than 1 in 10 are eligible at TCAT Murfreesboro.

Figure 2A: TCAT Entrants 25+ by FAFSA Status

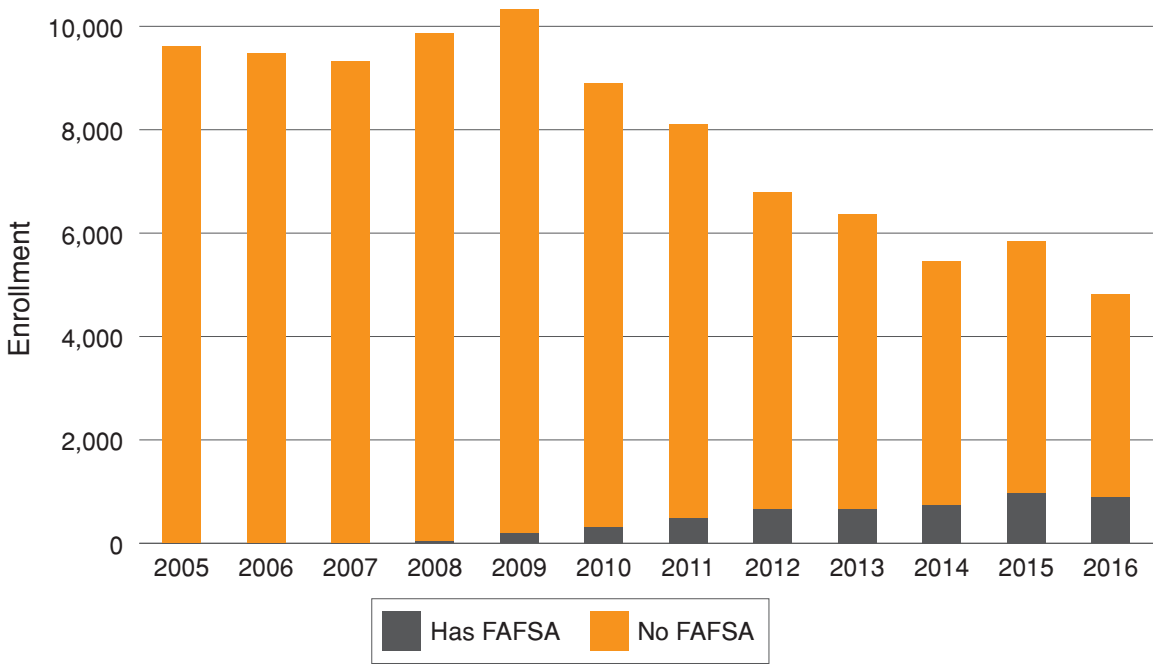


Figure 2B: TCAT Entrants Under 25 by FAFSA Status

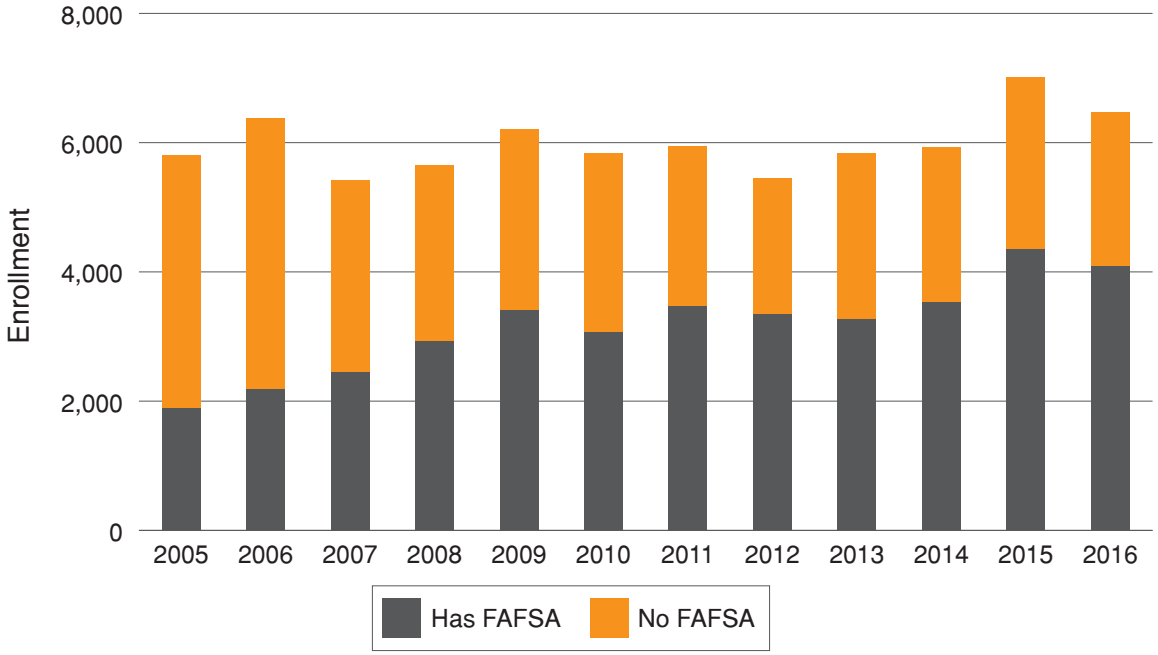


Figure 3: Percent of TCAT Students with Grant Aid

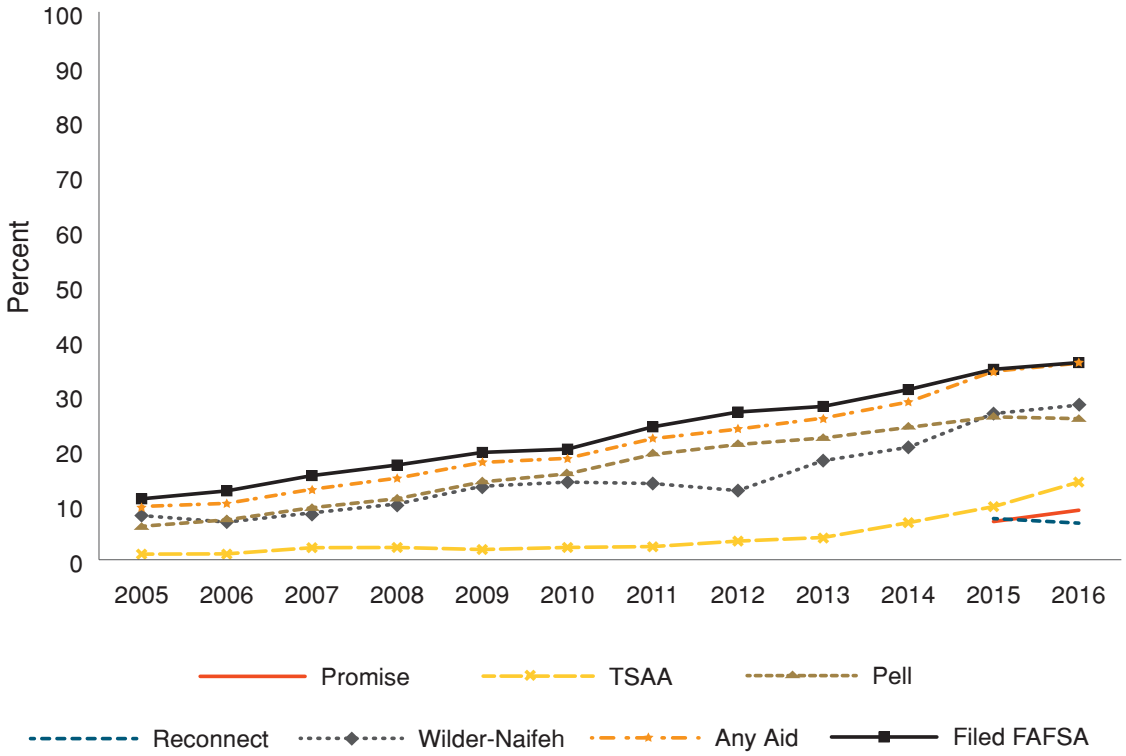


Figure 4: Percent of TCAT FAFSA Filers with Grant Aid

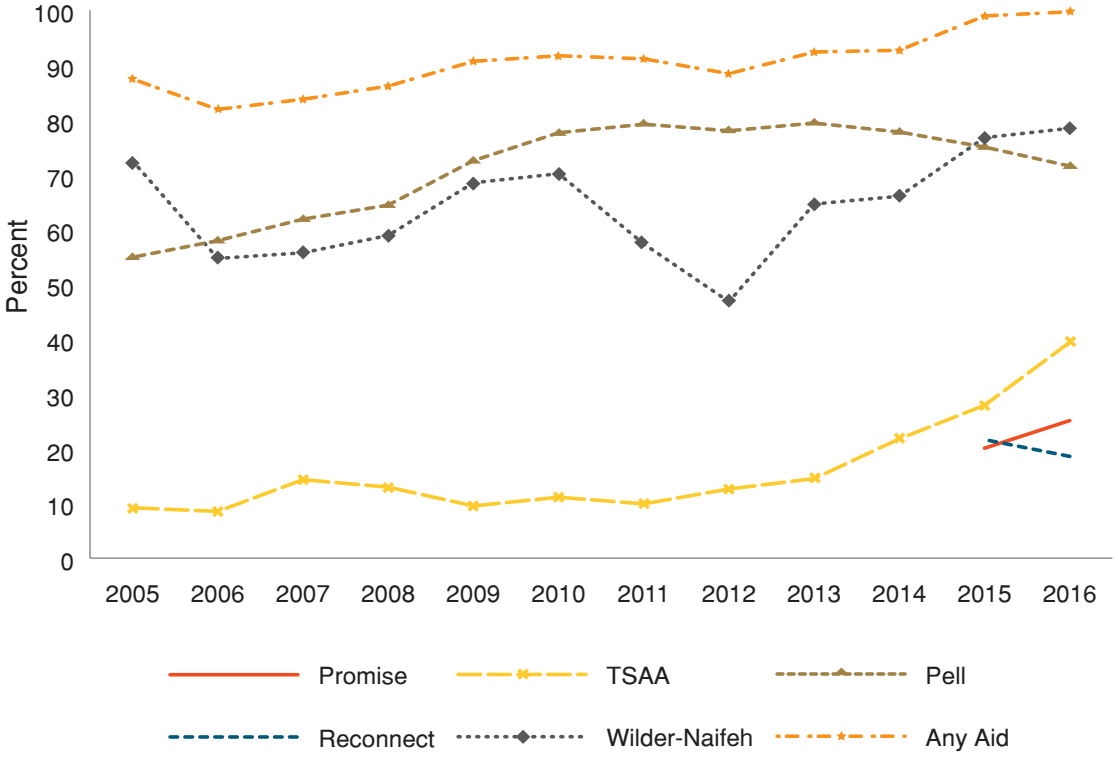
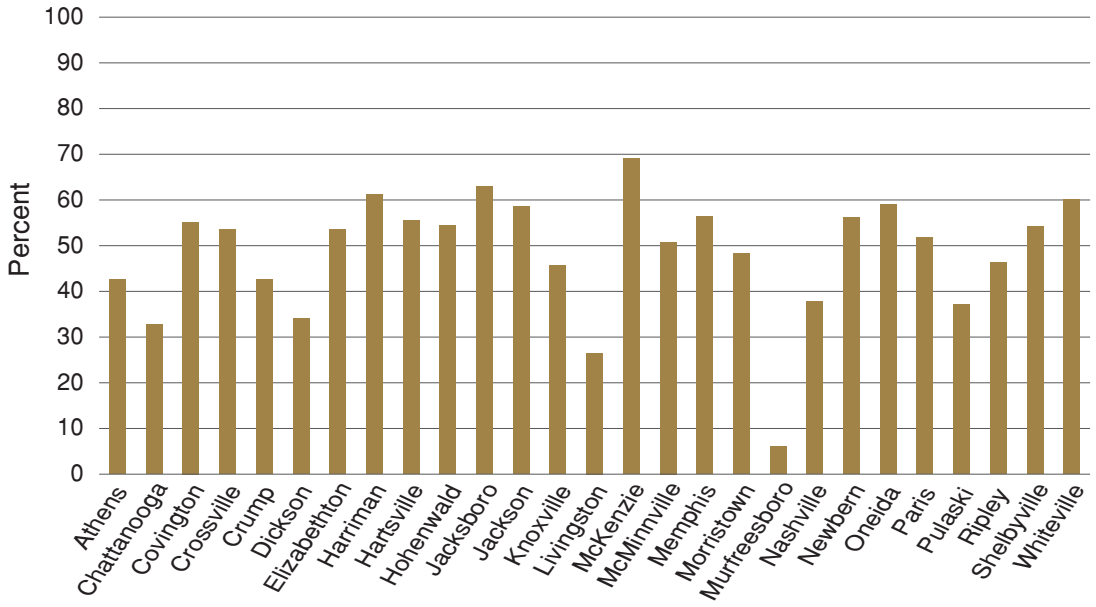


Figure 5: Percent of 2016 Students with FAFSA



Tennessee Reconnect and Promise are last-dollar grants that pledge to cover any tuition or required fees left over after other sources of aid have been obtained. As in the broader Tennessee Promise population, many Reconnect and Promise students in TCATs are eligible for additional federal and state aid. Table 1 statistics separate incoming 2015 and 2016 TCAT students into Reconnect students (Column 1) and Promise students (Column 2) and report on their eligibility for other aid programs.

The most striking insight from Table 1 is that almost all Reconnect students are eligible for other forms of grant aid processed through the FAFSA (97%), and 4 in 5 Promise students are eligible for other forms of aid. Very few are eligible for the state's merit-based HOPE scholarship. The most common form of aid among Reconnect and Promise students is the Wilder-Naifeh grant, followed by federal, need-based Pell and then state, need-based TSAA. Reconnect students are much more likely to be Pell-eligible than Promise students, perhaps owing to substantially lower income and expected family contribution among Reconnect students (results not shown). The TSAA is also needs-based, but is allocated on a first-come, first served basis according to the traditional filing calendar for FAFSA. It is possible that Promise students, coming straight from high school and more likely to enroll in the fall, are more aligned with that filing calendar than Reconnect students.

Table 1: Grant Aid for Tennessee Reconnect and Promise Students

	(1) Reconnect students (1,531)	(2) Promise students (2,932)
Pell eligible	77%	44%
TSAA eligble	18%	32%
Wilder-Naifeh eligible	85%	76%
HOPE eligible	<1%	1%
Any of the above	97%	81%

Notes: The table lists federal and state aid eligibility for incoming 2015 and 2016 TCAT students in Reconnect (Column 1) or Promise (Column 2).

V. FINANCIAL AID AND TCAT STUDENT OUTCOMES: DESCRIPTIVE STATISTICS

The purpose of financial aid is to alleviate the direct and indirect costs of schooling, allowing students to devote more time and energy to coursework. It is natural, then, to ask whether aid eligibility and receipt is associated with better student outcomes. In the TCAT setting, outcomes of interest include the following:

- **Average contact hours per term:** Contact hours are comparable to – or at least highly correlated with – hours spent directly engaged in coursework. A full-time TCAT program of study entails about 430 hours per term, roughly six hours per day, four days a week, for four months. Many TCAT programs are offered on a part-time basis with fewer contact hours. Contact hours are one of the fundamental differences between TCATs and credit-based higher education institutions. Credit hours in community colleges and universities roughly align with the number of hours per week in class, and credit hours are transferable between institutions under some articulation agreements. Contact hours are not typically convertible to credit hours for use at community colleges, although a TCAT diploma can count toward partial fulfillment of an Associate of Applied Science at one of the state's community colleges. For each student entering a TCAT between 2005 and 2016, we compute the average number of contact hours they earned across the terms when they were enrolled.

- **Total accumulated contact hours:** This outcome is computed as the total number of contact hours a student accumulated across all terms when they were enrolled or during a specified time following initial enrollment.

- **Any work while enrolled:** We identify TCAT students with any record of earnings covered by Unemployment Insurance (UI) and overlapping with their enrollment. All earnings figures are adjusted for inflation and equivalent to 2017 dollars. Note that UI-covered earnings exclude income from self-employment, contract work that resembles regular work but is treated as self-employment for tax purposes, income from other states, and income from some federal or agricultural employers.

- **Earnings while enrolled:** This is computed as the average amount of UI-covered earnings per 4-month trimester when a student was simultaneously enrolled in a TCAT.

- **Certificate attainment:** This is identified as any certificate award during the two calendar years following initial enrollment. Certificates are postsecondary credentials signifying the completion of short programs or sub-programs of study. Normal time to completion varies from less than one year to two years at full-time enrollment. Examples of certificate programs in Tennessee are "Diesel Engine Assembly" (864 hours) and "Nursing Assistant" (432 hours).

- **Diploma attainment:** This is identified as any diploma award during the time following initial enrollment. Diplomas, known as long-term certificates in other states, signify the completion of a program of study lasting up to two years at full-time enrollment. Examples of diploma programs include "Diesel Technician" (2,160 hours, or 20 months) and "Practical Nursing" (1,296 hours, or 12 months).

In Section VI we describe methods for assessing the causal effect of financial aid on these outcomes, but first, it is helpful to simply summarize TCAT student outcomes separately for financial aid recipients and other students. We begin to do so with Figure 6, which plots the average number of accumulated contact hours that 2004-2016 cohorts earned within the first 16 months of their TCAT enrollment, or up to four terms. Accumulated contact hours have risen steadily over that time, and have continued to rise with the 2015 or 2016 entrants who were the first eligible for Tennessee Promise or Tennessee Reconnect. We do not discern a noticeable tick up in contact hours for those cohorts, although we know from Figures 3-4 that Reconnect and Promise students represent a small percent of all TCAT students.

Table 2 takes a closer look at Tennessee Reconnect and Promise students, focusing on those who enrolled in 2015-16, for whom we can observe two full academic years of outcomes as well as the fall term of a third. Contact hours, completion, and work while enrolled are summarized separately for Reconnect students (Column 1), Promise students (Column 2), and other FAFSA-filing students not listed as participants in either Reconnect or Promise (Column 3).

Promise students enroll for more contact hours than Reconnect students, who in turn enroll for more contact hours than other FAFSA filers. We find that 55% of Promise students in the 2015 entering cohort completed a diploma at some point before the end of fall 2017, just slightly more than the equivalent percent of Reconnect students (52%) and 9 percentage points more than other students (46%). In regression analyses not shown, we find that the reported Table 2 gaps in diploma attainment are somewhat smaller when we control for race, ethnicity, gender, income, first-generation status,

Figure 6: Total Contact Hours over First 16 Months, by Cohort

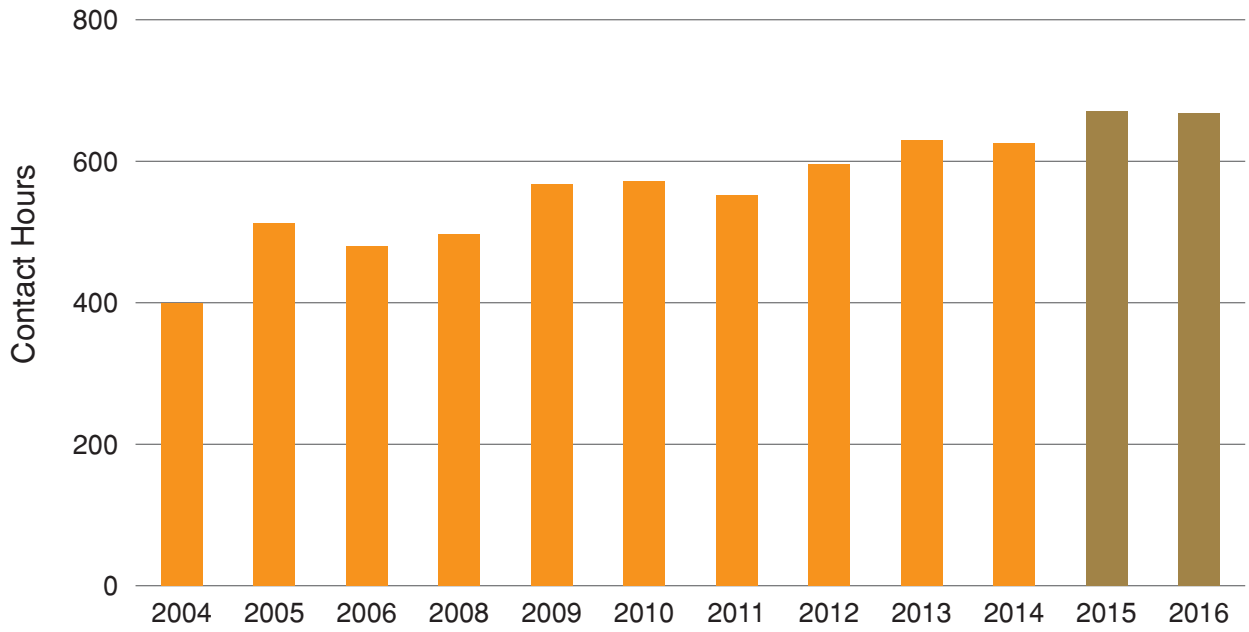


Table 2. Short-term Outcomes for Reconnect, Promise, and Other FAFSA-filing TCAT Students

Over their first two academic years:	(1) Reconnect students (800)	(2) Promise students (1,373)	(3) Other FAFSA-filing students
1. Average term contact hours	317	343	293
2. Total contact hours	979	1,227	955
3. Certificate within 2 years	23%	20%	27%
4. Diploma within 2 years	52%	55%	46%
5. Any work while enrolled	83%	85%	83%
6. Average 4-month earnings while enrolled (2017$)	3,659	2,765	2,783

Notes: For students who filed a FAFSA and started a TCAT program in 2015-16, the table reports average contact hours, attainment, and earnings while enrolled, with all statistics limited to the first 2.5 academic years of enrollment (2015-16, 2016-17, and the fall term of 2017-18).

veteran status, and fixed features of each TCAT campus. It should be noted that these different completion rates could be causal effects of Promise and Reconnect aid and non-financial support, or they could be due to omitted variable bias, that is, the idea that these programs are more likely to attract students with a higher unobserved desire or ability to complete a TCAT program.

In Table 3 we summarize these same six student outcomes, but for all students entering TCATs between 2005 and 2015, regardless of whether they filed a FAFSA. The first row of statistics in Table 1 show that aid recipients enroll for substantially more term contact hours, typically, than students without aid. Summing all of a student's contact hours across 2005-2016 school years, grant recipients earn about 87% more contact hours than students without aid: 1,050 versus 561.

The third and fourth rows of Table 3 report summary statistics for certificate and diploma completion within two years of enrolling, according to grant aid eligibility. Students with grant aid are considerably less likely to complete a short-term certificate than students without grant aid, but aid recipients are nearly twice as likely to complete a diploma. Much like we saw in Table 2 statistics for FAFSA filers (the vast majority of which receive grant aid, as shown in Figure 4), almost half of the students who enter a TCAT with grant support earn a diploma within two years. Just 1 in 4 students who enroll without grants processed through the FAFSA earn a diploma in that time.

Finally, the fifth and sixth rows of statistics in Table 3 report on the typical earnings that students collect outside of school while they are enrolled. Our prior hypothesis was that financial aid would offset some of the need to work outside of school, and also that students seeking financial aid could be more likely to be out of work. If so, these combined factors would manifest as lower typical earnings for financial aid recipients while they were enrolled. Contrary to these expectations, however, we find that aid recipients were much more likely to work while enrolled than other students, and their typical four-month earnings were $2,194 as opposed to $479 for students without aid.

Echoing our analysis of FAFSA filing rates over time, a complicating factor in this simple comparison of average earnings across aid recipients and non-recipients is the close relationship between state and federal labor

Table 3. Contact Hours, Earnings, and Completion by Aid Status

Student Outcome	(1) All entering TCAT students (160,283)	(2) Students without grant aid (125,609)	(3) Students with grant aid (34,674)
1. Average term contact hours	206	178	308
2. Total contact hours	667	561	1050
3. Certificate within 2 years	38%	42%	25%
4. Diploma within 2 years	30%	25%	47%
5. Any work while enrolled	27%	14%	77%
6. Average 4-month earnings while enrolled	$850	$479	$2,194

Notes: The table lists averages for each outcome listed at left for all TCAT students entering 2005-2015 (Column 1), for those that entered without Pell, TSAA, Wilder-Naifeh, or Reconnect grant aid (Column 2), and for those who entered with such grant aid (Column 3).

redevelopment initiatives and enrollment in TCATs. Workers who have lost their jobs are encouraged to access TCAT training programs, and students who do so can have their tuition subsidized by federal or state labor departments. These students would likely be out of work while enrolled, and their subsidies could supplant eligibility for federal and state grant aid.

Since we lack indicators for student participation in labor redevelopment and assistance programs, or a precise understanding of how eligibility for these programs is determined, the remainder of our analysis focuses on FAFSA filers to assess the causal effect of eligibility for state and federal need-based aid on outcomes summarized in Tables 2-3.

VI. THE EFFECT OF FINANCIAL AID ON TCAT STUDENT PERSISTENCE, COMPLETION, AND THE LINE BETWEEN COLLEGE AND WORK

Simple comparisons between aid recipients and other students, such as those in Tables 2-3, are informative but do not offer clear insights as to whether aid is responsible for differences in student completion or work while enrolled. Aside from their financial aid status, eligible and ineligible students may differ in unobserved ways that also affect later outcomes. To give just one example of this omitted variable bias, perhaps aid recipients had access to parents, friends, or school staff who advised they file a FAFSA and also advised they take a full course load and try to finish on time.

A randomized controlled trial that assigns a random group of aid applicants to receive meaningful financial aid packages and assigns the rest of the experimental subjects to receive less aid (or no aid) would avoid this kind of bias and offer a clean way to observe how financial aid affects student success in college and their need to work while enrolled. There are rare circumstances were such a study is possible,[22] but none of the grants we analyze in this report are allocated by random assignment. Pell and TSAA are need-based, while Wilder-Naifeh, Reconnect, and Promise eligibility are based largely on residency and FAFSA timing.

Eligibility determination for the Pell and TSAA grants, however, include a natural experiment that divides a small group of aid recipients as good as randomly from ineligible students. That is, in a very narrow window around eligibility cut points, we contend that ineligible applicants are equivalent to aid recipients, except for several hundred dollars in additional financial aid from Pell or TSAA.

When a prospective student files a FAFSA, he or she answers over 100 questions about household income, assets, and other household features such as the number of others enrolling in college. These inputs are entered into a formula to determine the student's EFC for college tuition and other expenses. EFC is typically less than the cost of attendance, and the applicant can use grants, scholarships, institutional tuition discounts, or loans to cover the gap. A student's total grant and scholarship aid cannot add up to more than the cost of attendance. These "overaward" circumstances are uncommon but may describe some TCAT students who live with family and have combined eligibility for Pell, TSAA, Wilder-Naifeh, and other awards.[23]

Students with low EFC are eligible for Pell or TSAA grants. Prospective students with 2016-17 EFC up to $5,234 were considered Pell eligible. Those with EFC just $1 higher were not eligible for any aid from Pell. Students with a 2016-17 EFC between $5,226 and $5,234 receive the minimum Pell $589 award. For EFCs below this range, the Pell award grows dollar-for-dollar up to the maximum Pell award, which was $5,815 in 2016-17. The Pell eligibility threshold moves from year to year, the minimum grant has varied from $400-976 over the cohorts in our sample, and the maximum has ranged from $4,050-5,815. Eligibility for the state-financed TSAA was determined by two factors: an EFC of $2,100 or less (typically less than half of minimum Pell eligibility), and a FAFSA filed early enough to qualify before TSAA allocations were exhausted. In results not shown, we do not find evidence that FAFSA applicants are "gaming" the EFC formula to obtain Pell or TSAA grants.[24]

Reasonably strict EFC cutoffs allow us to apply a statistical technique known as regression discontinuity to empirically quantify the effect of Pell or TSAA eligibility on student contact hours, completion, and earnings while enrolled. This estimation strategy addresses concerns of selection bias which can stem from unobservable student characteristics as described at the beginning of this section. Our first regression discontinuity analysis unfolds as a two-stage least squares regression model that takes the following form:

$$(1) \quad ELIGIBILITY_{ic} = \alpha_0 + \alpha_1 BELOW_{ic} + \alpha_2(EFC_{ic} - E_c) + \alpha_3 BELOW_{ic} * (EFC_{ic} - E_c) + \varepsilon_{ic}$$

$$(2) \quad Y_{ic} = \beta_0 + \beta_1 PREDICTED\_ELIGIBILITY_{ic} + \beta_2(EFC_{ic} - E_c) + \beta_3 BELOW_{ic} * (EFC_{ic} - E_c) + \varepsilon_{ic}$$

Equation (1) predicts Pell or TSAA eligibility as a simple function of the gap between student *i*'s EFC and the threshold for minimum grant eligibility in his/her cohort *c*, an indicator for having EFC at or below that threshold, and the interaction of those two terms. The parameter α_1 tells us the extent to which eligibility increases at the minimum grant threshold. That increase in eligibility is depicted in Figure 7. Panel 7A, as well as results from estimating Equation (1), shows that Pell eligibility rises 48% at the minimum grant threshold. Recall that we do not observe a student's final EFC, but rather, the parent and student components that usually add up to the EFC used in Pell determination. For this reason, some of students who are income-eligible for Pell according to these components are ultimately not given the grant. Reasons for this are beyond the scope of available data but could be due to the FAFSA verification process or unobserved sources of aid.[25] Note also that 5-10% of Pell-*in*eligible students with EFC higher than (to the right of) the threshold ultimately receive Pell, perhaps also due to EFC corrections in the verification process.

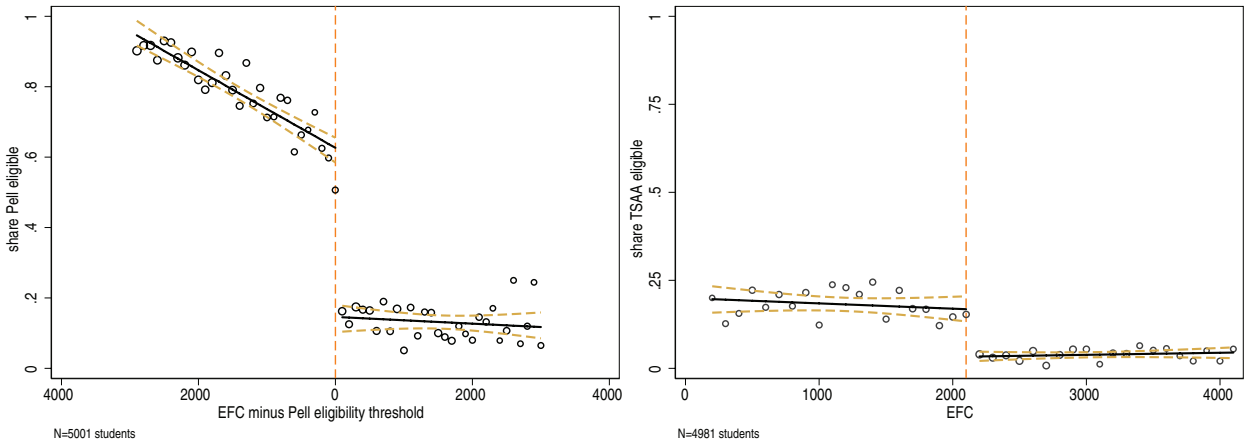
Nevertheless, a 50% discontinuity in eligibility is a sizable quasi-experiment in financial aid, leading to an average additional grant of $465, or just over 10% of tuition and fees for a year-long, full-time program.

The eligibility discontinuity is smaller for TSAA, which requires students to have a particular EFC and also file a FAFSA relatively early. Panel 7B and estimates of Equation (1) show that TSAA eligibility rises just 13% at the EFC cut point for that grant. This is a small bump in the percent of students with additional aid, compared to the Pell, but TSAA eligibility entails more than twice as much in additional funds as the minimum Pell award.

The second-stage Equation (2) estimates the effect of Pell or TSAA eligibility (separately, not in combination) on outcomes of interest: average contact hours, total contact hours, certificate or diploma completion within two years, any work while enrolled, and average 4-month earnings while enrolled. The specification includes the same arguments as Equation (1), but with grant eligibility predicted from a student's EFC being below the relevant cut point. Analytically, we are estimating the size and precision of differences in outcomes between students who just made the

Figure 7A: Pell Eligibility by EFC

Figure 7B: TSAA Eligibility by EFC



Notes: Scatter plots illustrate average Pell (7A) or TSAA (7B) eligibility against the gap between students' EFC and qualifying EFC values for each grant and for respective cohorts. Solid lines trace the linear relationship between eligibility and the EFC gap. Dashed lines encompass the confidence interval on each side of a given threshold.

grant cutoff and students who just missed it, and then adjusting for the difference in the likelihood of additional aid at the cutoff. We estimate Equations (1) and (2) for all entering TCAT students with FAFSAs on file for their first term, and who had EFC within $3,000 of the cutoff for Pell or TSAA in their cohort.[26] Although results really only apply to students right at the cutoffs, we follow standard practice for this method and include students more removed from the cut point to improve statistical precision.

Our main results for Pell and TSAA eligibility are reported in Table 4. Estimates of the effect of grant eligibility on each outcome (β_1 in the notation of Equation (2)) are listed first for each outcome and each grant, with 95% confidence intervals in brackets. Results for contact hours and completion are all statistically insignificant, meaning that we cannot reject the hypothesis that just meeting the EFC requirements for these grants had no effect on the intensity of enrollment or the likelihood of completion. Both grants are associated with more total contact hours (16 for Pell and 38 for TSAA), but as plainly seen from the confidence intervals, student outcomes are consistent with a wide range of negative or positive effects.

Figure 8 visualizes some of the findings from Table 4. In contrast to the sharp rise in eligibility at the threshold depicted in Figure 7, we see no discernible difference between marginally eligible and marginally ineligible students in terms of their average contact hours or diploma completion. Equation (2) results suggest that grant-eligible students earned $514-716 more from outside work opportunities than their ineligible counterparts while enrolled, but that this difference was not statistically significant for Pell or TSAA eligible students. Though imprecise, higher earnings while enrolled work against our prior hypothesis that grant aid may help students work less, although the line between work and school is blurred in TCATs, and it is possible that aid may have helped students secure better-paying work in tandem with their TCAT programs of study. And yet, Figure 8 does not depict a strong upward shift in earnings for minimally Pell eligible students.

Table 4. Regression Discontinuity Results for Pell or TSAA Eligibility

	(1) Minimum Pell eligibility	(2) TSAA eligibility
Average term contact hours	16.2 [-12.6, 45.1]	38.0 [-59.0, 134.9]
Total contact hours	127.6 [-61.2, 316.3]	51.0 [-525.0, 627.1]
Certificate attainment (%)	1.6 [-9.6, 12.7]	-18.0 [-54.4, 18.3]
Diploma attainment (%)	-1.9 [-14.6, 10.8]	12.5 [-28.3, 53.3]
Any work while enrolled (%)	5.9 [-3.8, 15.5]	17.3 [-13.8, 48.3]
Average 4-month earnings while enrolled (2017$)	514 [-152, 1,181]	716 [-1,484, 2,916]
Number of students	5,001	4, 981

Notes: The table presents results of Equation (2), estimated separately for each outcome listed at left, and for Pell and TSAA cutoffs. Each pair of results represents a different regression. The top statistic is the estimate for $\beta 1$, the effect of just meeting the cutoff for either grant. In brackets below this statistic is the 95% confidence interval. Robust standard errors are clustered by EFC.

Looking across Table 4 and Figure 8, results for minimum Pell and TSAA eligibility suggest that these grants do not consistently affect student outcomes, which would echo research on non-traditional students and financial aid in California.[27] But we caution against concluding that the Pell and TSAA have no effect on TCAT students, for a few reasons.

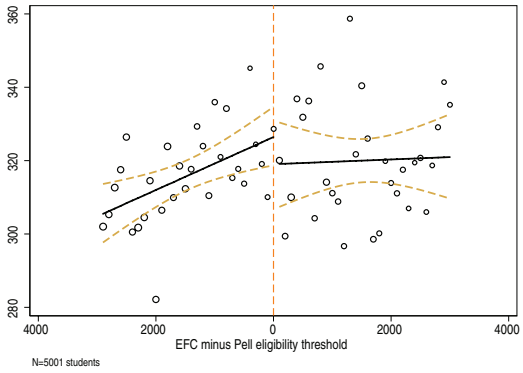
Foremost, confidence intervals reported in Table 4 are very wide and inconclusive as to whether these grants affected students, and to what degree if so. Consider diploma receipt at the TSAA threshold as an example. Noisy discontinuities in typical diploma attainment, when combined with a low percentage of students whose TSAA eligibility is actually affected by that threshold, leads us to infer that the effect of that TSAA eligibility on diploma receipt is anywhere from a 28-percentage-point reduction to a 53-point increase. Completion effects the size of those endpoints are almost unheard of in the financial aid literature. The [-28.3, 53.3] confidence interval spans all reasonable effects, including zero and plausible, positive effects. Confidence intervals may be large because of statistical power. Although 4,981-5,001 students is a large number, regression discontinuity requires much larger samples than other statistical methods (9-17 times as many as randomized controlled trials).[28] The treatment of minimal Pell eligibility is fairly modest as well, typically measuring $400-500 in additional grant aid.[29]

Regression discontinuity results for Pell and TSAA eligibility describe a minority of all 2005-2015 entering TCAT students with FAFSAs whose EFCs put them subjectively close to either grant eligibility cut point. A far greater number of TCAT students have incomes that result in an EFC of zero. This is true for 60% of entering TCAT students.[30] In order to assess the effect of grant aid on a lower-income – and much more numerous – group of students, we turn to another discontinuity inherent to the FAFSA process. With some exceptions, students whose adjusted gross income falls below a certain level ($20,000 – 31,000 depending on the year), and whose households are eligible to file a simplified income tax form (1040A or 1040EZ) are automatically given an EFC of zero and

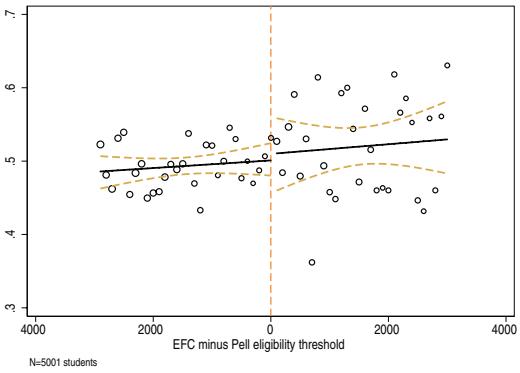
Figure 8: Student Outcomes by Pell or TSAA Eligibility

Proximity to Minimum Pell Eligibility and …

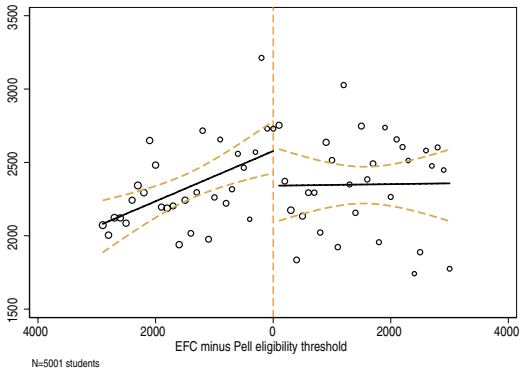
8A: Average Contact Hours per Term



8B: Diploma Receipt within Two Years

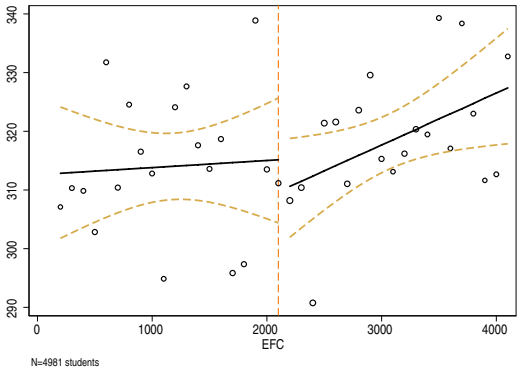


8C: Average 4-Month Earnings While Enrolled

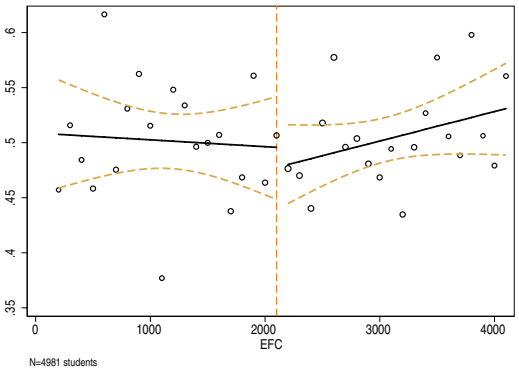


Proximity to TSAA Eligibility and …

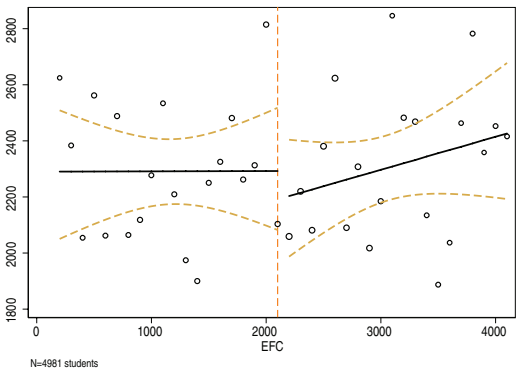
8D: Average Contact Hours per Term



8E: Diploma Receipt within Two Years



8F: Average 4-Month Earnings While Enrolled



Notes: Scatter plots illustrate average values of each listed outcome against the gap between students' and qualifying EFC values for Pell (panels 8A, 8B, 8C) or TSAA (Panels 8D, 8E, 8F). Solid lines trace the linear relationship between outcomes and the EFC gap. Dashed lines encompass the confidence interval on each side of a given threshold. Table 4 results quantify the vertical difference and statistical significance of the gap between each figure's two fitted lines for income-eligible (left of threshold) and income-ineligible (right) students.

the maximum Pell grant. Automatic Zero applicants might be able to skip much of the FAFSA (although this depends on where they are applying to enroll), and with a limited number of critical inputs, they may find it much easier to verify their FAFSA if asked to do so. We assess the effect of Automatic Zero designation in much the same way that we did for minimum Pell and TSAA eligibility. Specifically, we estimate another two-stage least squares regression discontinuity analysis:

$$(3) \quad EFC\_ZERO_{ic} = \alpha_0 + \alpha_1 BELOW_{ic} + \alpha_2(AGI_{ic} - A_c) + \alpha_3 BELOW_{ic} * (AGI_{ic} - A_c) + \varepsilon_{ic}$$

$$(4) \quad Y_{ic} = \beta_0 + \beta_1 PREDICTED\_EFC\_ZERO_{ic} + \beta_2(AGI_{ic} - A_c) + \beta_3 BELOW_{ic} * (AGI_{ic} - A_c) + \varepsilon_{ic}$$

In Equation (3), the treatment outcome is whether or not a student has EFC zero designation, which we predict as a function of adjusted gross income (AGI) and an indicator of having an AGI that qualifies for Automatic Zero EFC. Recognizing that this treatment is really two parts – simpler aid, as well as additional aid – we also estimate a version of Equation (3) where a student's potential Pell grant is the dependent variable. We exclude students with AGI reported to be a multiple of $1,000 to avoid a situation where results are driven by characteristics of round-number salary earners rather than Automatic Zero eligibility. Figure 9 depicts the discontinuous change in the likelihood of having an EFC of zero at the Automatic Zero threshold. Panel 9A and accompanying estimate of Equation (3) show that that likelihood grows by 43 percentage points. Applicants with income just above the Automatic Zero threshold likely qualify for large Pell grants, and perhaps even the maximum Pell grant. Nevertheless, Panel 9B shows that those just below the threshold tend to qualify for only $208 more in potential Pell aid.

Figure 9A: Zero EFC by AGI

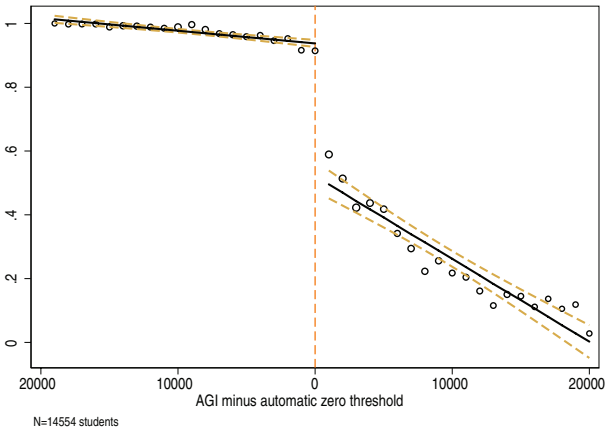
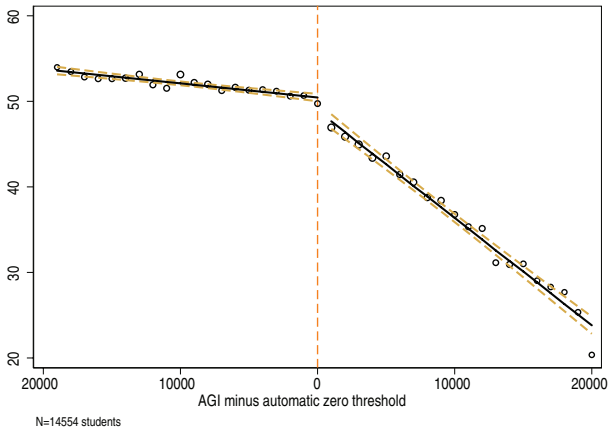


Figure 9B: Potential Pell Grant by AGI (in Hundreds)



Notes: Scatter plots illustrate the average likelihood of having a zero EFC (9A) or potential Pell aid (9B) against the gap between students' AGI and qualifying AGI values for the Automatic Zero EFC rule. Qualifying AGI values ranged from $21,000 – 30,000 across cohorts. Solid lines trace the linear relationship between Zero EFC status or aid amount, and the AGI gap. Dashed lines encompass the confidence interval on each side of a given threshold.

For Equation (4), we estimate the effect of Automatic Zero designation, or of additional Pell coming from that designation, on the same outcomes reviewed for minimum Pell and TSAA eligibility. Results are summarized in Table 5.[31]

Column (1) lists results when the treatment is a binary indicator of EFC equal to zero. If the Automatic Zero rule drives this treatment, it combines additional aid with the simplifying benefits of having a shorter FAFSA and possibly an easier verification process. We find that qualifying for the Automatic Zero rule leads to an insignificant 14 additional contact hours per term, on average, positive but statistically insignificant differences in total contact hours, an imprecisely lower likelihood of certificate attainment within two years, an insignificant 4 percentage point greater likelihood of diploma receipt within two years, and significantly more work while enrolled. These findings are in agreement in sign and statistical significance with those shown in Column (2), where we report that for each additional $100 attained at the Automatic Zero threshold, contact hours and completion rates do not significantly change, but earnings are $105 higher during each enrolled 4-month term. Comparing Columns (1) and (2), we see merit in the idea that the Automatic Zero rule affects students above and beyond its effect on Pell aid. We only see Pell grants rise $208, typically, below the income cutoff, and yet Column (1) estimates tend to be more than twice the estimated effect of each additional $100 at the Automatic Zero threshold.

Figure 10 provides visual support for the largely null results listed in Table 5, although it appears that the discontinuity in average 4-month earnings is driven in part by outliers with prior income about $4,000 less than the Automatic Zero line.

Further analysis, not shown here, indicates that students who just meet the Automatic Zero income rule may be fundamentally different than students who just miss it for reasons other than additional financial aid and aid simplification.

Table 5. Regression discontinuity results for Automatic-Zero EFC

	(1) Automatic Zero EFC	(2) Additional $100 in Pell aid
Average term contact hours	14.0 [-4.4, 32.4]	2.9 [-1.0, 6.7]
Total contact hours	62.9 [-45.0, 170.9]	12.9 [-9.6, 35.4]
Certificate attainment (%)	-3.3 [-10.0, 3.4]	-0.7 [-2.1, 0.7]
Diploma attainment (%)	3.8 [3.0, 4.6]	0.8 [-0.8, 2.4]
Any work while enrolled (%)	3.6 [-2.5, 9.7]	0.7 [-0.7, 2.1]
Average 4-month earnings while enrolled (2017$)	511** [81, 941]	105** [13, 196]
Number of students	14,554	14,554

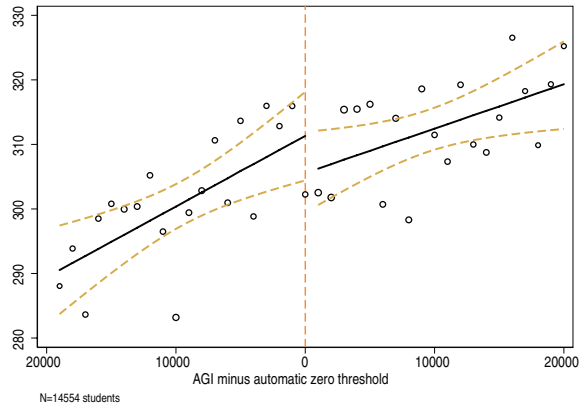
Notes: The table presents results of Equation (4), estimated separately for each outcome listed at left, and for predicted EFC = 0 determination (Column 1) and additional Pell dollars (in hundreds, Column 2). Each pair of results represents a different regression. The top statistic is the estimate for β1, the effect of just meeting the Automatic Zero cutoff. In brackets below this statistic is the 95% confidence interval. Robust standard errors are clustered by AGI.

* represents statistical significance at 90% confidence, ** at 95%, and *** at 99%

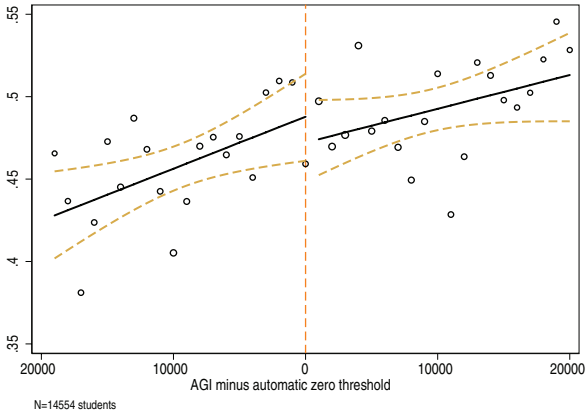
Figure 10: Student Outcomes by Automatic Zero Eligibility

Proximity to Automatic Zero Threshold and ...

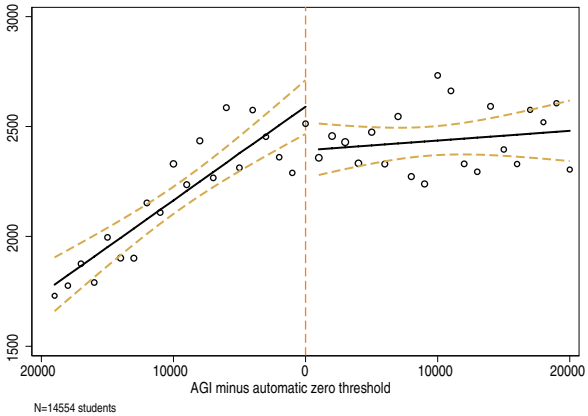
10A: Average Contact Hours per Term



10B: Diploma Receipt within Two Years



10C: Average 4-Month Earnings while Enrolled



Tellingly, just-eligible students were more likely to be working, and were earning significantly more, than just-ineligible students at least one year prior to enrolling in a TCAT.

Much like just-eligible Pell and TSAA students, our findings are inconclusive about the effects of the Automatic Zero financial aid policy on just-eligible students. Simpler aid determination bundled with modestly higher Pell grants does not appear to affect TCAT student outcomes to the extent seen in Texas among four-year university students.[32] It is certainly possible that TCAT students further from the eligibility threshold (for example, with incomes lower than the $15,000 - 31,000 Automatic Zero threshold) benefit more from these grants, which we would not infer from a regression discontinuity analysis of differences in student outcomes right at the threshold.

A related possibility is that marginal amounts of financial aid from need-based grants compete with the opportunity cost of persisting in college (meaning, the wage a student could earn instead), and that it would take much more than a small Pell grant to make enrollment worth the time. Results in Tables 4-5 for average contact hours, although insignificant, imply that students convert additional Pell grant aid to additional contact hours at a rate of about $9-10/hour, in line with the lower end of incomes for marginally Pell and Automatic Zero eligible students. A grant larger than the $200-500 increments studied here may elicit more persistence and completion.

Notes: Scatter plots illustrate the average amount of each outcome against the gap between students' AGI and qualifying AGI values for the Automatic Zero EFC rule. Qualifying AGI values ranged from $21,000 – 30,000 across cohorts. Solid lines trace the linear relationship between Zero EFC status or aid amount, and the AGI gap. Dashed lines encompass the confidence interval on each side of a given threshold. Table 5 results quantify the vertical difference and statistical significance of the gap between each figure's two fitted lines for income-eligible (left of threshold) and income-ineligible students.

VII. ENDNOTES

[1] This report is the result of a collaboration between researchers at the University of Tennessee and Vanderbilt University known as the Tennessee Postsecondary Evaluation and Analysis Research Lab (TN-PEARL). See Carruthers and Welch (2020) or additional robustness checks and technical details. Carruthers, C.K. and Welch, J.G. *Financial Aid for Nontraditional Students: Take-up and Estimated Effects in Technical Colleges.* Working Paper. https://volweb.utk.edu/~ccarut1/research.html. We are grateful to the Tennessee Higher Education Commission and the Tennessee Department of Labor and Workforce Development for providing data, to Tom Jenkins for technical assistance accessing data, and to Brian Douglas, Emily House, and Jason Lee for answering our contextual and technical questions. Findings and opinions expressed in this study do not reflect the position of any campus, funder, or state agency. All errors are our own.

[2] College Board, *Trends in Student Aid 2018*. https://trends.collegeboard.org/sites/default/files/2018-trends-in-student-aid.pdf

[3] Lumina Foundation, "A Stronger Nation" report series. See the Foundation's latest attainment estimates here: http://strongernation.luminafoundation.org/report/2019/#nation.

[4] Tennessee Higher Education Commission *2014-15 Fact Book*.

[5] The state computes TCAT completion percentages according to guidelines developed by their accrediting organization, the Council for Occupational Education. These guidelines differ a great deal from 6-year graduation rates used by community colleges and universities. The Council for Occupational Education allows for "non-graduate completers" who have entered employment in their field (and so, presumably acquired the requisite skills) to count as program completers alongside students who earned certificates and diplomas at the completion of all coursework (Sykes, 2011). Sykes, A. (2011). Background paper: Calculating job placement rates under gainful employment regulations. https://nces.ed.gov/npec/data/Calculating_Placement_Rates_Background_Paper.pdf

[6] Carnevale, A. P., Smith, N., & Strohl, J. (2013). Recovery: Job growth and education requirements through 2020. *Georgetown University Center on Education and the Workforce.*

[7] Carruthers, C. K., & Sanford, T. (2018). Way station or launching pad? Unpacking the returns to adult technical education. *Journal of Public Economics*, 165, 146-159.

[8] Total cost of attendance figures for TCAT-Nashville were taken from IPEDS (https://nces.ed.gov/ipeds/use-the-data).

[9] Dynarski, S., & Scott-Clayton, J. (2013). *Financial aid policy: Lessons from research* (No. w18710). National Bureau of Economic Research.

[10] For a recent review, see Page, L. C., & Scott-Clayton, J. (2016). Improving college access in the United States: Barriers and policy responses. *Economics of Education Review,* 51, 4-22.

[11] Carruthers, C. K., & Welch, J. G. (2019). Not whether, but where? Pell grants and college choices. *Journal of Public Economics*, 172, 1-19

[12] Denning, J. T., Marx, B. M., & Turner, L. J. (2017). *ProPelled: The effects of grants on graduation, earnings, and welfare* (No. w23860). National Bureau of Economic Research.

[13] See Gurantz (2018) for one setting where financial aid for non-traditional students had little to no effect on completion or earnings, as well as a review of the related literature on financial aid for non-traditional students. Gurantz, O. (2018). Impacts of State Aid for Non-Traditional Students. CEPA Working Paper No. 18-19. *Stanford Center for Education Policy Analysis*.

[14] Tennessee Promise funds can also be used at a small number of four-year colleges and universities that have associate programs.

[15] See Figure 2.7: Tennessee Higher Education Commission *2015-16 Fact Book*.

[16] Dynarski, Susan, and Judith Scott-Clayton, 2007. "College Grants on a Postcard: A Proposal for Simple and Predictable Federal Student Aid." Discussion Paper 2007-01. The Hamilton Project, Washington, DC.

[17] All individual-level data described herein was approved for our research use by state agencies, following the governance procedures and policies of the Tennessee Student Longitudinal Data System (TLDS, or "P-20"). Individually identifying information such as names or identification numbers are removed and replaced with random alphanumeric strings. This project and others in the TN-PEARL suite of research were approved by the University of Tennessee Institutional Review Board (#UTK IRB-17-04041-XP).

[18] Non-credit students include those with training codes for occupational certification or re-certification, as well as students in special interest courses such as Scrapbooking or Calligraphy.

[19] Specifically, we assigned the first quarter of each calendar year and 1/3 of the second to the spring trimester, 2/3 of the second and third quarters to summer, with fall represented by 1/3 of the third quarter and all of the fourth quarter.

[20] Betts, J. R., & McFarland, L. L. (1995). Safe port in a storm: The impact of labor market conditions on community college enrollments. *Journal of Human Resources*, 741-765.

[21] The 2018 Tennessee Promise Report puts the current FAFSA filing rate at 79% among individuals under 19. https://www.tn.gov/thec/research/redirect-research/tn-promise-annual-report.html

[22] Angrist, J., Hudson, S., & Pallais, A. (2015). Evaluating econometric evaluations of post-secondary aid. *American Economic Review*, 105(5), 502-07.

[23] The 2017-18 cost of attendance for full-time enrollment at TCAT-Athens, for example, was $9,003 for students living with family ($13,959 for students living on their own) according to IPEDS. The maximum Pell grant that year was $5,920, a Wilder-Naifeh grant could provide an additional $2,000, and a TSAA grant was worth $1,000. This leaves just $83 between the cost of attendance and total aid, meaning that additional aid such as a private scholarship or the HOPE scholarship could be scaled back to prevent overaward. Note that in this case, the student would not be eligible for any Reconnect or Promise funds, since $4,038 in tuition and fees were easily covered by other grants.

[24] We find no statistically significant jump in the density of applications just below the EFC threshold, nor do we find significant changes in the likelihood of students' gender, race, parental education, or predicted values of outcomes associated with the Pell eligibility threshold.

[25] In our earlier study of Pell and college choice for traditional aged students, we found a near-perfect correspondence between final EFC and Pell eligibility.

[26] We omit students enrolling in TCAT-Chattanooga because of missing enrollment data from 2007 and 2008.

[27] Gurantz (2018).

[28] Deke, J., & Dragoset, L. (2012). Statistical Power for Regression Discontinuity Designs in Education: Empirical Estimates of Design Effects Relative to Randomized Controlled Trials. Working Paper. Mathematica Policy Research, Inc.

[29] Pell and TSAA regression discontinuity results are broadly robust to several specification checks that vary the bandwidth, add controls, or change the functional form of Equations (1-2). Note that additional Pell grant aid may have less bearing after last-dollar Reconnect and Promise were made available, although we find results to be equivalent to what we report here when we exclude cohorts eligible for those programs.

[30] We exclude this large group of lower-income students from the Table 4 analysis because regression discontinuity applies to the narrow window around eligibility, and the volume of EFC-zero students would skew results away from that window.

[31] Not shown, but available on request, are robustness and specification checks for automatic zero results that add controls, modify the functional form of the running variable, or modify the bandwidth. These are broadly in agreement with what is reported in Table 5.

[32] Denning et al. (2017)