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. The application process for the federal Pell grant includes a natural experiment that allows us to study quasi-experimental differences in aid for a small group of low-income students. We find no precise effect of additional aid bundled with simplification on typical contact hours each term, earnings while enrolled, or certificate or diploma attainment. Grants larger than the $244 increments studied here may be necessary to elicit significant changes in completion or the need to work while enrolled.

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1 Introduction

In 2014, Tennessee launched the "Drive to 55" initiative, aspiring to have 55% of working-age adults hold a postsecondary credential by 2025. Attainment goals like Drive to 55 are motivated by predictions that a majority of jobs will soon require college training (Carnevale et al., 2013). Postsecondary certificates and diplomas count toward Tennessee's 55% target, and those offered by Tennessee Colleges of Applied Technology (TCATs) are a key part of the state's attainment and workforce goals. Over 80% of TCAT students complete their program or find work in a related field (Tennessee Higher Education Commission, 2019), and TCAT programs are designed to be responsive to regional labor needs.

TCAT students can finish a certificate or diploma program in 1-2 years. This is quick compared to associate's and bachelor's degrees, but nonetheless a significant investment of time and money. TCAT tuition and fees are similar to what students pay to enroll in Tennessee community colleges.[1] Unlike community colleges, TCAT students accumulate contact hours rather than credit hours, their day-to-day coursework tends to be more applied and technical, and they rarely transfer in pursuit of higher degrees. TCAT students are more likely to be older, displaced from the workforce, or otherwise non-traditional, and their programs are focused on skill development and job placement.

A large literature has studied financial aid for traditional-age students attending community colleges or four-year universities, but less is known about financial aid and students attending technical colleges such as TCATs. We estimate the effects of aid on TCAT student success using a natural experiment within the application process for the federal Pell grant. With some exceptions, students whose adjusted gross income falls below a certain level ($15,000 – 31,000 depending on the year) are automatically assigned zero "expected family contribution" and given the maximum Pell grant. This Automatic Zero rule bundles aid simplification with a small amount of additional aid, on average, for students just below

[1]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.

the income threshold. We know of no other study focusing on the effect of financial aid for 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

The federal Pell grant is one of the most common forms of aid for TCAT students. 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. Using research designs similar to ours, two related studies examine whether additional Pell aid from the Automatic Zero rule affects college completion and later earnings. Denning et al. (2019) show that Pell leads to faster graduation for university students in Texas, as well as higher post-college earnings that more than recoup the federal investment. Eng & Matsudaira (2021) study all U.S. students with federal loans who started college between 2002 and 2010 (22 million in total, likely including some of the TCAT students in our samples). They find small and inconsistent effects of Pell on the likelihood that borrowers completed college within four years, and no significant effect of Pell on later earnings. We add to this set of analyses by (1) focusing on TCAT students, who would have been grouped with community college students in Eng and Matsudaira's (2021) national study, (2) studying college completion for TCAT students with and without federal loans, and (3) estimating effects on completion as well as intermediate outcomes such as contact hours and working while enrolled.

The effects of financial aid for non-traditional students–older enrollees, veterans, technical college students, or for-profit students, among others–have been mixed. 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) studied a need-based and merit-based scholarship for non-traditional students in California, finding that the grant did not affect the likelihood of graduation for students intending to enroll in community colleges, public universities, or private not-for-profit universities. By contrast, Eng & Matsudaira (2021) found suggestive but inconsistent evidence that an additional $1,000 in Pell aid benefitted independent students more than dependent students.

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. These process efficiencies should clarify aid determination in ways that support student progress. But the Automatic Zero rule is not tied to incentives or support services that complement aid, the

rule appears to have limited effects on two-year students nationwide, and aid in general tends to have smaller effects on nontraditional college students. The relevant literature suggests that aid bundled with a simplified application might not register a large difference in TCAT student outcomes.

3 Pell and Automatic Zero EFC

The federal Pell grant, named for U.S. Senator Claiborne Pell, 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). For the cohorts we study, the FAFSA included over 100 questions about household income, assets, and other household features. Critical inputs for aid determination were 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 were eligible for more aid. These and other inputs were factored into formulas that determine each student's expected family contribution (EFC) toward college tuition and other expenses. Pell eligibility was strictly determined by whether a student's EFC was below a specific value, and this value changed each year depending on appropriations. Students enrolled full-time in 2018-19 with EFC equal to $5,486 were entitled to a Pell grant worth $652. Those with an EFC just $1 higher were not eligible for any aid from Pell. The grant grew as EFC fell, such that the maximum grant for 2018-19 was $6,095 for students with zero EFC. The minimum Pell grant varied from $400-976 over the cohorts in our sample, and the maximum ranged from $4,050-5,815.

In order to assess the effect of grant aid on lower-income, non-traditional students, we focus on students near the Automatic Zero threshold. 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 $244 less in Pell grant aid than marginally below-threshold students.

To provide more concrete examples, 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. Independent students with dependents other than a spouse in 2016-17 qualified for an Automatic Zero EFC if the student's and spouse's combined income was $25,000 or less. Independent students *without* dependents did not qualify for the Automatic Zero EFC.[2]

4 Data

We rely on enrollment records for all students who attended one of 26 out of 27 TCATs between 2005 and 2016.[3] These were provided by the Tennessee Higher Education Commission 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. We merged enrollment and completion records with additional information from FAFSA records describing family income, financial aid eligibility, and financial aid receipt.

Most critical for this analysis, the data include indicators of eligibility for the Pell grant

[2]In addition to income requirements, a dependent student's parents (or the student and spouse, if independent) must have been (1) eligible to file an IRS Form 1040A or 1040 EZ or no income tax return at all, (2) participating in a means-tested federal benefit program (Medicaid, Supplemental Security Income, Supplemental Nutrition Assistance Program, the Free and Reduced Price School Lunch Program, Temporary Assistance for Needy Families, or the Special Supplemental Nutrition Program for Women, Infants, and Children), or (3) a dislocated worker

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

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 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.[4] We adjust nominal earnings to real 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.

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 Section 5 analysis is restricted to the subset of 2006-2016 cohorts who filed a FAFSA. We omit the

[4]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.

2005 cohort for regression discontinuity analysis because their Automatic Zero threshold was just $15,000. Students in the neighborhood of that threshold were already very needy, and the threshold had no significant effect on their Pell aid. We limit the Section 5 analysis to FAFSA filers because our research design relies on fields that are only computed or observed for FAFSA filers: expected contribution, Pell eligibility, and adjusted gross income.

As illustrated in Figure 1, FAFSA filing almost always results in financial aid for TCAT students. Figure 1 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 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.[5]

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

[5]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.

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 other institutions, 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.

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 some 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 overlapped 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.

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 were much less likely to complete a short-term certificate than students without grant aid, but aid recipients were nearly twice as likely to complete a diploma. Almost half of the students who entered a TCAT with grant support earned a diploma within two years. Just 1 in 4 students who enrolled without grants processed through the FAFSA earned a diploma in that time.

The fifth and sixth rows of 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. Contrary to this expectation, however, aid recipients were much more likely to work while enrolled, and their typical four-month earnings were \$2,194 as opposed to \$479 for students without aid. 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

The Pell grant is non-random and based on need, but the determination of eligibility includes two natural experiments that allocate aid and FAFSA simplification 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 results not shown but available on request, we find that minimum Pell eligibility had no discernible effect on students' postsecondary persistence or completion, although null effects may be attributable to the small number of TCAT students with EFC close to the qualifying threshold. A second quasi-experiment, which we utilize here, covers a larger group of TCAT students whose adjusted gross income is close to the Automatic Zero threshold that entitles them to the maximum Pell grant.

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. Our regression discontinuity analysis starts as a two-stage least squares model:

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

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

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 an Automatic Zero designation, and of modest amounts of additional Pell aid coming from that designation, on enrollment, completion, and work outcomes described in Section 4. 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. The parameter α_1 estimates the local effect of just meeting the Automatic Zero rule on the likelihood of having a zero EFC, and β_1 estimates the effect on college outcomes and earnings while enrolled. We use a triangular kernel to weight observations more if they are closer to the threshold.

Equations 1 and 2 estimate the Automatic Zero treatment effect on a given outcome by approximating two polynomial relationships between that outcome and AGI. In each model, one polynomial covers students below the threshold, who qualify for Automatic Zero EFC. The other covers students above the threshold, whose EFC values are determined by formula. Approximations are measured with error, especially at boundary points such as the threshold we study here. We can reduce misspecification bias by limiting the sample to a small bandwidth around the threshold, but at the cost of more variance in regression discontinuity estimates. We adapt the conventional two-stage least squares framework to address these issues. First, analytical samples for each outcome are limited to a bandwidth that optimizes the bias-variance tradeoff (Calonico et al., 2014). Second, and also following Calonico et al. (2014), we report bias-corrected β_1 point estimates along with standard errors that account for estimation error in bias correction.[6] Our conclusions hold without these adaptations, as discussed in the appendix.

The Automatic Zero treatment is really two parts–simpler aid, as well as additional aid–so 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 \$100 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 un-

[6]Since we are using local linear polynomials, bias-correction relies on curvature of the second-degree approximations to adjust $\hat{\beta}_1$ by an estimate of misspecification bias. See Calonico et al. (2014) and Cattaneo et al. (2019a) for details.

biased 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.

We require a strong first stage effect of the Automatic Zero threshold on FAFSA simplification and Pell aid to estimate effects of aid on TCAT completion and intermediate outcomes. Figure 2 and the first row of Table 2 show Equation 1 results. Figure 2 depicts the discontinuous change in the likelihood of having an EFC of zero at the Automatic Zero threshold. The accompanying Equation 1 estimate in Table 2 shows that this likelihood grows by 31-32 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. In some cases, final EFC may be different from the sum of those components, perhaps because of FAFSA verification. And third, independent applicants without dependents other than a spouse are not eligible for an Automatic Zero EFC. Nevertheless, a 31-32% 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. Those just below the threshold tend to qualify for only $244-265 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 up to $20,000 from the cutoff for Automatic Zero designation in their cohort.[7] Optimal bandwidths range from $4,511 to $8,486.

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

[7]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, gender, and parental education are well-balanced at that threshold, and that results are robust to the addition of controls, wider or narrower bandwidths, quadratic polynomial approximations, cluster-robust standard errors, and conventional two-stage least squares without bias correction.

designation on each outcome (bias-corrected β_1 in Equation 2) are listed first for each outcome, and robust standard errors are shown below each β_1 estimate. Columns 1-2 exclude applicants with AGIs in even $1,000 heaps, and Columns 3-4 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 16.6 additional contact hours per term, on average, positive but statistically insignificant differences in total contact hours, an imprecisely lower likelihood of certificate or diploma attainment within two years, and insignificantly lower earnings while enrolled. These findings are in agreement in sign and statistical significance with those shown in Column 2. There, we report that for each additional $100 attained at the Automatic Zero threshold, contact hours and completion rates do not significantly change, nor do earnings while enrolled. 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. Pell grants rise just $244 on average below the income cutoff, and yet Column 1 estimates, though imprecise, tend to be more than 2.4 times 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 little bearing on inferences. The magnitude of β_1 estimates changes quite a lot between Columns 1 and 3, and between Columns 2 and 4, but standard errors are very large in all four models. When we include heaped $1,000 AGIs, for example, regression discontinuity estimates fall from an statistically insignificant 16.6 average contact hours (or 2.4 per additional $100 in aid) to an insignificant 4.5-hour gain in TCAT enrollment intensity (or 1.3 per $100). Column 1-2 estimates are within a standard error of their Column 3-4 counterparts.

Figure 3 provides visual support for many of the null results listed in Table 2. The scatter plot in each panel summarizes average outcomes within evenly spaced bins that mimic the

underlying variation in the data (Calonico et al., 2015). Solid lines trace linear approximations of the unknown polynomial relationship between each outcome and a student's AGI relative to the threshold. Visual discontinuities between linear approximations are different than what we report in Table 2. The latter are bias-corrected β_1 estimates from bandwidths narrower than the $20,000 window shown in each panel of Figure 3. Nonetheless, it is clear from both Table 2 and Figure 3 that students just below the Automatic Zero threshold are not remarkably different than students above it, in terms of contact hours, completion rates, or earnings while enrolled.

6 Discussion

Looking across results, we conclude that marginal Pell aid and FAFSA simplification from the Automatic Zero rule did not significantly help students intensify their contact hours or work less outside of school. 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, where Pell eligibility may attract large amounts of additional state aid (Denning et al., 2019; Eng & Matsudaira, 2021). It is certainly possible that TCAT students even further from the eligibility threshold (for example, with incomes lower than the $20,000 - 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. With several thousand observations in each optimal bandwidth (and up to 13,752 overall), our null results are probably not due to low statistical power. Eng & Matsudaira (2021) study over 22 million students and likewise find that the Automatic Zero quasi-experiment in Pell aid had inconclusive effects on degree completion.

The estimated effect of Automatic Zero eligibility on 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 2.4 additional

contact hours per term according to Table 2, or a rate of $14 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 derived from Automatic Zero eligibility may be insufficient to elicit enrollment gains that would translate into higher rates of diploma and certificate completion. Larger and more salient grants (Mayer et al., 2015), as well as programs that address non-financial constraints (Evans et al., 2020), have had more success with non-traditional students.

7 Appendix

Figure A.1 illustrates results from a manipulation test of the Automatic Zero thresholds. Following Cattaneo et al. (2019b), 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 somewhat significant decline in the density of student AGIs just below the qualifying threshold. There are fewer students with AGIs who 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 A.1 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 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 A.2 lists our finings; there are no concerning changes in expected TCAT outcomes at the Automatic Zero thresholds.

Table A.3 lists regression discontinuity results for the Automatic Zero thresholds under four 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, cohort fixed effects, and fall entry. With controls, most point estimates shrink toward zero, but standard errors are still quite large and we cannot reject the null hypothesis for any outcome.

The Column 3 specification uses a quadratic approximation rather than a linear one, yielding no change to our conclusions.

Column 4 of Table A.3 omits cohorts who started between 2012 and 2014. The quasi-experiment was less stark for these students, in part because of a reduced Automatic Zero qualifying threshold. Many students just above that threshold already had zero EFC by formula. Falling just short of the Automatic Zero line increased the rate of zero EFC by only 9-19 percentage points, and Pell awards did not increase significantly. Although Column 4 focuses on cohorts who experienced a stronger first-stage effect of the policy, standard errors are nonetheless too wide to conclude that Automatic Zero affected college or earnings while enrolled.

Finally, Column 5 of Table A.3 reports results when we allow errors to be correlated within each student's cohort and school. Unlike conventional linear estimators, clustering in the bias-corrected regression discontinuity model changes both standard errors *and* point estimates, since the optimal bandwidth depends in part on estimated variance. Column 5 results are very similar to our baseline results without clustering.

With Figure A.2, we examine the sensitivity of results to bandwidth and to the bias correction procedure. Each figure plots point estimates and 95% confidence intervals from conventional Equation 1 and 2 estimates, without correction for misspecification bias in the polynomial approximations. 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. The Calonico et al. (2014) optimal bandwidth is marked with a vertical dashed line, and the bias-corrected β_1 estimate is marked with a horizontal dashed line.

Conventional estimates for contact hour and certificate outcomes (panels A, B, and C of Figure A.2) are very similar to bias-corrected estimates. Bias-corrected estimates for diploma receipt and working while enrolled (panels D, E, and F) are typically within the confidence interval for conventional estimates, with the exception of diploma results at very large bandwidths. And even at the largest bandwidths, conventional estimates are not significantly different from zero.

Table A.4 lists bias-corrected results by subgroup. Column 1 repeats baseline, full sample results for comparison. The Automatic Zero treatment contrast was typically larger for dependent students (Column 2). The threshold increased their average Pell award by $355 (versus $244 overall), and the likelihood that they had a zero EFC increased by 39 percentage points (versus 31-32 percentage points). Standard errors are somewhat smaller in Column 2 than in Column 1, but nonetheless larger than any of the corresponding point estimates. Columns 3 and 4 report results by gender, and Columns 5 and 6 report results by race. The imprecise discontinuity in earnings while enrolled is larger for women than for men, and larger for white students than Black, but none of these estimated discontinuities are statistically significant.

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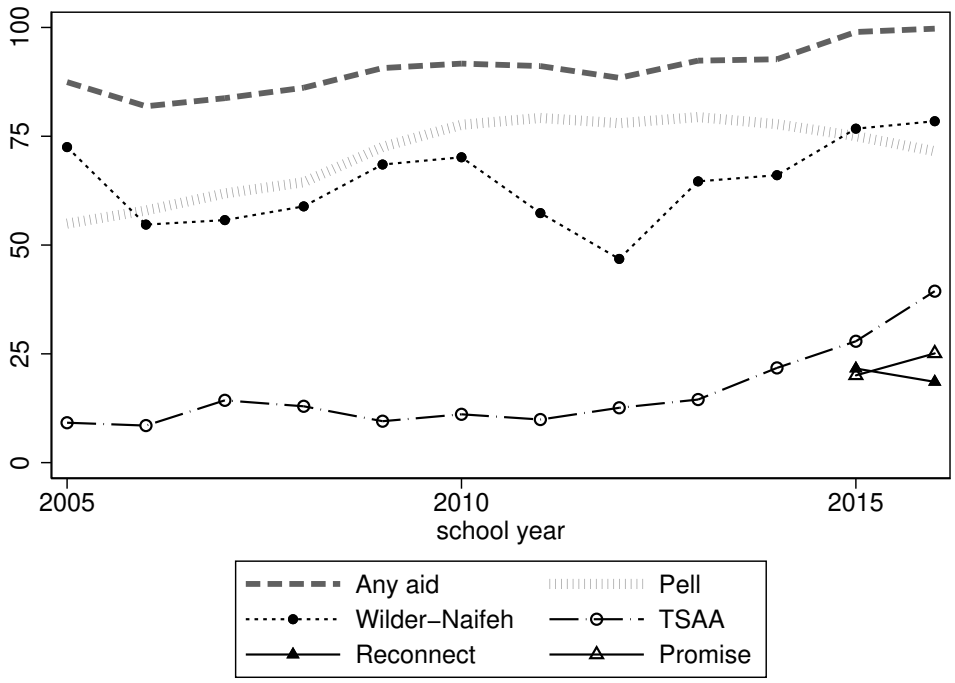


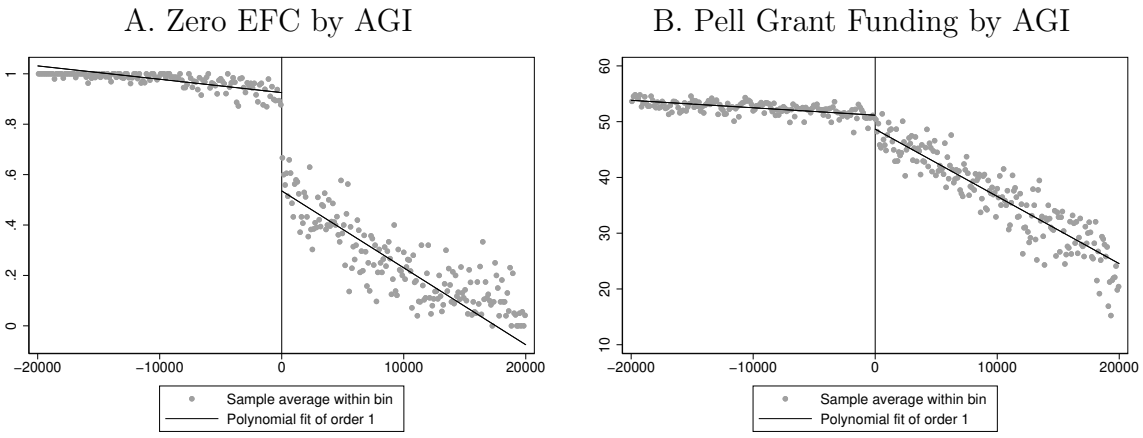
Figure 1: Percent of FAFSA-filing TCAT Students with Grant Aid

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 2: Automatic Zero Eligibility and Pell Funding by AGI



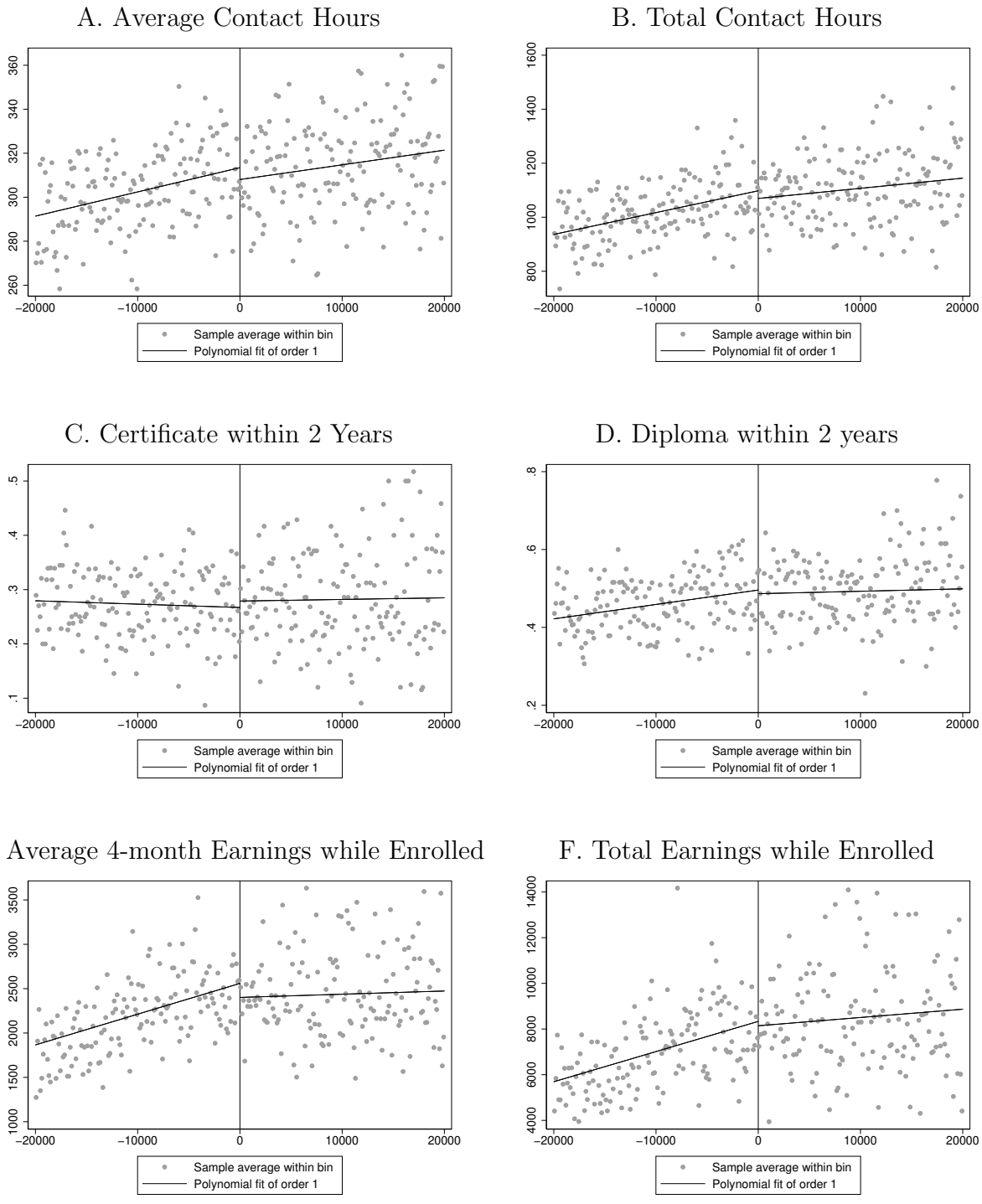
Notes: Scatter plots illustrate the average likelihood of having a zero EFC (3A) or potential Pell aid (3B) against the gap between students' AGI and qualifying AGI values for the Automatic Zero EFC rule. Pell grant amounts are in hundreds of 2017$. Qualifying AGI values ranged from $20,000 – 31,000 across cohorts. Solid lines trace the linear relationship between zero EFC status or aid amount, and the AGI gap. Bin partitions are chosen to be evenly spaced and to mimic the variability of the underlying data (Calonico et al., 2015). Discontinuities in figures cannot necessarily be reconciled with Table 2 estimates, since the latter are bias-corrected and derived from different bandwidths.

Table 2: Regression discontinuity results for Automatic-Zero EFC

	(1) Automatic Zero EFC	(2) Additional $100 Pell Aid	(3) Automatic Zero EFC	(4) Additional $100 Pell Aid
First Stage Estimates				
	0.314***	2.44***	0.319***	2.65***
	(0.030)	(0.67)	(0.029)	(0.66)
Second Stage Estimates				
Average term contact hours	16.55	2.36	4.45	1.31
	(36.16)	(4.88)	(24.97)	(3.64)
Total contact hours	89.08	11.42	46.07	6.03
	(172.55)	(22.97)	(139.94)	(18.38)
Certificate attainment (0,1)	-0.027	-0.004	-0.0365	-0.004
	(0.096)	(0.012)	(0.093)	(0.012)
Diploma attainment (0,1)	-0.055	-0.010	-0.012	-0.003
	(0.138)	(0.020)	(0.099)	(0.014)
Any work while enrolled (0,1)	0.039	0.008	0.043	0.007
	(0.110)	(0.016)	(0.112)	(0.015)
Total earnings while enrolled (2017$)	-1301.44	-159.21	-561.96	-42.65
	(2681.97)	(375.25)	(2396.82)	(343.92)
Average 4-month earnings while enrolled (2017$)	122.95	31.44	296.81	39.25
	(590.53)	(86.47)	(666.04)	(84.52)
Number of students	13,752	13,752	14,097	14,097
With $1,000-multiple AGI?	No	No	Yes	Yes

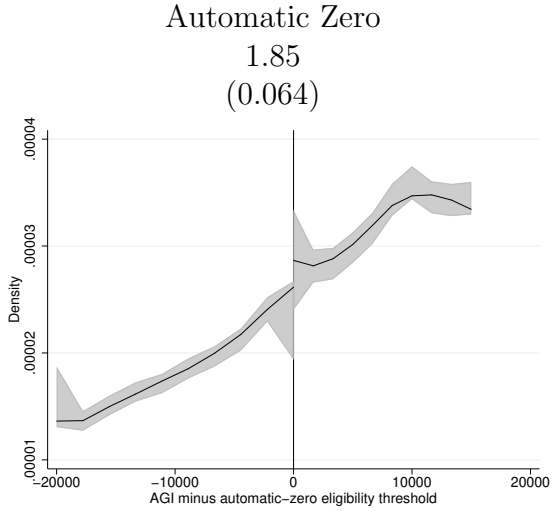
Notes: The table presents bias-corrected results of Equation 1 (first row) and Equation 2 (subsequent rows), estimated separately for each outcome listed at left, and for predicted $EFC = 0$ determination (Columns 1 and 3) and additional Pell dollars (in hundreds, Columns 2 and 4). Columns 1-2 report results under our preferred sample construction, which omits FAFSA filers with AGIs that are even multiples of $1,000. Columns 3-4 include these filers. The top statistic in each cell is the bias-corrected estimate for the effect of just meeting the Automatic Zero cutoff: α_1 in first-stage estimates and β_1 in second-stage estimates. Standard errors in parentheses account for estimation error in bias correction (Calonico et al., 2014).
* represents statistical significance at 90% confidence, ** at 95%, and *** at 99%

Figure 3: Student Outcomes by Automatic Zero Eligibility



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 \$20,000 – 31,000 across cohorts. Solid lines trace the linear relationship between zero EFC status or aid amount, and the AGI gap. Bin partitions are chosen to be evenly spaced and to mimic the variability of the underlying data (Calonico et al., 2015). Discontinuities in figures cannot necessarily be reconciled with Table 2 estimates, since the latter are bias-corrected and derived from different bandwidths.

Figure A.1: 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. (2019b), a manipulation test statistic is reported for each threshold along with p-value in parentheses.

Table A.1: Regression Discontinuity Results for Student Characteristics

	(1)	(2)	(3)	(4)	(5)
			Mother college	Father college	
	White	Female	educated	educated	First generation
Automatic Zero	-0.001	-0.044	-0.020	-0.004	0.005
	(0.037)	(0.043)	(0.032)	(0.026)	(0.035)

Notes: The table lists bias-corrected 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. The top statistic in each cell is the bias-corrected estimate for the effect of just meeting the Automatic Zero cutoff. Standard errors in parentheses account for estimation error in bias correction (Calonico et al., 2014).
* represents statistical significance at 90% confidence, ** at 95%, and *** at 99%

Table A.2: 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 Zero	-0.48	9.76	0.003	-0.003	-0.001	174.20	26.24
	(1.67)	(14.67)	(0.003)	(0.004)	(0.001)	(155.21)	(19.10)

Notes: The table lists bias-corrected 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. The top statistic in each cell is the bias-corrected estimate for the effect of just meeting the Automatic Zero cutoff. Standard errors in parentheses account for estimation error in bias correction (Calonico et al., 2014).

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

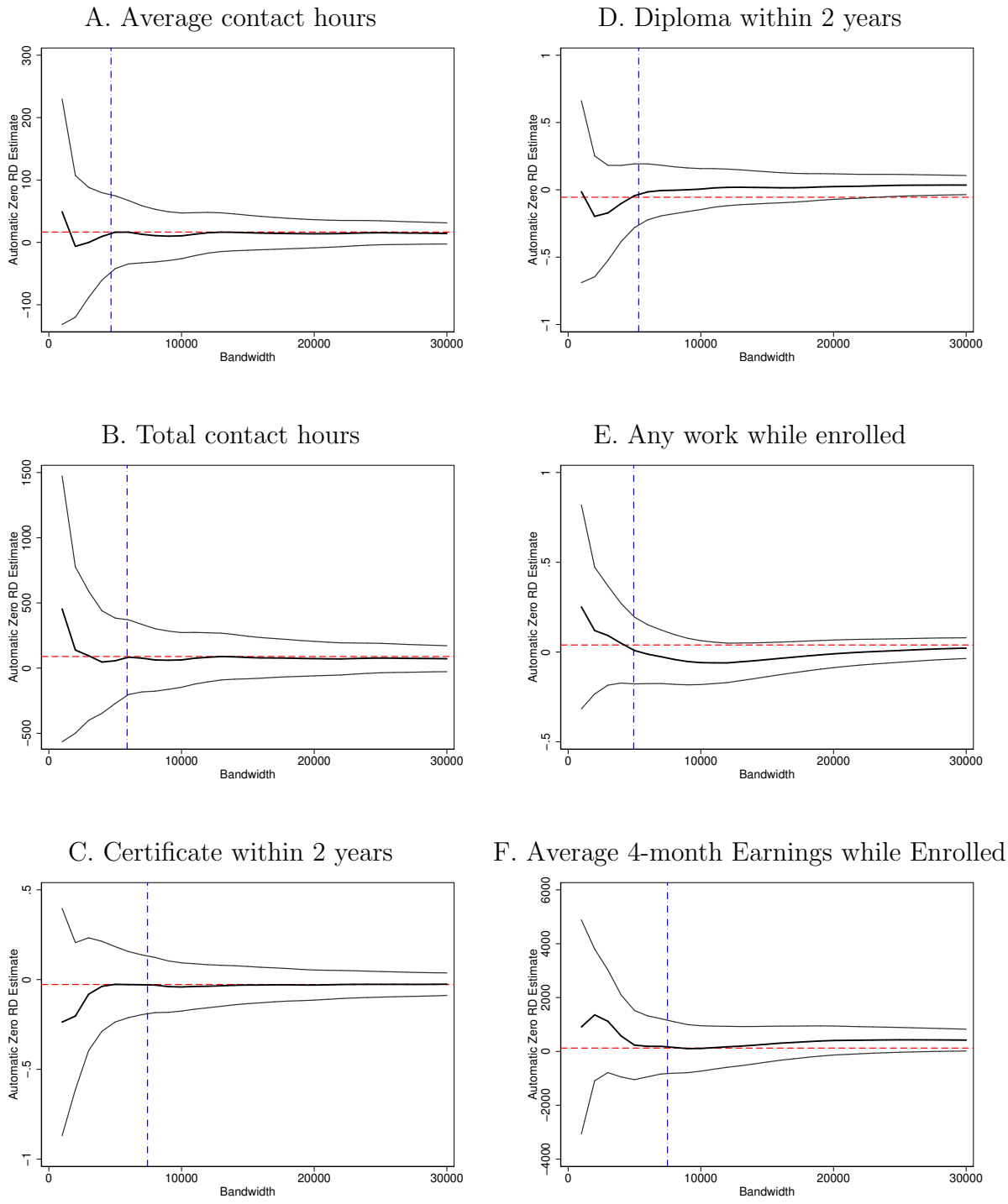
Table A.3: Alternate Specifications for Automatic Zero Regression Discontinuity Results

Outcome	(1) Baseline	(2) With covariates	(3) Quadratic Polynomial	(4) Omitting 2012-2014	(5) Clustered SEs
Average contact hours	16.55	22.65	4.89	14.28	18.45
	(36.16)	(32.99)	(52.06)	(30.04)	(36.65)
Total contact hours	89.08	30.87	23.97	-15.06	87.97
	(172.55)	(183.01)	(294.23)	(176.89)	(179.04)
Certificate	-0.027	-0.024	-0.076	0.091	-0.028
	(0.096)	(0.105)	(0.172)	(0.108)	(0.101)
Diploma	-0.055	-0.045	-0.193	-0.012	-0.053
	(0.138)	(0.139)	(0.198)	(0.126)	(0.136)
Any work while enrolled	0.039	0.021	0.139	-0.076	0.033
	(0.110)	(0.093)	(0.168)	(0.096)	(0.115)
Total earnings while enrolled	-1301.44	-1184.23	172.89	2056.61	-1282.64
	(2681.97)	(2696.09)	(4466.65)	(2445.69)	(2592.74)
Average 4-month earnings while enrolled	122.95	191.64	1079.01	684.65	120.35
	(590.53)	(572.56)	(1139.04)	(611.82)	(572.87)
Number of students	13,752	13,752	13,752	8,177	13,752

Notes: The table presents bias-corrected results of Equation 2, estimated separately for each outcome listed at left. The top statistic in each cell is the bias-corrected estimate for the effect of just meeting the Automatic Zero cutoff. Standard errors in parentheses account for estimation error in bias correction (Calonico et al., 2014). Column (1) repeats baseline results from Column (1) of Table 2. Column (2) specifications include controls for gender, race, Hispanic ethnicity, parental education, cohort, and fall entry. Column (3) specifications use quadratic rather than linear approximations. Column (4) omits 2012, 2013, and 2014 cohorts, who faced a lower Automatic Zero threshold and smaller first-stage discontinuities in Zero EFC and Pell aid. Column (5) clusters standard errors by institution and cohort, which also changes the optimal bandwidth and bias-corrected point estimate relative to Column (1).

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

Figure A.2: Regression Discontinuity Results for Automatic Zero EFC, by Bandwidth



Notes: Each figure depicts conventional β_1 regression estimates and 95% confidence intervals from 30 separate estimations of Equation 2 for the listed outcome, at bandwidths varying from \$1,000-\$30,000 around qualifying AGI for the Automatic Zero EFC rule. For each outcome, the corresponding Table 2 Column (1) estimate is marked with a dashed horizontal line, and the optimal bandwidth is marked with a dashed vertical line.

Table A.4: Automatic Zero Regression Discontinuity Results, by Subgroup

Outcome	(1) Baseline	(2) Dependents	(3) Female	(4) Male	(5) Black	(6) White
Average contact hours	16.55	19.29	49.26	-5.16	-20.50	21.47
	(36.16)	(27.14)	(74.90)	(34.00)	(63.48)	(42.26)
Total contact hours	89.08	72.03	-122.47	72.63	-218.42	173.92
	(172.55)	(155.88)	(206.40)	(233.88)	(360.46)	(177.66)
Certificate	-0.027	-0.051	-0.008	-0.039	0.074	-0.052
	(0.096)	(0.093)	(0.211)	(0.136)	(0.249)	(0.118)
Diploma	-0.055	0.013	0.086	-0.158	-0.167	0.039
	(0.138)	(0.119)	(0.205)	(0.170)	(0.268)	(0.121)
Any work while enrolled	0.039	0.008	0.031	0.035	-0.002	-0.009
	(0.110)	(0.108)	(0.209)	(0.120)	(0.205)	(0.110)
Total earnings while enrolled	-1301.44	-1621.82	-6246.33	1080.60	-48.38	-2355.47
	(2681.97)	(2078.60)	(4001.90)	(3811.94)	(6212.08)	(3228.08)
Average 4-month earnings while enrolled	122.95	-36.82	-928.59	879.03	1551.81	-266.51
	(590.53)	(434.53)	(1223.56)	(851.33)	(1561.75)	(717.24)
Number of students	13,752	8,699	6,838	6,914	2,849	10,178

Notes: The table presents bias-corrected Equation 2 results, estimated separately for different student subgroups. The top statistic in each cell is the bias-corrected estimate for the effect of just meeting the Automatic Zero cutoff. Standard errors in parentheses account for estimation error in bias correction (Calonico et al., 2014).

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