Financial Aid and Simplification: Estimated Effects in Technical Colleges

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Abstract

We explore the effects of financial aid and aid simplification on the intensity of enrollment, attainment, and working while enrolled among certificate and diploma-seeking students in technical colleges. A small amount of aid bundled with simplification is not consistently linked to changes in typical contact hours each term, earnings while enrolled, or a significantly different likelihood of completing a certificate or diploma program within two years. Our estimates, though imprecise, suggest that simplification may enhance the effects of aid alone, and that students convert grant aid to additional contact hours at a rate of $11-12/hour. Grants larger than the $200 increments studied here may be necessary to elicit significant changes in completion.

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1 Introduction

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. Initiatives 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.[1] Included in this initiative are financial aid programs for students attending one of the state's twenty-seven Tennessee Colleges of Applied Technology (TCATs). TCATs are public institutions, and required tuition and fees are similar or less than what students pay to enroll in Tennessee community colleges.[2] Programs of study are also similar between TCATs and community colleges, and both award postsecondary certificates and diplomas in well-defined skills and occupations. Unlike community colleges, TCAT students accumulate contact hours rather than credit hours, their schedules are determined by program rather than a timetable of classes, their day-to-day coursework tends to be more applied and technical, and they rarely transfer in pursuit of a higher degree. TCAT students are more likely to be older, displaced from the workforce, or otherwise non-traditional, and their programs are highly focused on skill development and job placement. A large literature has examined the impact of aid on enrollment and success in college, particularly for traditional-age students attending community colleges or four-year universities, but less is known about how financial aid impacts students attending technical colleges such as TCATs.

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 82% of students in a TCAT cohort completed their programs. This compares very favorably to completion percentages of 28% in the state's community colleges

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

[2] For example, 2019-2020 tuition and fees for full-time students at TCAT-Nashville was typically $4,236, versus $4,294 for students at Nashville State Community College. Full-time tuition figures for these two institutions were taken from IPEDS (`https://nces.ed.gov/ipeds/use-the-data`).

and 58% across Tennessee public universities, although caution should be exercised when making direct comparisons across these sectors because of different definitions of completion.[3] 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 (Carnevale et al., 2013), albeit not necessarily a college credential. 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 Tennessee Higher Education Commission, 86% of recent TCAT completers available for job placement found work in their field (Tennessee Higher Education Commission, 2019a). In a recent study, Carruthers & 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.

Against the growing importance of financial aid and technical college enrollment, we seek to estimate the effect of financial aid on a number of TCAT student outcomes: contact hours, outside work while enrolled, and the likelihood of attaining a certificate or diploma. This analysis follows a previous report (Carruthers & Welch, 2020), which provides an in-depth descriptive analysis of the take-up of different types of aid available to TCAT students, including Tennessee Promise and Reconnect, Tennessee Student Assistance Awards (TSAA), the Pell grant, and the State Wilder-Naifeh Technical Skills grant. Here, we provide a focused examination of the causal impact of aid on TCAT student success using a natural experiment within the application process for the Pell grant. With some exceptions, students whose

[3]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).

adjusted gross income falls below a certain level ($15,000 – 31,000 depending on the year), and whose households are eligible to file a simplified 1040A or 1040EZ income tax form are automatically given an "expected family contribution" toward college costs of zero and the maximum Pell grant. This Automatic Zero rule bundles FAFSA simplification with a small amount of additional aid, on average, for students just below the income threshold. 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.

2 Related Research

Financial aid can help students enroll in and complete college, more so if the requirements to obtain aid are transparent and timely (Scott-Clayton & Dynarski, 2013). 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 (Page & Scott-Clayton, 2016), although the effects of particularly successful low-touch information treatments do not always replicate at a larger scale (Bird et al., 2019; Gurantz et al., 2020). For students who are already enrolled, changes in financial aid can affect persistence, credit accumulation, and completion, both in circumstances where performance criteria are tied to aid renewal (Carruthers & Özek, 2016; Scott-Clayton & Schudde, 2019), and in circumstances where gains or cuts in aid are due to program rules (Denning, 2019; Denning et al., 2019).

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,

Carruthers & Welch (2019) find that Pell eligibility has little to no effect on whether or where students go to college. Of course, aid can benefit students after they enroll in college, and in a research design similar to ours, Denning et al. (2019) show that additional grant aid from Pell leads to faster graduation for university students in Texas, as well as higher post-college earnings that more than recoup the federal investment (Denning et al., 2019).

While aid appears to matter and to pass cost-benefit tests for traditional-aged college students pursuing associate's or bachelor's degrees, the effects of financial aid for non-traditional students–older enrollees, veterans, technical college students, or for-profit students, among others–have been mixed. We add to this smaller literature with this study. Focusing on individuals age 22-35 in the Current Population Survey, Seftor & Turner (2002) found that a $1,399 average increase in Pell grants corresponded with higher postsecondary enrollment rates of 1.4 - 1.5 percentage points, notably less than the 3 - 6 point range of results from studies of predominantly traditional students (Deming & Dynarski, 2010). Likewise, Barr (2015, 2019) found that college benefits embodied in the Post-911 G.I. Bill led to enrollment and completion gains of less than one percentage point per $1,000 in additional annual aid. Gurantz (forthcoming) studies a need-based and merit-based scholarship for non-traditional students in California, finding that the grant does not affect the likelihood of graduation for students intending to enroll in community colleges or public/non-profit four-year universities.

Some interventions that fold performance incentives, application assistance, or advising into aid per se have been more successful at raising enrollment and credit accumulation among independent and older students, albeit with mixed and limited effects on persistence and degree completion (Richburg-Hayes et al., 2009; Bettinger et al., 2012; Mayer et al., 2015). Aid incentives tied to current or future performance can elicit more time and effort toward educational activities (De Paola et al., 2012; Barrow et al., 2014; Barrow & Rouse, 2018; Barrow et al., 2020), whereas aid that is conditioned on past performance may flow to students whose postsecondary success is less sensitive to additional funding (Gurantz, forthcoming; Jones et al., 2020).

Synthesizing and applying the related literature to the question at hand leaves us uncertain about the *a priori* effect of Automatic Zero simplification and aid on TCAT student persistence, work while enrolled, and completion. The Automatic Zero rule simplifies the outcome of an opaque set of formulas that determine federal financial aid, and in principle, shortens the amount of information that students need to supply to those formulas. These process efficiencies and their later effects on FAFSA verification should clarify aid determination in ways that support student progress. But the Automatic Zero rule is not tied to incentives or support services that have been shown to complement aid, which when combined with prior evidence that aid has a smaller effect for nontraditional college students, suggest that aid bundled with a simplified application might not register a large difference in student outcomes.

3 Pell and Automatic Zero EFC

The federal Pell grant, named for U.S. Senator Claiborne Pell (D-RI), 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 requires students to complete the Free Application for Federal Student Aid (FAFSA). The form is typically more complex and lengthier than an income tax return as a prospective student who files a FAFSA answers over 100 questions about household income, assets, and other household features such as the number of others enrolling in college. Critical inputs for aid determination are a family's adjusted gross income and the number of household members in college (Dynarski & Scott-Clayton, 2007). 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 tuition and other 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. Those with an EFC just $1 higher were not eligible for any aid from Pell. The grant grows as EFC falls, such that the maximum grant for 2018-19 is $6,095 for students with zero EFC. 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.

EFC is typically less than the cost of attendance (which includes typical living expenses), 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.[4]

In order to assess the effect of grant aid on lower-income, non-traditional students, we focus on students near the Automatic Zero threshold. Automatic Zero is a policy rule that allocates a simplified FAFSA process and, on average, additional aid to small number of students as good as randomly. Students whose adjusted gross income falls just below their cohort's Automatic Zero threshold ($15,000 - 30,000) generally qualify for 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. Students with income just above the threshold are obligated to complete all FAFSA components. Marginally above-threshold students still have very low incomes and are typically eligible for Pell grants, but as we show in Section 5, they nonetheless receive $208 less in Pell grant aid than marginally below-threshold students.

[4]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 could be scaled back to prevent overaward.

To provide a concrete example, a dependent student automatically qualified for an Automatic Zero EFC (and thus the maximum Pell grant) in 2016-17 if the combined income of the student's parents was $25,000 or less. For independent students with dependents other than a spouse in 2016-17, a student qualified for an Automatic Zero EFC if the student's and spouse's combined income was $25,000 or less. Independent students *without* dependents other than a spouse do not qualify for the Automatic Zero EFC. In addition to income requirements, Automatic Zero determination relies on eligibility to file a simplified federal income tax return, participation in a means-tested federal benefits program, or the student's parent (or student or student's spouse) being a dislocated worker.[5]

4 Data

Data used in this study begins with enrollment records for all students who attended one of 26 TCATs between 2005 and 2016.[6] These were provided by the Tennessee Higher Education Commission (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.[7] 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 the Pell grant

[5]Specifically, a student's parents (or a student and the student's spouse if independent) must have been eligible to file an IRS Form 1040A or 1040 EZ, not required to file any income tax return, or filed a IRS Form 1040 but were not required to. The designed means-tested federal benefit programs include the Medicaid Program, the Supplemental Security Income (SSI) Program, Supplemental Nutrition Assistance Program (SNAP), the Free and Reduced Price School Lunch Program, the Temporary Assistance for Needy Families (TANF) Program, or the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

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

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

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. We were not provided final EFC values, however, which has implications for our analysis and results as described below.

We are also missing information on students' external support from grants or labor redevelopment programs. Individuals who are out of work can participate in initiatives such as the Trade Adjustment Assistance or Workforce Innovation and Opportunity Act programs. 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.

For students working in occupations and for employers covered by Unemployment Insurance (UI), 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.[8] We build a 2005-2016 dataset by merging individual information on enrollment, background, institutional characteristics, awarded degrees and certificates, financial aid, and earnings while enrolled. We exclude individuals who appear to be dual enrolled high school students.

In this section, summary statistics describing TCAT students cover all first-time enrollees between academic years 2005-2006 and 2016-2017, but the analytic sample for the analyses presented in Section 5 is restricted to the subset of those cohorts who filed a FAFSA. Restricting the sample to FAFSA filers is necessary in evaluating the effect of financial aid programs such as the Automatic Zero EFC designation for the maximum Pell grant. Eligibility for the Pell grant is based on students' EFC, and eligibility for an Automatic Zero EFC is based on AGI. Both EFC and AGI are components of the FAFSA data and serve as critical

[8]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 the summer trimester, with fall represented by 1/3 of the third quarter and all of the fourth.

components in our analytical design (see Section 5 for details). EFC and AGI information are not available for students who choose not to or were not able to file a FAFSA.

Figure 1 illustrates the percent of TCAT students who filed a FAFSA seeking aid to support their first TCAT term, by age group and 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). Panel A 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 noted in Section 3. 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 B of Figure 1 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,[9] but it is not clear if this has spilled over into substantially higher rates of aid applications for non-traditional students.

As illustrated in Figure 2, FAFSA filing rarely does not lead to aid for TCAT students. Figure 2 shows the percent of TCAT FAFSA filers with different types of grants over time. Over 9 in 10 filing a FAFSA to enroll in 2005 were eligible for either a Pell, Wilder-Naifeh, or TSAA grant. 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

[9]The Tennessee Promise is a last-dollar scholarship for recent high school graduates that can be used to complete an associate degree or certificate program at a public community college or TCAT. Filing a FAFSA is required for eligibility. The state's 2019 Tennessee Promise report puts the current FAFSA filing rate at 82% among traditional-aged prospective college students (Tennessee Higher Education Commission, 2019b).

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.[10]

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.

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

[10]TSAA grants are awarded to full-time TCAT students who file a FAFSA and have an EFC less than a set amount (currently $2,100, identifying much needier students than the minimum Pell award). The grant is allocated first-come, first-served until appropriated funds run out. The Wilder-Naifeh Technical Skills grant is worth up to $2,000 for students pursuing certificate or diploma programs in TCATs, and eligibility requires filing a FAFSA and state residency of at least one year.

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).

Any work while enrolled: We identify TCAT students with any record of UI-covered earnings in quarters that overlaps with their enrollment.

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. Likewise, total earnings while enrolled is the total amount of UI-covered earnings when a student was simultaneously enrolled in a TCAT. 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.

In Section 5 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. Table 1 describes outcomes of interest for all students entering TCATs between 2005 and 2015 (regardless of whether they filed a FAFSA) and then separately for students with and without grant aid. The first row of statistics in Table 1 show that aid recipients enrolled 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 earned about 87% more contact hours than students without aid: 1,050 versus 561.

The third and fourth rows of Table 1 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. 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 1 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 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 or eligibility for labor redevelopment and assistance programs, 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 Table 1.

5 Estimated Effect of Financial Aid on TCAT Persistence, Completion, and Work while Enrolled

Simple comparisons between aid recipients and other students, such as those in Table 1, 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 (Angrist et al., 2015; Carrell & Sacerdote, 2017). The Pell grant is non-random and based on need, but the determination of eligibility includes two natural experiments that allocate aid as good as randomly among a small group of applicants. One of those experiments is in a very narrow window around the annual EFC cutoff points for minimum Pell eligibility. In a broader report on financial aid among TCAT students, we show that minimum Pell eligibility has no discernible effect on students' post-secondary persistence or completion, although null effects may be attributable to the small number of TCAT students with EFC close to the qualifying threshold (Carruthers & Welch, 2020). A second quasi-experiment, which we utilize here, covers a more numerous group of TCAT students whose adjusted gross income is close to a threshold that entitles them to an Automatic Zero EFC and the maximum Pell grant.

Specifically, the income cutoffs for Automatic Zero EFC allow us to apply regression discontinuity methods to empirically quantify the effect of Pell grant aid and aid simplification

on student contact hours, completion, and earnings while enrolled. This estimation strategy addresses concerns of selection bias which can stem from unobservable student characteristics. Our regression discontinuity analysis unfolds as a two-stage least squares regression model that takes the following form:

$$Elig_{ic} = \alpha_0 + \alpha_1 \mathbf{1}(AGI_{ic} \leq \bar{A}_c) + \alpha_2(AGI_{ic} - \bar{A}_c) + \alpha_3 \mathbf{1}(AGI_{ic} \leq \bar{A}_c) * (AGI_{ic} - \bar{A}_c) + \varepsilon_{ic} \tag{1}$$

$$Y_{ic} = \beta_0 + \beta_1 \hat{Elig}_{ic} + \beta_2(AGI_{ic} - \bar{A}_c) + \beta_3 \mathbf{1}(AGI_{ic} \leq \bar{A}_c) * (AGI_{ic} - \bar{A}_c) + \varepsilon_{ic} \tag{2}$$

Equation 1 predicts the likelihood of having zero EFC as a simple function of the gap between student i's AGI and the Automatic Zero qualifying AGI in their cohort c, an indicator for having an AGI at or below that threshold, and the interaction of those two terms.

Equation 2 estimates the effect of Automatic Zero designation, and of modest amounts of additional Pell aid coming from that designation, on the 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 Automatic Zero eligibility predicted from a student's AGI being below the relevant cut point. Analytically, we are estimating the size and precision of differences in outcomes between students who just made the Automatic Zero cutoff and students who just missed it, and then adjusting for the difference in the likelihood of additional aid at the cutoff.

Recognizing that the Automatic Zero treatment is really two parts – simpler aid, as well as additional aid – we also estimate a version of Equation 1 where a student's potential Pell grant is the dependent variable, and second-stage Equation 2 returns the estimated local average treatment effect of an additional dollar of Pell aid arising from Automatic Zero designation.

In preferred specifications, 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. Excluding $1,000-valued heaps can help us make unbiased inferences about un-heaped aid applicants (Barreca et al., 2016). Since this exclusion reduces the density of students at the threshold, we also report findings with round AGIs for comparison.

Figure 3 depicts the discontinuous change in the likelihood of having an EFC of zero at the Automatic Zero threshold. Panel A and the accompanying Equation 1 estimate show that likelihood grows by 43 percentage points. This is a fuzzy discontinuity with less than a 100 percent first-stage effect for a few reasons. First, many applicants with income just above the Automatic Zero threshold will qualify for the maximum Pell grant with the complete FAFSA form. Second, 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. Reasons for this are beyond the scope of available data but could be due to the FAFSA verification process or unobserved sources of aid. Below the Automatic Zero threshold, independent applicants without dependents other than a spouse are not eligible for an Automatic Zero EFC. Nevertheless, a 43% discontinuity in Automatic Zero determination is a sizable quasi-experiment in financial aid and FAFSA simplification. For this group of applicants, however, the Automatic Zero rule does not result in a large amount of additional grant aid. Panel B of Figure 3 shows that those just below the threshold tend to qualify for $208 more in potential Pell aid.

We estimate Equations 1-2 for all entering TCAT students with FAFSAs on file for their first term, and who had an AGI within $20,000 of the cutoff for Automatic Zero designation in their cohort.[11] 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.

Main results are summarized in Table 2. Estimates of the effect of Automatic Zero

[11]See the appendix for robustness and specification checks in support of the validity of regression discontinuity identification assumptions at the automatic-zero threshold. There, we show that exogenous variables such as student race and gender are well-balanced at that threshold, and that results are robust to the addition of controls, wider or narrower bandwidths, and rounding of the running variable.

designation on each outcome (β_1 in Equation 2) are listed first for each outcome, and robust standard errors clustered by AGI are shown below each β_1 estimate. Columns (1) and (3) exclude applicants with AGIs in even $1,000 heaps, and Columns (2) and (4) include them.

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 earnings while enrolled. These findings are in agreement in sign and statistical significance with those shown in Column (3), 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 (3), 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 on average below the income cutoff, and yet Column (1) estimates, though imprecise, tend to be more than twice the estimated effect of each additional $100 at the Automatic Zero threshold.

Table 2 shows that our preference for excluding students with AGIs that are even multiples of $1,000 has bearing on inferences. When we include these heaped $1,000 AGIs, regression discontinuity estimates rise from an insignificant 14.0 average contact hours (or 2.9 per additional $100 in aid) to a statistically significant 24.2-hour gain in TCAT enrollment intensity (or 2.8 per $100) in Column (2) and (4). The additional likelihood of diploma receipt also increases from a statistically insignificant 3.8 percentage points to a marginally significant 8.0 percentage points between Columns (1) and (2). Nonetheless, we stop well short of interpreting Columns (2) and (4) to mean that FAFSA simplification and additional

aid arising from the Automatic Zero rule increase contact hours and completion for students in the narrow window around the qualifying threshold. The best we can do in light of plausible unobserved differences between heaped and non-heaped students is seek out an unbiased estimate of the Automatic Zero rule on non-heaped students.

Figure 4 provides visual support for many of the results listed in Table 2, without $1,000 AGI heaps, where 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. Applicants with marginally qualifying AGI, just left of the threshold, had a similar intensity of earnings as applicants just right of the threshold.

Further analysis discussed in the appendix indicates that students who just met the Automatic Zero income rule may have been fundamentally different, in terms of their earnings before and during enrollment, than students who just missed it for reasons other than additional financial aid and aid simplification. Tellingly, just-eligible students were earning significantly more than just-ineligible students at least one year prior to enrolling in a TCAT.

Looking across results, we see little evidence, or at best, inconsistent evidence that marginal Pell aid from the Automatic Zero rule helps students intensify their contact hours in a given term. The magnitude of contact hours gains, though imprecise, may help us to understand why the Automatic Zero rule has such little effect. An additional $100 in annual Pell aid, divided over three terms, translates to 2.8 - 2.9 additional contact hours per term according to Table 2, or a rate of $11 - 12 in financial aid per additional contact hour. Annualized, this rate aligns with adjusted gross income in the range targeted by the Automatic Zero rule. If TCAT students need a wage-equivalent amount of financial aid to supplant hours of work for hours of schooling, then the relatively small grant increments ($208, according to Figure 3) derived from Automatic Zero eligibility may be insufficient to elicit enrollment gains that would translate into higher rates of diploma and certificate completion.

6 Discussion

Certificate and diploma programs such as those offered by Tennessee Colleges of Applied Technology are strategically important to state education and labor development objectives, both in and beyond Tennessee. They offer programs of study that are tightly aligned with specific occupations and industries, and under Tennessee's model, they exhibit high completion and job placement rates. Technical college students face many of the same financial barriers to enrolling and persisting in college as their community college and university counterparts, but we know little about how financial aid operates for non-degree students. Here, we examine the causal effects of quasi-experimental access to aid and to aid simplification. We find that meeting the threshold for an Automatic Zero EFC has little discernible effect on the intensity of student enrollment or the likelihood of timely program completion. Although some specifications point to gains in contact hours, 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 (Denning et al., 2019). It is certainly possible that TCAT students even 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 Pell aid to make enrollment worth the time. Results in Table 2, Columns (3) and (4), for average contact hours, consistent in magnitude but not precision across samples, imply that students convert additional Pell grant aid to additional contact hours at a rate of about $11-12/hour. Despite the simplifying benefits of the Automatic Zero rule, grants larger than the $200 increments studied here may be necessary to elicit more persistence and completion among technical college students.

7 Appendix: Robustness, Specification, and Falsification Tests

Figure 5 illustrates results from a manipulation test of the Automatic Zero thresholds. Following Cattaneo et al. (2019), we use a nonparametric estimator to depict the density of the running variable as local polynomials on either side of the rule's threshold, and robust bias-corrected confidence intervals to assess the hypothesis that the distribution of FAFSA filers does not disproportionately favor one side of the threshold. The test statistic and p-value, which are listed above the figure, indicate that there is a significant decline in the density of student AGIs just below the qualifying threshold. There are fewer students with AGIs that just meet the criteria for the Automatic Zero rule than we would expect if the probability of any given AGI value varied smoothly over that threshold. This might not reflect manipulation of the Automatic Zero rule so much as our choice to omit filers with AGIs in even $1,000 increments. The Automatic Zero rule is tied to a multiple of $1,000 for each cohort, and when we add these filers back to the sample, we do not detect a significant change in the density of AGIs around the qualifying threshold.

Table 3 lists discontinuity estimates for exogenous student features that we would not expect to be influenced by financial aid. The purpose of this robustness test is to assess whether students are significantly different on one side of the threshold in observable ways that might influence outcomes of interest. If so, our identification strategy would be at risk of inferring that financial aid affected those outcomes, when in fact we should attribute an effect to changes in the observable composition of students at the threshold. The threat from discontinuities in unobservable factors is more plausible in that case as well. For the Automatic Zero thresholds, estimated discontinuities in exogenous student features are small and statistically insignificant.

In addition to testing for discontinuities in pre-existing student features, we can also assess the regression discontinuity identifying assumption by testing whether expected college

outcomes are significantly different for marginally eligible students, versus those who just missed the Automatic Zero cutoff. Specifically, we regress each outcome as a linear function of student gender, race, parental education, and an indicator for students who first enroll in a TCAT in the fall term, and then we compute predicted outcomes as a linear function of those variables and estimated coefficients. We then estimate Equation 1 for predicted outcomes, generating estimates of discontinuities in expected contact hours, completion, and earnings. Table 4 lists our finings; we detect no concerning changes in expected TCAT outcomes at the Automatic Zero thresholds.

Table 5 lists regression discontinuity results for the Automatic Zero thresholds under two alternative specifications. Column (1) lists baseline results for comparison. Column (2) lists results when we add covariates to Equations 1-2: student gender, race, parental education, first-generation status, and fall entry. With controls, the estimated effect of Automatic Zero eligibility on average contact hours is a marginally significant 15.7 gain in hours, versus a statistically insignificant 14.0-credit gain in Column (1) of Table 5. Column (3) results in Table 5 are from a specification where the AGI running variable is rounded up to the next $1,000 increment. This adaptation might be expected to smooth some of the noise across AGI bins, at the risk of producing inconsistent estimates (Dong, 2015). Point estimates change very little and most standard errors shrink between the baseline and rounded specification, but nevertheless this alternative construct of the running variables does not change our inferences about the effect of financial aid rules on TCAT student outcomes.

Figure 6 illustrates the sensitivity of results to bandwidth around the Automatic Zero threshold. Each panel connects point estimates from several iterations of Equations 1-2, where (left to right) each iteration widens the bandwidth of students included the estimation sample. These point estimates are represented by the central line moving left to right in each panel, with the confidence interval represented by lines above and below.

Regression discontinuity inferences only apply to students in a very narrow window around a given threshold, but we include students more removed from the threshold to

increase precision. Figure 6 depicts a classic bias-variance tradeoff. Larger bandwidths have narrower confidence intervals, but point estimates also tend to move away from their value when samples are limited to a narrow window of students near the thresholds, whose financial aid is determined as good as randomly. Figure 6 also illustrates bandwidth sensitivity for Automatic Zero results. We find inconsistent evidence of positive effects on average contact hours as well as more consistently positive estimates for average earnings while enrolled.

Figure 7 explores results for student earnings in more detail. A positive effect of aid and aid simplification on average earnings per enrolled term is counterintuitive and inconsistent with null results for total earnings while enrolled and the likelihood of working while enrolled. To better understand the dynamics of this result, we estimate Equations 1-2 for earnings in several individual four-month periods prior to and after enrollment in a TCAT. Figure 7 plots results. There, we show significant discontinuities in student earnings up to a year *prior to* enrollment, which decline thereafter. Students who were marginally eligible for the Automatic Zero rule tended to earn $622-952 more per four-month period before enrollment than students whose AGI placed them just outside of the Automatic Zero rule. This difference was $628-671 over the 8 months after enrollment and statistically insignificant after that. The $511 discontinuity in average earnings while enrolled, reported in Table 2, appears to be rooted in a spurious difference between eligible and ineligible students rather than a causal effect of the Automatic Zero rule on working while enrolled.

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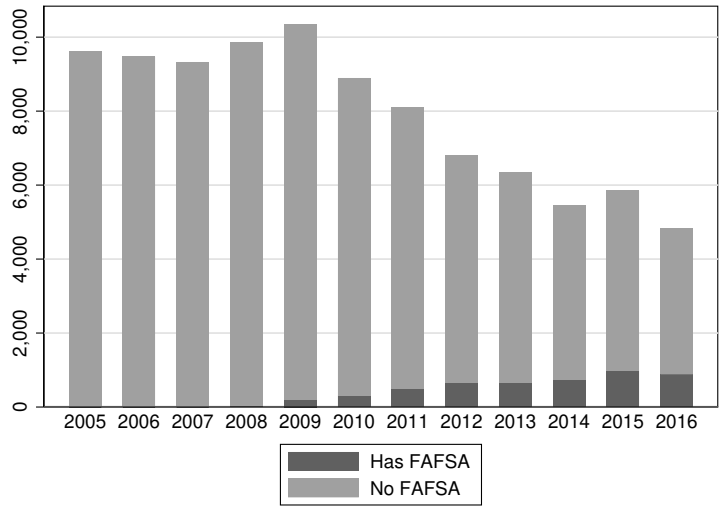
TCAT entrants 25-80 or missing age



TCAT entrants under 25

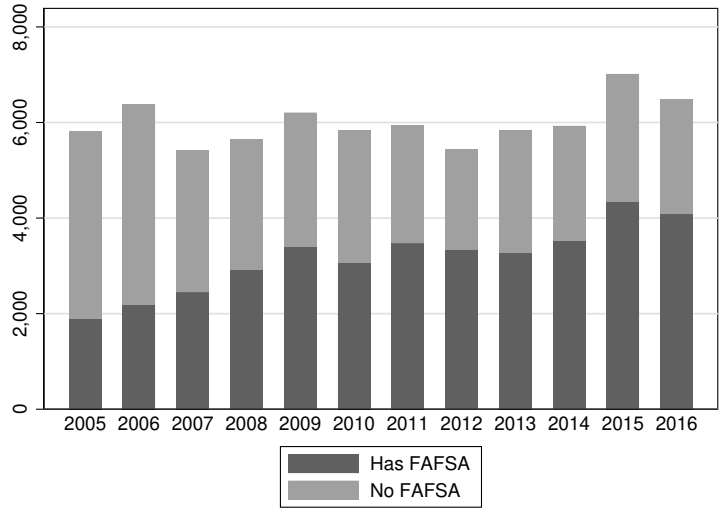


Figure 1: TCAT Student FAFSA Filing by Age Group

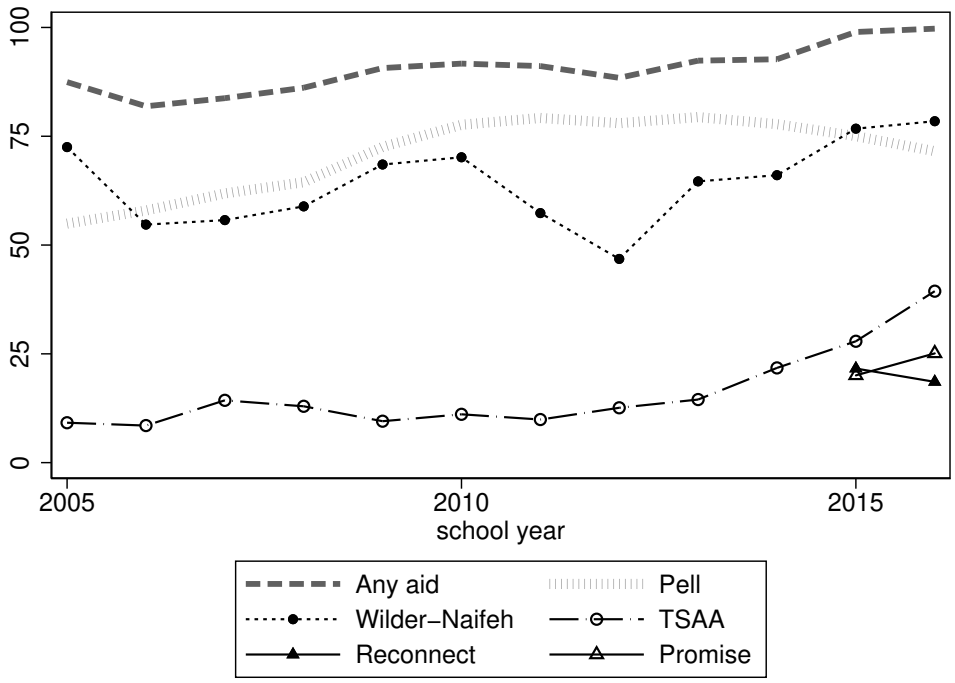


Figure 2: Percent of FAFSA-filing TCAT Students with Grant Aid

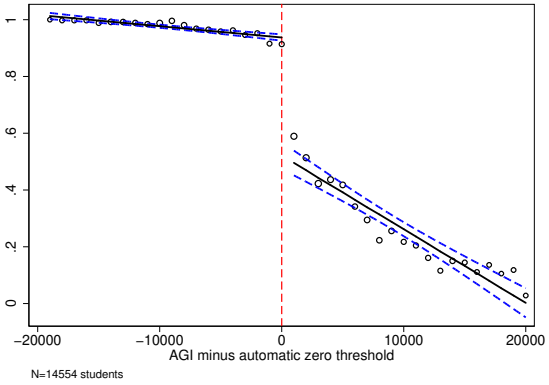
Table 1: Contact Hours, Earnings, and Completion by Aid Status

Student Outcome	(1) All entering TCAT students	(2) Students without grant aid (125,609)	(3) Students with grant aid (34,674)
Average term contact hours	206	178	308
Total contact hours	667	561	1050
Certificate within 2 years	38%	42%	25%
Diploma within 2 years	30%	25%	47%
Any work while enrolled	27%	14%	77%
Average 4-month earnings while enrolled (2017$)	$850	$479	$2,194

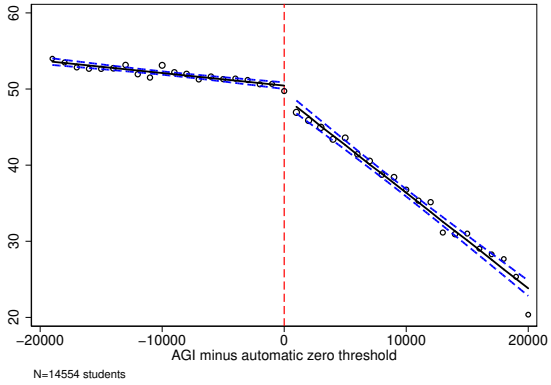
Notes: The table lists averages for each outcome listed at left for all TCAT students entering 2005-2015 (Column 1), for those that entered without Pell, TSAA, Wilder-Naifeh, or Reconnect grant aid (Column 2), and for those who entered with such grant aid (Column 3).

Figure 3: Automatic Zero Eligibility and Pell Funding by AGI

A. Zero EFC by AGI



B. Pell Grant Funding by AGI



Notes: Scatter plots illustrate the average likelihood of having a zero EFC (3A) or potential Pell aid (3B) against the gap between students' AGI and qualifying AGI values for the Automatic Zero EFC rule. Pell grant amounts are in hundreds of 2017$. Qualifying AGI values ranged from $15,000 – 31,000 across cohorts. Solid lines trace the linear relationship between zero EFC status or aid amount, and the AGI gap. Dashed lines encompass 95% confidence intervals of linear estimates.

Table 2: Regression discontinuity results for Automatic-Zero EFC

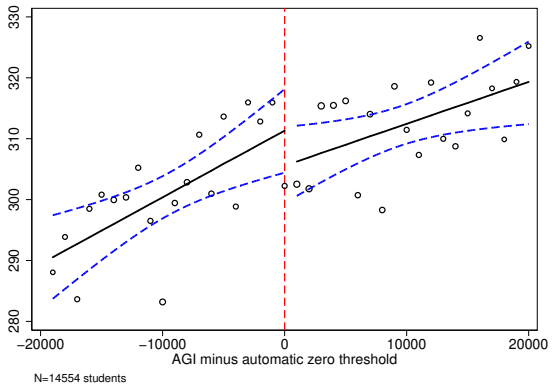
	(1)	(2)	(3)	(4)
	Automatic Zero EFC		Additional $100 in Pell aid	
Average term contact hours	13.979	24.201**	2.865	2.792***
	(9.378)	(10.485)	(1.958)	(1.075)
Total contact hours	62.923	76.800	12.895	8.858
	(55.074)	(53.095)	(11.483)	(6.423)
Certificate attainment (0,1)	-0.033	-0.033	-0.007	-0.004
	(0.034)	(0.034)	(0.007)	(0.004)
Diploma attainment (0,1)	0.038	0.080*	0.008	0.009
	(0.039)	(0.043)	(0.008)	(0.004)
Any work while enrolled (0,1)	0.036	0.062*	0.007	0.007
	(0.031)	(0.037)	(0.007)	(0.004)
Total earnings while enrolled (2017$)	730.676	1230.705	149.743	141.960
	(965.257)	(978.474)	(197.283)	(107.662)
Average 4-month earnings while enrolled (2017$)	510.859**	705.7169***	104.694**	81.40312***
	(219.227)	(241.444)	(46.573)	(25.826)
Number of students	14,554	16,116	14,554	16,116
With $1,000-multiple AGI?	No	Yes	No	Yes

Notes: The table presents results of Equation 2, estimated separately for each outcome listed at left, and for predicted $EFC = 0$ determination (Columns 1-2) and additional Pell dollars (in hundreds, Columns 3-4). Columns (1) and (3) report results under our preferred sample construction, which omits FAFSA filers with AGIs that are even multiples of $1,000. Columns (2) and (4) include these filers. The top statistic in each cell is the estimate for β_1, the effect of just meeting the Automatic Zero cutoff. Robust standard errors are clustered by AGI.

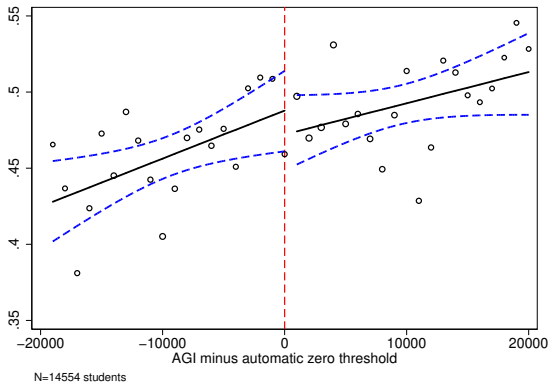
* represents statistical significance at 90% confidence, ** at 95%, and *** at 99%

Figure 4: Student Outcomes by Automatic Zero Eligibility

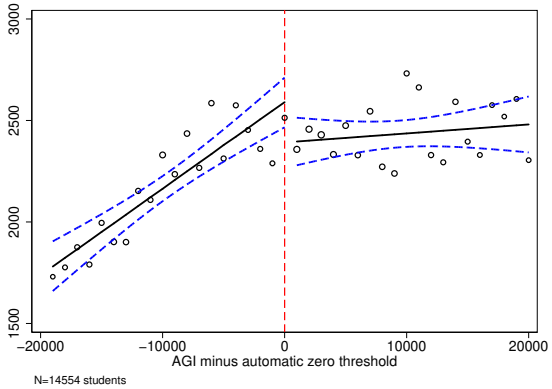
A. Average Contact Hours



B. Diploma Receipt within 2 years

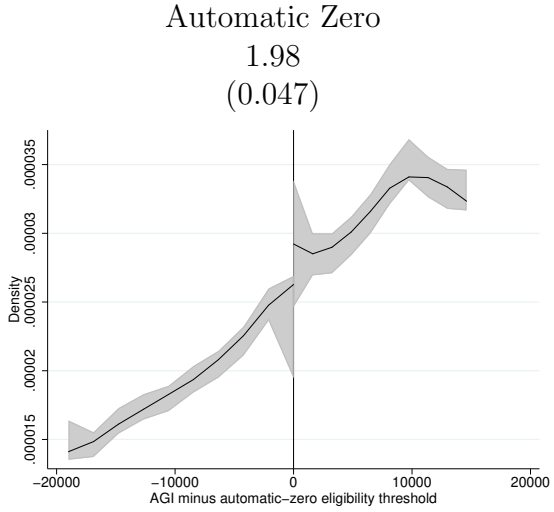


C. Average 4-month earnings while enrolled



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 $15,000 – 31,000 across cohorts. Solid lines trace the linear relationship between zero EFC status or aid amount, and the AGI gap. Dashed lines encompass 95% confidence intervals of linear estimates. Table 2 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.

Figure 5: Density Estimate and Manipulation Test Results



Notes: The figure plots local polynomial estimates and confidence intervals for the density of the running variable around the Automatic Zero eligibility threshold. Following Cattaneo et al. (2019), a manipulation test statistic is reported for each threshold along with p-value in parentheses.

Table 3: Regression Discontinuity Results for Student Characteristics

	(1)	(2)	(3)	(4)	(5)
			Mother college	Father college	
	White	Female	educated	educated	First generation
Automatic Zero	-0.018	-0.015	-0.011	0.007	-0.003
	(0.014)	(0.016)	(0.014)	(0.011)	(0.015)

Notes: The table lists Equation 1 results for student features that we would not expect to be affected by eligibility (race, gender, and parental education). For each student characteristic, the table lists estimates of α_1, the coefficient on the $\mathbf{1}(AGI_{ic} \leq \bar{A}_c)$ indicator that AGI falls below the Automatic Zero threshold. Robust standard errors, in parentheses below each coefficient, are clustered by AGI.
* statistically significant at 10%, ** 5%, *** 1%

Table 4: Regression Discontinuity Results for Predicted Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Average contact hours	Total contact contact	Certificate within 2 years	Diploma within 2 years	Any work while enrolled	Total earnings while enrolled	Average 4-month earnings while enrolled
Automatic	-0.344	1.622	-4.5e-04	-0.003	2.0e-05	9.59	22.454
Zero	(0.628)	(5.460)	(0.001)	(0.002)	(4.3e-04)	(8.126)	(19.058)

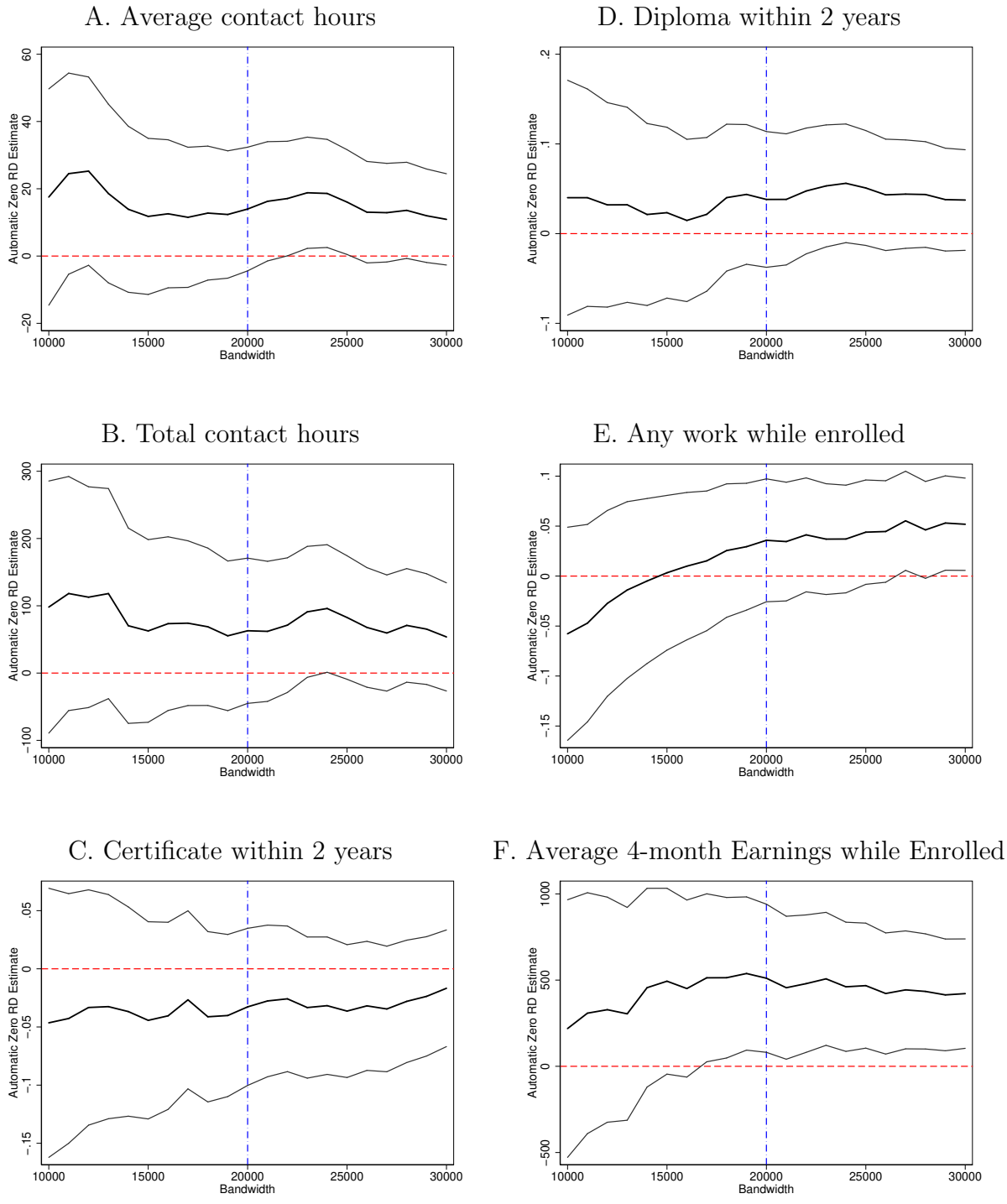
Notes: The table lists Equation 1 results for predicted outcomes, estimated as a linear function of student gender, race, parental education, and fall entry. For each predicted outcome, the table lists estimates of α_1, the coefficient on the $\mathbf{1}(AGI_{ic} \leq \bar{A}_c)$ indicator that AGI falls below the Automatic Zero threshold. Robust standard errors, in parentheses below each coefficient, are clustered by AGI.
* statistically significant at 10%, ** 5%, *** 1%

Table 5: Alternate Specifications for Automatic Zero Regression Discontinuity Results

Outcome	(1) Baseline	(2) With covariates	(3) $1,000 AGI bins
Average contact hours	13.979	15.716*	13.398
	(9.378)	(9.418)	(10.358)
Total contact hours	62.923	58.089	57.006
	(55.074)	(54.610)	(44.295)
Certificate	-0.033	-0.032	-0.029
	(0.034)	(0.035)	(0.026)
Diploma	0.038	0.046	0.034
	(0.039)	(0.039)	(0.035)
Any work while enrolled	0.036	0.031	0.033
	(0.031)	(0.032)	(0.029)
Total earnings while enrolled	730.676	564.878	565.944
	(965.257)	(962.079)	(714.090)
Average 4-month earnings while enrolled	510.859**	486.120**	472.604***
	(219.227)	(220.041)	(176.431)
Number of students	14,554	14,554	14,554

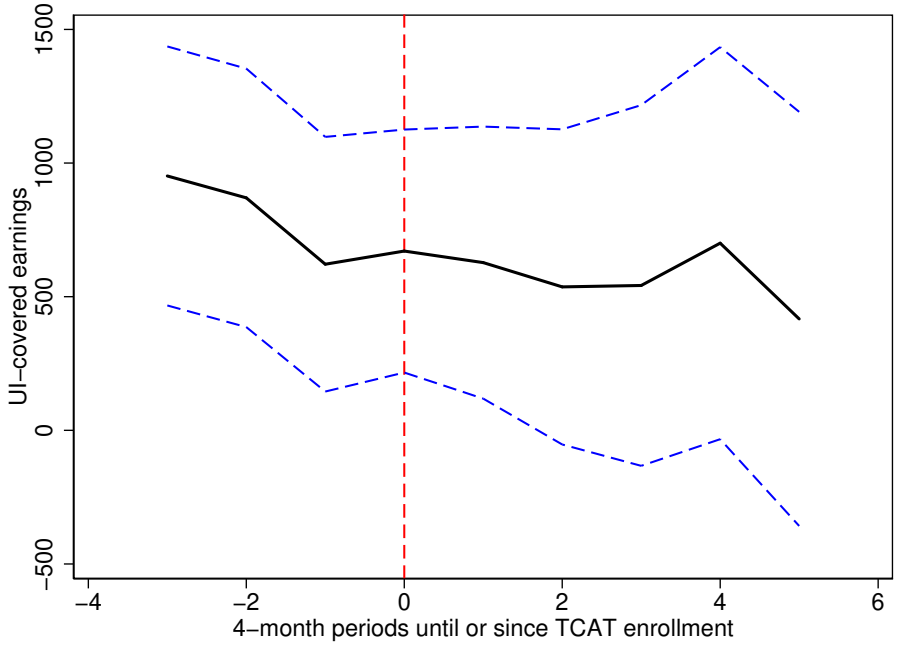
Notes: The table presents results of Equation 2, estimated separately for each outcome listed at left. Each cell of results represents a different regression. The top statistic is the estimate for β_1, the effect of just meeting the cutoff for an Automatic Zero EFC. In parentheses below this statistic is the robust standard error, which allows for correlated errors among students with the same AGI.
* represents statistical significance at 90% confidence, ** at 95%, and *** at 99%

Figure 6: Regression Discontinuity Results for Automatic Zero EFC, by Bandwidth



Notes: Each figure depicts β_1 point estimates and 95% confidence intervals from 20 separate estimations of Equation 2 for the listed outcome, at bandwidths varying from \$10,000-\$30,000 around qualifying AGI for the Automatic Zero EFC rule.

Figure 7: Regression Discontinuity Results for Earnings at the Automatic Zero Threshold, by Time until or since Enrollment



Notes: The figure depicts β_1 point estimates and 95% confidence intervals from 9 separate estimations of Equation 2 for earnings in 4-month periods before and after initial TCAT enrollment.