Does Free Community College Change Who Enlists in the Military? Qualitative and Quantitative Evidence from Tennessee Promise[1]

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ABSTRACT

Young adults in the United States face critical decisions after high school, often defined by employment, enrollment, or enlistment. Military service provides educational benefits, but the attractiveness of this pathway wanes with perceived college affordability. We use the roll out of tuition-free community college in Tennessee to study the effects of Promise scholarships on enlistment. We find a 28 percent decline in military enlistment driven by Army, Navy, and Coast Guard, and concentrated in low-income counties. In addition, the composition of successful enlistees shifted towards those with more mechanical and automotive aptitude.

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I. INTRODUCTION

As young adults near the end of compulsory secondary schooling in the U.S., they face a decision about what to do next. Broadly, the alternatives include what many states and school districts refer to as the "three Es:" employment, enrollment, or enlistment (Pondiscio, 2019). These three pathways involve costs and benefits that vary in terms of choice of location, choice of career, lifetime earnings, and upfront investment.

Enlistment typically represents more certainty in short-term employment and financial security than the other two Es, at significant expense to choice of short-term location and occupation. Going to work right out of high school offers more individual autonomy than military service, although many higher-paying occupations will be out of reach. Postsecondary enrollment can open the door to those occupations, but academic success in college is uncertain and requires years of direct costs and foregone short-run earnings.

The three E's overlap, however, and do not preclude each other. Military service is one form of employment, and the U.S. Department of Defense is the single largest employer of new high school graduates (Engel, Gallagher, and Lyle 2010). Service in the U.S. military offers a path to college that alleviates credit constraints, debt aversion, and imperfect information about benefits. Beginning in 1944, the Department of Defense has offered the GI Bill to veterans of the Armed Forces. The current version of the GI Bill, the Forever GI Bill, is available to service members and veterans who have completed 36 months of active service. The GI Bill covers tuition for public colleges and universities, up to $25,000 for private or nonprofit schools, as well as location-based living stipends.

While the GI Bill is generous, surveys indicate that the education incentive becomes less of a factor the more an individual feels they can pay for college. Among surveyed members who

stated they could not pay for college at all, 86% indicated that education incentives were a main factor for military service. When individuals reported they could pay for 1%-24% of their college expenses, joining the military for educational reasons dropped to 41% (Barr, 2016). A significant change in the relative price of postsecondary education should cause young adults to substitute away from military service towards either other career goals or education opportunities by lowering the value of postsecondary education benefits tied to military service. The "free college" benefit projected by the GI Bill now faces more competition from state and local Promise programs that also cover college tuition. Promise programs have much lighter preconditions than three years of military service, but Promise grants are typically less generous than the GI Bill, and they do not offer mortgage, healthcare, or other benefits from military service.

We examine how the plausibly exogenous rollout of the Tennessee Promise free community college model affected student considerations toward military service as well as the volume and composition of new enlistments in Promise-eligible counties. We estimate the effect of free community college on the volume and composition of applications and new enlistments in Promise-eligible counties. The earliest phase of Promise in Tennessee significantly increased college enrollment for eligible students (Carruthers and Fox, 2016), and increased the likelihood of two-year college completion (Carruthers et al., forthcoming). Following statewide expansion in 2015, college-going increased by an unprecedented 10% (THEC and TSAC, 2021). We assess if some of those gains in college enrollment may have come from students who would have otherwise enlisted in the Armed Forces after high school.

Drawing on insights from 19 focus groups with 60 Tennessee Promise students, we find that students view military service as a significant source of financial aid for college, and that

Tennessee Promise factored into some students' decision of whether to enlist or enroll in college immediately after high school. Drawing on administrative application and enlistment records for every branch of the U.S. military and a quasi-experimental research design, we find no change in applications to enlist (a low-stakes signal of interest). However, we do find that there was a 28 percent decline in total enlistment when Tennessee Promise or one of its predecessors arrived in a given county. In addition, we find that the composition of successful enlistees may have changed, favoring recruits who scored higher on mechanical and automotive sections of the Armed Service Vocational Aptitude Battery (ASVAB). We also find similar results for recruits of all races and ethnicities and for females. Further, we show that our results are most stark for low-income recruits. Back-of-the-envelope calculations suggest that marginal college enrollees were disproportionately likely to have enlisted in the absence of free community college.

II. RELATED LITERATURE

Effects of Relative Prices on Enrollment in Higher Education

Becker (1964) showed that high school students will weigh the relative prices of enlistment, employment, and enrollment when deciding their future careers and human capital investment. For example, reducing the direct cost of postsecondary enrollment through financial aid can raise the likelihood of going to college at all (Cornwell et al., 2006; Deming & Dynarski, 2010; Angrist et al., 2022; Hershbein et al., 2019; Dynarski et al., 2022), and aid targeting specific institutions or sectors can shift enrollment choices in expected ways (van der Klaauw, 2002; Andrews et al., 2010; Cohodes & Goodman, 2014; Gurantz, 2019). We also know that students do not perfectly account for the cost of college or their choice set (Avery and Kane 2004), that more opaque financial aid awards have little effect on college enrollment (Carruthers

& Welch, 2019), and that efforts to provide better information or assist with financial aid applications can meaningfully affect students' college choices (Bettinger et al., 2012; Barr & Castleman, 2017; Carrell & Sacerdote, 2017; Dynarski et al., 2021). On the margin, financial aid or access to better colleges can have a large and positive net effect on short-term and projected earnings (Hoekstra, 2009; Denning et al., 2019; Angrist et al., 2020; Smith et al., 2020), suggesting that students' postsecondary enrollment choices are not entirely dictated by rate-of-return optimization.

The Role of Education Benefits for Enlistment

Since the end of World War II, the Department of Defense has used education benefits codified by various iterations of the GI Bill as a key tool to recruit and retain qualified personnel. Defense-funded grants for tuition and living expenses are conditioned on a period of service and have typically been generous enough to evoke the compelling idea of "free college" that other public and private funders have more recently adopted. Simon et al. (2010) and Warner (1990) both show that changes in the generosity of the Montgomery GI Bill correlated with changes in the number and quality of recruits. Kleykamp (2006) finds that among high school graduates, college aspirations were significantly related to the choice to enroll rather than work, but also to the choice to enlist rather than work.

The GI Bill has been effective as a recruitment tool, but also as a policy lever for increasing college enrollment and attainment. The combination of the WWII and the Korean War GI Bills increased college going and graduation rates among young men by around 15-20% (Stanley, 2003), although these estimates were concentrated among veterans from households with above median income. Looking across birth cohorts with different exposure to the WWII

GI Bill, Bound and Turner (2002) found that military education benefits increased college enrollment for veterans compared to non-veterans. Turner & Bound (2003) found that the WWII GI Bill increased educational attainment for both Black and White veterans outside the South, but the GI Bill had little effect on college going for Black veterans inside the South. Angrist & Chen (2011) use draft lottery data from the Vietnam War to show that the GI Bill from that era increased post-secondary educational attainment among those who were drafted.

The Post 9/11 GI Bill (PGIB), also known as the Forever GI Bill since 2018, is the most recent iteration of military funded education benefits. Relative to its predecessor, the Montgomery GI Bill (MGIB), the PGIB was one of the largest expansions of college aid for veterans. The PGIB increased aid for tuition, added housing and living stipends, and made it possible for veterans to transfer unused benefits to a spouse or dependent (Kofoed, 2020). Barr (2015, 2019) shows that the PGIB increased veteran enrollment, particularly into four-year colleges, and subsequently increased the likelihood that veterans graduated from college.

It is increasingly clear that inadequate information or financial resources hinder some students' access to college, that financial aid or advising can help, and that GI Bill education benefits are one form of effective aid for students seeking postsecondary degrees. Enlisting in the military is a lengthy individual commitment, however, and we know very little about the margin between postsecondary enrollment and enlistment. One reason is the lack of exogenous variation in financial aid eligibility linked to data describing individual or local enlistment.

Most closely related to our research, Barr (2016) examines the effect of state merit aid on enlistment. He finds that when states initiated lottery-funded merit aid scholarships, the probability of military enlistment decreased by 0.6 percentage points (a 6% reduction relative to the baseline). We add to this insight by examining the effect of a broader financial aid campaign

on aggregate enlistment volumes, relying on the expansion of Tennessee's "free community college" model from one county in 2009 to the entire state in 2015. The state-funded Tennessee Promise and its privately funded predecessors were not tied to high school grades, SAT/ACT scores, or income requirements. As a result, Tennessee Promise extends to students who are more likely to be on the margin between enlistment and college enrollment than the merit aid Tennessee HOPE scholarship that was already in place during this time.[2] The program's universal "free college" message accompanied efforts to improve the perceived value of college and ultimately raise postsecondary attainment among the state's workforce. This broad-based marketing of college *per se*, along with last-dollar support for tuition, may have resonated more than merit-based or need-based options among students who would have otherwise enlisted in pursuit of a military career or GI Bill education benefits. On the other hand, Tennessee Promise scholarships were typically worth less than $1,000 per year, which is less than the value of Tennessee HOPE and an order of magnitude less than the benefits associated with the GI Bill.

III. PROGRAM AND POLICY BACKGROUND

Knox Achieves, a privately funded nonprofit organization, pledged to pay community college tuition and fees for any Knox County high school graduate, beginning with the graduating class of 2008-2009. Any graduate from a Knox County public high school was eligible, regardless of grades, standardized test scores, or family income. This "place-based" criteria resembles other Promise programs such as Kalamazoo Promise (Bartik et al., 2019),

[2] Charles et al. (2018) provide a theoretical model that helps explain the importance of the two-year college cost margin. Their model assumes college attendance becomes less costly – in terms of effort and psychological costs – for higher-ability students. This provides two important results: (1) lower-ability students attend two-year colleges and (2) their college attendance is more responsive to price changes. The relevant result is that two-year colleges capture the marginal college attendee.

Pittsburgh Promise (Page et al., 2019), and Say Yes to Education in Syracuse and Buffalo, New York (Sohn et al., 2017). To receive tuition benefits, Knox Achieves participants needed to meet with volunteer mentors, file a Free Application for Federal Student Aid (FAFSA), graduate from high school, and enroll right away in a Tennessee community college. To maintain their tuition benefits after enrollment, students needed to enroll full time, maintain a 2.0 grade point average (GPA) or better, and continue to meet with volunteer mentors. Knox Achieves tuition benefits were "last dollar," meaning that the program covered any difference between a student's tuition bill and money provided by other grants and scholarships. About half of Knox Achieves students did not actually receive financial aid from the program, because they qualified for need-based federal Pell grants, merit-based Tennessee HOPE scholarships, and other grants that covered their tuition and fees. Even so, Carruthers and Fox (2016) show that eligibility for Knox Achieves significantly increased the likelihood of college enrollment.

After three years serving only Knox County residents, the program expanded under the name "tnAchieves," serving the 2011-2012 class in 23 counties, 26 counties for 2012-2013, and 27 counties for 2013-2014. In 2014, Governor Bill Haslam signed Tennessee Promise into law, adopting the tnAchieves model across all 95 counties in Tennessee. Knox Achieves, tnAchieves, and Tennessee Promise benefits and requirements were very similar, and in the quantitative analysis, we treat them as part of the same phased intervention, which we refer to from here on as the Promise program. Figure 1 depicts this staggered rollout. The high school class of 2015 was the first to be eligible for statewide Promise, and their college-going rate increased by 10% over the 2014 rate, from 58.6% to 64.4% (THEC and TSAC, 2021). Community colleges, where Promise benefits could be used, saw even larger enrollment gains. Enrollment modestly declined across the state's four-year public universities in 2015 before recovering in 2019 (THEC, 2021).

Both the size and composition of new community college students changed notably starting with the first Promise cohort in 2015. House and Dell (2020) find that Promise students in community colleges tended to have higher family income after 2015 than first-time students in previous years, and they were less likely to be the first in their family to attend college. In the years since statewide Promise implementation, state reports on "vertical" transfer from 2-year schools to 4-year schools are similarly consistent with a post-Promise compositional change in students who first enroll in community colleges (THEC, 2023). These changes could be due to a number of factors, one of which we are able to explore here. Promise may have pulled students into community colleges from counterfactual pathways in the labor force, four-year colleges, or the military. Given differences in the academic preparation of work-bound, university-bound, and military-bound students, it is not clear *ex ante* if post-Promise community college cohorts would be more or less suited for postsecondary success.

IV. QUALITATIVE EVIDENCE

Qualitative Methods

To explore mechanisms underlying the enrollment-enlistment tradeoff under Promise, we draw on data collected during focus groups with first-year Promise students at community and technical colleges across the state. A member of the research team facilitated 19 focus group meetings lasting 60-90 minutes each at 12 campuses of 10 public colleges (60 total participants) in March and April of 2018. This qualitative data collection was part of a broader effort to understand student experiences under Promise, and in particular, student perceptions of Promise and expectations for the program and their colleges (Kramer, 2022). Accordingly, the focus groups were limited to students who enrolled in college and persisted until at least their second

term. The research team member selected sites to cover a wide variety of campus experiences and geographies and conducted recruitment for the focus groups in collaboration with Tennessee Promise and campus-based student affairs staff. First-year Promise students received an email and text message about the opportunity to participate in a voluntary focus group about their Promise experience. They were offered one community service hour (toward their community service required for continued Promise eligibility) and lunch in exchange for their time and perspectives.

The research team member conducted focus groups at three technical colleges, six community colleges, and one four-year institution that serves students across all regions of the state. Table A.1 in the appendix provides additional details on the students who participated in focus groups, as well as their colleges. Focus groups discussed college search, transition, and the first semester of enrollment. Most pertinent to this study are aspects of students' college search and decision to enroll.[3] All focus groups were audio recorded and transcribed verbatim. The research team member used an inductive, open coding approach in alignment with grounded theory techniques (Charmaz, 2006; Strauss & Corbin, 1990). As findings emerged through coding, the research team member explored the breadth and depth of enrollment decision themes within and across focus groups, taking an iterative approach to coding and writing analytic memos to capture themes and insights that arose from the data.

Qualitative Results

Military enlistment questions were not an explicit part of the semi-structured interview instrument, but nonetheless, the enlistment-enrollment margin emerged as an important part of

[3] See the Appendix for the semi-structured interview instrument.

student decisions about what to do after high school and how to pay for college. To summarize results, participants across focus group settings articulated that they were uncertain about going to college and reluctant to take on student debt, which for some, initially piqued their interest in enlistment and the GI Bill incentive. When tuition-free community college became available through Promise, this shifted their short-term preferences toward enrollment over enlistment, but (in some cases) without completely ruling out enlistment at a later point. Below, we provide more detail on specific themes that emerged around college affordability, and for some focus group members, how Promise supplanted military education benefits as the way to pay for college. Exemplar quotes from focus group participants highlight important links and tradeoffs in their postsecondary decisions.

First, consistent with the financial aid literature, students articulated the importance of affordability in their decision about whether to enroll in college. Many participants said they had been uncertain about attending college, and their concerns often centered on financing. This view was repeated across participants, colleges, and geographic settings. To give one example, a technical college student described how Promise alleviated financial challenges around paying for college:

> *Well, I mean, my dad was into clock repair and my mother was working insurance. Now she's trying not to pull her hair out over her job. And you know, [Promise offers] $2,000 for college. It was like, "Well, ain't no reason I shouldn't now," because financial shouldn't be too much of a problem [with the aid]…So, that's what influenced my decision.*

While a few participants said they would have been able to attend college without Promise, the vast majority articulated that it would have been difficult or impossible to attend without the tuition-free scholarship. One community college student put it plainly:

> *I wouldn't have never been here if they didn't have it. But they do, and here I am.*

Participants mentioned other sources of aid beyond Promise that were important in choosing to enroll, such as Pell Grants. They also referenced the GI Bill as an important resource for pursuing postsecondary education, referring to it either by name or generally as a benefit to be earned through military service. One community college student captured this theme in their description of how their family leveraged both the GI Bill and Promise to provide postsecondary opportunities for their children:

> *My parents…used the GI Bill for my sister…We kind of were struggling at that point. But, then with [Promise and other scholarships] that we looked into, we found a way to work it out [for me to attend].*

Promise, as a newer financial aid program, shifted students' and families' decision-making with regard to postsecondary enlistment or enrollment. Focus group participants articulated that they directly weighed their initial inclination or plans to enlist in the military against the new opportunity to pursue a college education tuition-free under Promise. This experience was particularly prevalent among participants at community colleges. When pressed regarding the details they considered in choosing between enlistment and enrollment,

participants responded that financial considerations contributed to their initial inclinations to enlist. Specifically, participants referenced military tuition assistance as being a compelling benefit of enlistment. Focus group participants went on to describe how their preference to enlist changed with Tennessee's commitment to pay for college. When asked about whether Promise shaped where they chose to go to college, one community college student stated:

> *I guess…because if I didn't have like a full ride, I probably would have enlisted. Because that's what my original plan was, enlist, and then like go to college while I'm in the service. But I think the Promise, or like the Pell Grant and everything, really helped me. It really helped show me that I can do this and it not like put me in a bunch of debt.*

Access to Promise allowed such students to enroll in college directly rather than serve in the military prior to or concurrent with their pursuit of a college degree. Some admitted that this was perhaps a more challenging path for them to take. As articulated by one community college student:

> ***"****I was thinking about enlisting because of course that seems easier [than going to college first], but it's really just -- I learned early on you've just got to stay to it and it's going to suck, but in the end it's likely going to be worth the trouble. You know what I mean?"*

Participants saw value in pursuing a college degree, even if they maintained an interest in ultimately joining the Armed Forces. Several participants who discussed enlistment during the

decision-making process shared that they maintained an interest in serving in the Armed Forces. These individuals shared their belief that by pursuing postsecondary training prior to joining the Armed Forces, they would be able to explore potential occupational areas of interest and, by earning college credits and a degree, they might be able to enter the workforce with better pay or occupational choices.

These qualitative results both motivate and support our quantitative analysis. While the focus groups met in a post-Promise environment and were limited to enrolled college students in their second term of study, our qualitative analysis provides richer justification for our interpretation of the results that follow. Namely, many students who received aid from Tennessee Promise considered enlistment as a realistic alternative to college in large part because of the financial risks of college attendance. These risks appear salient particularly to students considering enrollment at community colleges where tuition is lower.

V. EMPIRICAL EVIDENCE FROM A QUASI-EXPERIMENTAL DESIGN

Application, Enlistment, and ASVAB Data

We obtained de-identified 2006-2019 Armed Forces records on applications and enlistments from the Defense Manpower Data Center (DMDC). For enlistees, we additionally observe measures of academic and technical aptitude from overall and subject scores on the ASVAB. We begin by focusing on enlistees under age 21 and aggregating these data to the county-year level to study the effect of free community college on total under-21 enlistments in a county as well as average ASVAB scores among new enlistees. We identify every application and enlistment into the Department of Defense by branch as well as enlistments into the United

States Coast Guard. These data include age, gender, race and ethnicity, date of enlistment, county, and for successful enlistees, overall and subject ASVAB. We do not observe applicants' or enlistees' socioeconomic background, high school, ACT/SAT scores, high school GPA, or other historical factors.

An Armed Forces application is best interpreted as an indication of interest and does not precisely capture actual intent to enlist. Applying to the Armed Forces is an early and non-binding step toward enlistment, and on average, 80% of applicants do not ultimately enter the Armed Forces (Ernst, 2014). Based on conversations with Tennessee recruiters, the moment a potential recruit initiates the process and provides their basic information, they are deemed an applicant and recorded in the system. At a later point, applicants report to a Military Entrance and Processing Station to determine medical and AFQT qualification. Applicants do not incur any service obligations unless they sign a DD Form 4, the Enlistment/Reenlistment Document for the Armed Forces of the United States. At that point, they are considered an enlistee and would show up in our enlistee data.

We identify and remove counties outside of Tennessee that had their own local Promise programs during the 2006-2019 sample window, as identified by the Upjohn Institute database of local Promise initiative (Miller-Adams et al., 2017). We choose not to fold these out-of-state programs into our Promise treatment measure because their benefits and requirements in many cases are very different from the consistent last-dollar, broad-based model that evolved from Knox Achieves to tnAchieves to Tennessee Promise. We also choose not to leave these other programs in the control group since their effects may have been amplified or indirectly affected by what was happening in Tennessee. Results focus on the U.S. Southern region (16 states and Washington, D.C., as defined by the Bureau of Labor Statistics). The Appendix reports results

for the eight-state Southeast region as well as the U.S.[4] Results reflect the impact of Tennessee's free community college model on student interest in and commitment to the military, but subject to local caps and quotas on new enlistees as well as the military's discretion in selecting recruits for service.

The ASVAB became the military's common selection and classification test in 1976 (Fischl et al., 1980). Today's ASVAB is a nationally normed test designed to screen recruits for aptitude and identify an individual's best occupational areas. Many high school students take the ASVAB for this latter career exploration purpose, although ASVAB data used in this study are limited to enlistees. The ASVAB was last normed through the Profile of American Youth, in tandem with the National Longitudinal Survey of Youth (Moore et al., 2000).

The ASVAB is administered in a computer adaptive format for most recruits or in a longer pencil-and-paper format for recruits who do not live near a Military Entrance Processing Station. The test covers ten topics: General Science, Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, Numeric Operations, Coding Speed, Automotive and Shop Information, Mathematics Knowledge, Electronics, and Mechanical Comprehension. Among these ten, scores for Arithmetic Reasoning, Mathematics Knowledge, Word Knowledge, and Paragraph Comprehension constitute the AFQT. Each branch has a minimum required AFQT score for enlistment. Word Knowledge tests vocabulary, and Paragraph Comprehension tests reading comprehension. The Arithmetic Reasoning section includes short mathematical word problems, whereas the Mathematical Knowledge section tests more formulaic high school level math.

[4] In the U.S. analysis, we exclude California, New York, and Oregon from the sample because their statewide Promise programs are distinct from Tennessee's model and were introduced around the same time.

When combined with the AFQT sections, the other parts of the ASVAB help to determine a recruit's best occupational areas. The General Science section tests life and physical science knowledge. The Numeric Operations section includes simple, two-number computations. Coding Speed tests how quickly and accurately a recruit can retrieve information from a table. The Automotive and Shop Information section tests knowledge of automobile systems and tools. The Electronics Information section covers electricity, circuits, and associated formulas. Finally, the Mechanical Comprehension section tests mechanical principles and applied physics.

Estimation

We assemble a panel of county-level enlistment, application, and ASVAB data combined with county-by-year Promise availability (Figure 1) and then estimate the following:

$$y_{sct} = \nu_c + \lambda_t + \beta_1 Promise_{ct} + \boldsymbol{\beta_n X_{ct}} + \varepsilon_{sct} \quad (1)$$

where y_{sct} is the number of enlistments in or applications to service *s,* in county *c*, and year *t*. Parameters ν_c and λ_t are county and year fixed effects, $Promise_{ct}$ is a binary treatment indicator equal to 1 when county *c* in year *t* is participating in a Promise program and is 0 otherwise. The term $\boldsymbol{X_{ct}}$ is a vector of time-varying county controls (log population, median income, unemployment rate, and poverty rate), and ε_{sct} is the idiosyncratic error term. When analyzing effects on enlistee aptitude, we define y_{sct} as the county-level average ASVAB score. We cluster standard errors at the county level. For enlistment, application, and ASVAB outcomes, we weight Equation (1) by county population.[5]

For enlistments and application outcomes, we prefer to estimate y_{sct} in levels with county fixed effects and log population controlling for county scale.[6] There is an empirical

[5] Weighting is justified by a modified Breusch-Pagan test, which indicates that there is significant heteroskedasticity attributed to variation in county size (Solon et al., 2015).

[6] See Appendix Tables A.8 and A.9, which report first-difference estimates of the effect of $Promise_{ct}$ on year-to-year changes in enlistment and ASVAB outcomes.

disadvantage to this approach, however, because county fixed effects explain the vast majority of variation in enlistments and applications. Omitting all controls but ν_c from Equation (1) yields an R-squared greater than 0.90. We tested Equation (1) against models with more aggregated fixed effects and concluded that county fixed effects are necessary for consistent estimates of β_1.[7] Alternatively, we could define y_{sct} to be applications or enlistments per capita, which would allow for a scale-invariant interpretation of β_1. We have found, however, that given the high baseline degree of explained variance in Equation (1), additionally controlling for population through the dependent variable's denominator leads to a small number of overly influential observations as measured with Cook's Distance. We include mean y_{sct} in tables reporting Equation (1) estimates to facilitate interpretations of the magnitude of $\hat{\beta}_1$.

As a two-way fixed effects evaluation of a staggered-entry program, results are vulnerable to dynamic treatment effect heterogeneity, i.e., the possibility that early-entry counties like Knox may serve as bad controls for late-entry counties (Goodman-Bacon, 2021). In this application, we find that identification is dominated by comparisons between treated counties in Tennessee and counties that were not treated in the sample window. Specifically, a Goodman-Bacon et al. (2019) decomposition shows that 99% of Equation (1) estimates for β_1 derive from two-by-two, difference-in-differences comparisons between Tennessee counties that were treated with Promise and out-of-state counties that were not treated in the sample window. In addition, we complement our main Equation (1) results for enlistment with a richer event study model, where the $Promise_{ct}$ treatment indicator is disaggregated into indicators of years

[7] We evaluated the Equation (1) model with county fixed effects against a parallel model with state-by-population-decile fixed effects. County fixed effects would be consistent under either model, but less efficient if state-by-population fixed effects are sufficient to control for unobserved spatial heterogeneity. Papke & Wooldridge's (2023) modified Hausman test rejected equality between the two models, leading us to conclude that county fixed effects are necessary.

relative to implementation. We apply Borusyak et al. (2021) and Borusyak's (2023) imputation procedure to estimate anticipatory effects of Promise prior to implementation as well as post-implementation effects that can vary over time.

Enlistment, application, and ASVAB data allow us to examine effects on a large number of outcomes: 6 different measures of enlistment (overall and across the 5 branches), 6 different measures of application interest, and 11 different measures of enlistee aptitude (overall ASVAB scores and scores on 10 subject subtests). With this array of outcomes, our inferences are more vulnerable to false discovery. With this in mind, we report cluster-robust standard errors from which traditional *p* values can be derived, representing the probability of rejecting a true null for a single outcome. But we assess statistical significance using sharpened *q* values, which can be interpreted similarly but adjust for multiple inferences (Benjamini et al., 2006; Anderson, 2008).

Estimated Effects on Enlistment and Enlistee ASVAB

Table 1 lists Equation (1) estimates for enlistments, across all Armed Forces and by branch. Promise is linked to 8.67 fewer enlistees per county, which is about 28% of the mean volume of new enlistees in a county-year. This nearly 9-person drop is significant with over 95% confidence according to Anderson's (2008) sharpened *q*-values. Army, Navy, and Coast Guard enlistments fell by about 5.2, 2.9, and 0.6 respectively when Promise was introduced in a county, and all these estimates are statistically significant at the 95% level. Estimated effects are smaller and statistically insignificant for new enlistment into the Air Force and Marines, which is consistent with the more elite reputation of those branches among prospective enlistees (Wardynski, Lyle, and Colarusso 2010). Coefficients on other control variables suggest that

growth in a county's median income is associated with a lower volume of new enlistees, and that higher unemployment rates weakly increase enlistments.

Figure 2 illustrates estimated effects of Promise availability over time, derived from Borusyak et al's (2021) event study specification of Equation (1) with leading and lagging $Promise_{ct}$ indicators. Our first takeaway from Figure 1 is that pre-treatment placebo estimates (depicted to the left of year zero, in red) are consistent with well-balanced prior trends in enlistment across treated and control counties. Coefficients for leading $Promise_{ct}$ indicators are positive, suggesting that future Promise counties had somewhat higher enlistments than controls, but confidence intervals are wide and suggest that the excess was not significantly different from zero. Our second takeaway is that the pattern of post-treatment estimates (to the right of year zero, in blue) are consistent with intensifying effects of Promise over time. Enlistments changed very little in the first two years of a county's Promise program before falling by about 10 recruits in year three, growing to a roughly 30-recruit shortfall in year six. This 0-30 range includes the 9-person average treatment effect reported in Table 1, suggesting that the sign and significance of Equation (1) results are not meaningfully misrepresented by time-varying treatment effect heterogeneity, although longer-term effects on enlistment may be considerably larger than what we report in Table 1.

ASVAB results from Equation (1) in Table 2 can give us a sense of how the composition of new enlistees changed after the introduction of Promise. Since the volume of accepted applicants decreased with free community college, we may see shifts in ASVAB performance that reflect differences in aptitude between students who chose college over the military because of Promise, and those whose decision to join the military was not swayed by Promise.

We find that the average overall ASVAB score for new enlistees increased by 0.42 points, or 0.8% of the mean and 15.8% of the standard deviation, after Promise. The AFQT sections that determine eligibility to enlist changed very little. Scores for Arithmetic Reasoning declined by 0.41 points after Promise (13.8% of a standard deviation), while scores for Word Knowledge, Paragraph Comprehension, and Mathematical Knowledge increased by small and statistically insignificant amounts.[8] Arithmetic Reasoning subtests include short mathematical word problems, whereas Mathematical Knowledge subtests have high school-level problems that are more formulaic than applied. Post-Promise enlistees were slightly less adept at solving word problems and insignificantly different in formulaic math, possibly indicating a subtle shift toward more technical and more advanced math proficiency. Post-Promise enlistees were also stronger in Automotive and Shop subtests, by 0.38 points (8.7% of a standard deviation), coding, by 0.29 points (7.7% of a standard deviation), and they scored 3.38 points higher on the subtest for Mechanical Comprehension (26.6% of a standard deviation). Altogether, ASVAB subject results suggest that among the students who found themselves on the margin between enlisting in the military or enrolling directly in college (and whose AFQT scores would have qualified them for the military), Promise encouraged less technically adept students to enroll in college. This finding indicates that after Promise, enlistee cohorts were relatively more knowledgeable about automotive and mechanical systems, similar to pre-Promise cohorts in terms of qualifying AFQT scores, and thus somewhat higher-scoring on the overall ASVAB.

Appendix tables A.2 – A.3 and A.5 – A.6 report Equation (1) results for the narrower Southeastern sample and the broader U.S. sample. Other states in the Southeast may be more like Tennessee in terms of postsecondary and labor counterfactuals after high school, whereas the

[8] Estimated effects on Mathematical Knowledge and Paragraph Comprehension scores were significant at the 90% level

U.S. sample may afford more degrees of freedom and more precise estimates. The sign and significance of the results are similar across different samples. Estimated enlistment declines are larger when we narrow our focus to the Southeast (Table A.2) as well as when we broaden the sample to include states outside of the South (Table A.5). ASVAB results for the Southeast and U.S. samples are consistent with what we report in Table 2, in that post-Promise recruits are relatively stronger in Automotive and Mechanical knowledge and weaker in Arithmetic Reasoning.

Estimated Effects on Applications

Table 3 shows results from Equation (1) when the dependent variable represents overall applications and applications by branch. Table 3 reports results for the U.S. South, which is consistent with what we find for the narrower Southeast sample and the broader U.S. (see Tables A.4 and A.7 in the appendix). We find that Promise has no significant effect on overall applications and no significant effect on applications received in any branch. Marine Corps applications counterintuitively *increase* by an amount that is subjectively large (12.87 applicants per county, or 37.2% of a standard deviation) and statistically significant with conventional *p*-values, but sharpened *q*-values adjusting for multiple inferences are more consistent with the null. While the number of Marine Corps applicants may have increased by an imprecisely estimated figure, this did not yield any significant change to actual enlistments in the Marine Corps as evidenced by Table 1.

Promise's overall null effect in enlistment applications, coupled with evidence of a negative effect on enlistment, echoes some of the themes that emerged from our qualitative analysis. Some focus group participants, even though they had chosen college over the military

in the short term and cited Promise as part of their decision-making, also shared that they maintained an interest in the Armed Forces. This finding indicates that, on the margin, young people still consider military membership, but that some ultimately withdraw when Promise is available. Promise in and of itself might not offer a net benefit strong enough to stop students from registering a low-stakes signal of interest in the Armed Forces, but this alternative source of "free college" may have been enough to sway some potential recruits away from obligating themselves to service immediately after high school.

Heterogenous Treatment Effects for Enlistment by Demographics and Income

Finally, we estimate how Tennessee Promise affected potential recruits of various racial and socioeconomic backgrounds differently with regards to the decision to attend college or enlist. These results are not only helpful because of the desire to attract a diverse population into local Tennessee community colleges but also to ensure diversity within the military (Greenberg et al. 2022; Kofoed and mcGovney 2019). Figure 3 illustrates Equation (1) estimates effects on the number of enlistees by race, indicating that the introduction of Tennessee Promise reduced enlistment rates for every demographic group. We estimate that tuition-free community college reduced the number of black enlistees by a marginally significant 5.1 recruits and reduced white, Hispanic, and female recruits by a more precise 5.9, 5.8, and 3.8 recruits, respectively.

Next, we estimate Equation (1) for four different subgroups of counties with different levels of median income. Figure 4 illustrates results by branch and income quartile, where the first quartile represents the lowest-income counties and the fourth quartile represents the highest-income counties. We find that the lowest-income counties exhibited a significant reduction of 6.9 recruits, with the Army accounting for nearly half of that decline. Estimated magnitudes are

smaller for the next two income quartiles and insignificantly different from zero, other than a significantly negative 4-person decline among Army enlistees in counties with third-quartile income. Highest income counties realized the largest drop in the number of enlistees (14.6 overall), but this is statistically imprecise and represents a smaller share of average annual enlistees than the 6.9-recruit decline in low-income counties, which tend to be smaller and more rural.[9] Looking across Figure 4, we conclude that Promise reduced enlistment at all levels of area income, but with more ambiguity and imprecision in higher income counties. These results are consistent with qualitative sentiments from Promise student focus groups, in that students with the lowest financial resources might be close to the margin between enter military service and college enrollment.

Heterogenous Treatment Effects for ASVAB by Income

Finally, we study how the Tennessee Promise program changed the composition of a given recruit's ASVAB score by median county household income quartile. Figure 5 displays the point estimates for each of the subtests of the ASVAB by income quartile. Across the income distribution, we find that small gains in overall ASVAB scores are driven by large improvements in average Mechanical Comprehension scores ("Mech."), offset to a small degree by declines in Arithmetic Reasoning ("Arith.") and other subtests that are markers for college readiness. This pattern is most prominent in lowest-income counties. These results agree with our full-sample baseline results for ASVAB scores that indicate enlistees are less likely to be on the "college track" and more likely to have technical or mechanical aptitude.

[9] There are 73.2 enlistees annually, on average, in counties with median income in the 4th (highest) quartile versus 7.9 enlistees in counties with median income in the 1st (lowest) quartile. In addition, 1st quartile counties are more likely to be smaller and more rural, with an average population of 21,200 people, versus 178,800 for 4th quartile counties.

VI. DISCUSSION

Our quantitative analysis suggests that the 2009-2015 expansion of last-dollar free community college from one county in Tennessee to the state reduced new military enlistments among under-21 individuals. Overall enlistments declined by about 8.67 recruits per county each year, which was largely accounted for by declines in Army and Navy recruits. This represents a large, 28% change in average county enlistments. By comparison, Barr (2016) estimates that merit aid availability led to a 6% reduction in the likelihood of individual enlistment. It is reasonable that tuition-free community college might resonate with a larger number of prospective enlistees, since Promise eligibility covered almost every high school graduate in the state, including those who were not eligible for merit aid.

The magnitude of estimated enlistment declines suggests that Promise's marginal college enrollees may have disproportionately come from students who would have enlisted in the absence of the Promise program. State agencies estimate that the statewide expansion in 2015 led to "4,000 new entrants into higher education" (THEC and TSAC, 2018), which was derived from the change in the size of the college-going population of high school graduates from one cohort to the next. Prior to that point in time, perhaps 1 – 2% of the non-college-going population of 18-20 year-old Tennesseans enlisted in the military.[10] We may expect total enlistments across the state to decrease by up to 80 if a proportionate share of marginal college students would have instead joined the military. Our estimates, however, are consistent with over 500 individuals shifting from service to college in 2015.[11] This suggests that the "free college" message from

[10] The 1 – 2% figure comes from the American Community Survey and other sources. Limiting the 2011 – 2014 American Community Survey to 18-20 year old high school graduates who are not enrolled in college, and who lived in Tennessee one year prior to being surveyed, we find that 0.7 – 2.2% had a military occupation. Similarly, the total number of Tennessee enlistees age 18-20, pre-2015, is just under 1% of the 18-20 year-old cohort.
[11] The 500-recruit estimate comes from multiplying our 8.67 estimate from Table 1 by 62 counties that were newly treated in 2015.

Promise, as well as aid and advising support that came along with it, was particularly persuasive for students who might have otherwise qualified for education benefits through the Armed Forces.

Our analysis of enlistees' average ASVAB scores suggests that the composition of enlistees changed when high school students were eligible for Promise. Enlistee aptitude shifted to favor mechanical and applied knowledge, perhaps because students with these skills were less interested in and less affected by tuition-free community college. We also find that Promise had no significant effect on overall applications to the Armed Forces. This indicates that initial interest in the military did not change after the introduction of Promise, but that the program led some graduating high school seniors to enroll in college before or instead of joining the military.

Qualitative data collection and analysis sheds light on the mechanisms working at the enrollment-enlistment tradeoff under Promise, as well as the salience of military versus state education grants. In focus groups with first-year Promise scholarship recipients across Tennessee, participants described the importance of access to resources to finance their college education in their decision-making processes. Students articulated a reluctance to take on student debt and a preference for grant aid or scholarships to finance their postsecondary education. Participants directly referenced enlistment and the GI Bill as an alternative way that they could afford college. However, for some students, access to Promise made college enrollment a more appealing decision, at least in the short term. Students shared that Promise allowed them to enroll in college directly rather than serve in the military prior to or concurrent with their pursuit of a college degree.

Both Promise and military service benefits pair financial aid for postsecondary education with "free college" messaging, i.e., a high degree of certainty about the tuition cost of college.

Burland et al. (2022) find that prospective college students value certainty in knowing what college will cost, especially if that certainty is conveyed up front and without contingencies. In Tennessee, students on the enrollment-enlistment margin may have reacted to the shorter and less contingent path to college offered by Promise, even though GI Bill benefits outstrip average Promise grants many times over and can be used at a much larger set of colleges and universities.

These findings have implications for other delayed sources of financial aid that require a period of service, for example, in the public sector, with specific firms, or in specific occupations. Finally, our findings also have implications for Armed Forces recruitment, which fell significantly short of its goals in 2022. The so-called "recruiting crisis" may have many demographic, cultural, and economic roots beyond the scope of our analysis (Kesling, 2023; Rogin and Corkery, 2023), but at a minimum, our findings indicate that even small changes in expected tuition can lead large numbers of young adults to choose college over the military as their first destination after high school.

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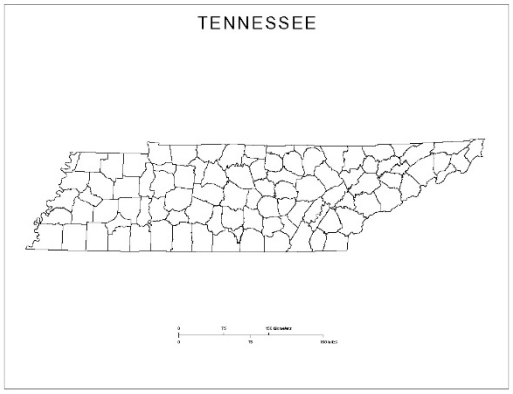
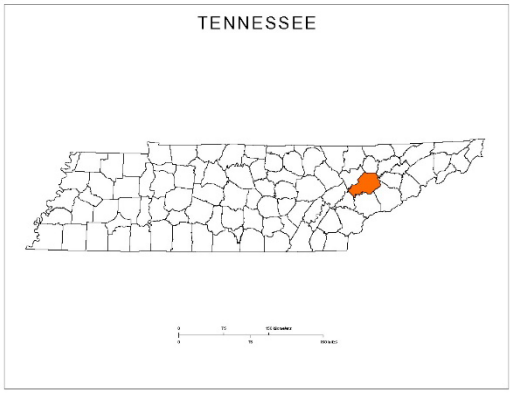
Figure 1. Expansion of the Promise model from 2007-2015

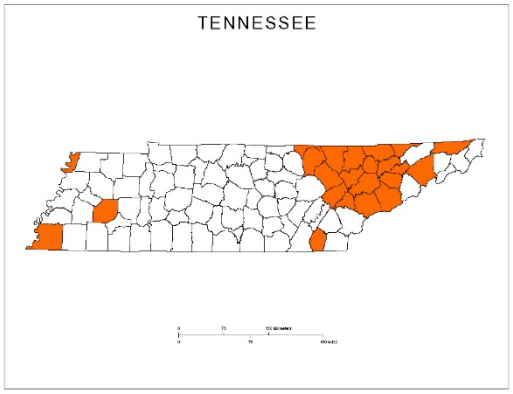
Classes of 2007 and 2008



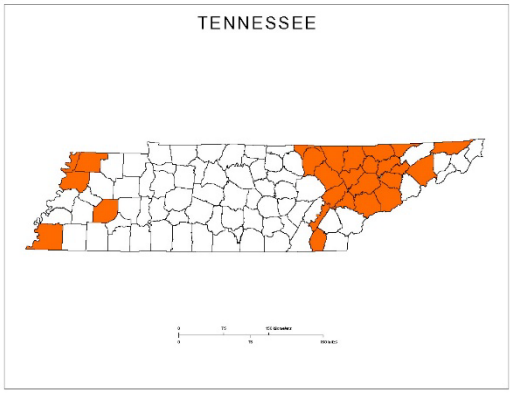
Classes of 2009, 2010, and 2011 (Knox Achieves)



Class of 2012 (tnAchieves)



Class of 2013 (tnAchieves)



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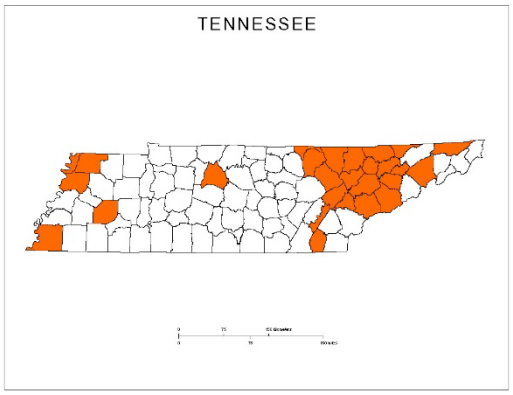


Class of 2015-2017 (Tennessee Promise)

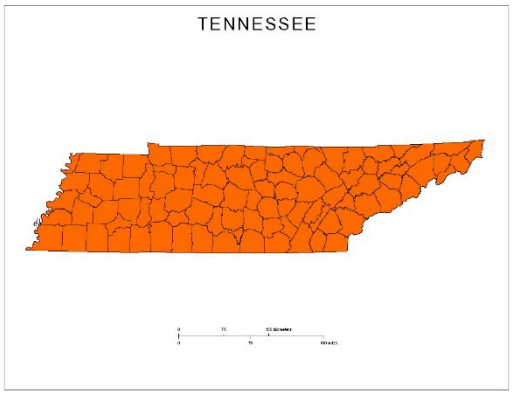
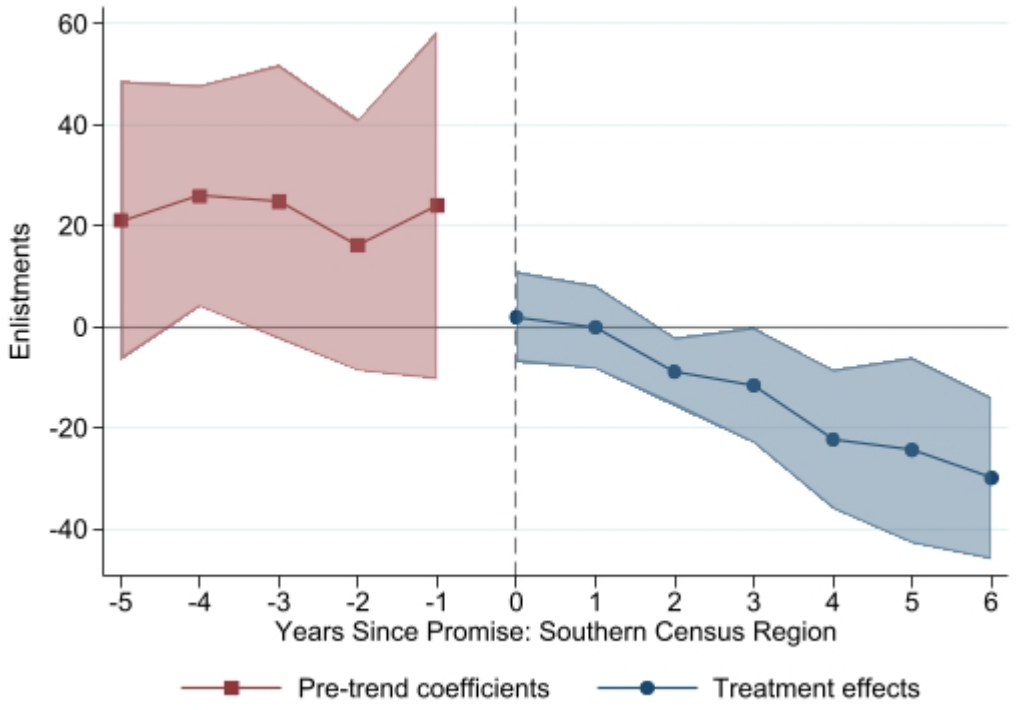


Figure 2. Event study estimates on the effect of free community college on enlistments



Notes: Imputation event study estimates follow Borusyak et al. (2021) and Borusyak (2023).

Table 1: Estimated effects of free community college on enlistment

	(1) All New	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	-8.67**	-5.17**	-2.92**	-0.18	0.22	-0.62***
	(3.50)	(2.02)	(1.45)	(1.73)	(1.02)	(0.24)
	[0.028]	[0.028]	[0.035]	[0.441]	[0.441]	[0.028]
ln(Pop)	230.37	111.40	55.41	34.69	27.29	1.60
	(52.95)	(40.25)	(10.30)	(10.69)	(7.14)	(2.15)
ln(Med Inc)	-175.22	-113.11	-35.37	-16.97	-13.79	4.02
	(107.79)	(62.18)	(23.50)	(12.48)	(12.05)	(2.53)
Unemp	8.40	5.10	1.79	0.73	0.71	0.07
	(6.70)	(3.58)	(1.35)	(0.73)	(0.96)	(0.18)
Poverty	-3.16	-1.87	-0.60	-0.45	-0.30	0.05
	(2.57)	(1.43)	(0.59)	(0.27)	(0.35)	(0.05)
Intercept	-711.93	-63.05	-246.18	-205.19	-137.10	-60.41
	(630.51)	(266.94)	(216.21)	(88.62)	(171.98)	(38.38)
Outcome mean	30.66	11.72	6.49	5.49	6.44	0.52
Outcome s.d.	(77.07)	(29.20)	(18.91)	(12.91)	(17.40)	(1.83)
Obs	18425	18425	18425	18425	18425	18425
R^2	0.98	0.96	0.97	0.96	0.98	0.81

Notes: Authors' calculations. The sample includes all counties in the Southern Census region, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008).
** / ** / *** signifies if the Promise coefficient is statistically significant at 10 / 5/ 1%*

Table 2: Estimated effects of free community college on ASVAB scores

	(1) Overall	(2) GenSci	(3) Arith	(4) Word	(5) Para	(6) Num Ops	(7) Coding	(8) Auto	(9) Math	(10) Electronic	(11) Mech
Promise	0.42***	0.00	-0.41***	0.03	0.12*	0.15	0.29**	0.38***	0.18*	0.08	3.38***
	(0.11)	(0.10)	(0.14)	(0.10)	(0.07)	(0.11)	(0.14)	(0.12)	(0.09)	(0.09)	(0.62)
	[0.001]	[0.375]	[0.007]	[0.312]	[0.092]	[0.121]	[0.057]	[0.005]	[0.057]	[0.200]	[0.001]
ln(Pop)	-0.52	-0.06	0.48	-1.27	-0.08	0.30	-0.60	-2.40	-1.88	-0.87	1.15
	(0.34)	(0.47)	(0.36)	(0.34)	(0.27)	(0.34)	(0.47)	(0.39)	(0.34)	(0.29)	(1.54)
ln(Med Inc)	1.29	0.70	1.02	1.18	0.12	0.73	0.66	0.49	0.81	0.81	6.42
	(0.34)	(0.48)	(0.38)	(0.37)	(0.37)	(0.38)	(0.43)	(0.46)	(0.45)	(0.35)	(1.47)
Unemp	0.01	-0.01	0.01	-0.01	0.01	0.04	0.00	0.03	-0.01	-0.00	0.08
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.06)
Poverty	-0.02	-0.03	-0.01	-0.00	0.00	0.01	-0.03	-0.00	-0.01	-0.00	-0.13
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)
Intercept	44.06	46.71	36.16	53.95	53.12	43.08	51.93	71.41	67.50	54.07	-37.30
	(4.84)	(6.54)	(4.99)	(5.26)	(5.04)	(5.58)	(6.79)	(6.24)	(5.91)	(4.78)	(22.50)
Outcome mean	51.10	53.03	52.44	50.73	53.33	54.38	51.77	48.90	53.15	51.83	41.44
Outcome s.d.	(2.65)	(3.43)	(2.96)	(2.89)	(2.59)	(2.61)	(3.78)	(4.38)	(3.77)	(2.59)	(12.70)
Obs	17623	17623	17623	17623	17623	17623	17623	17623	17623	17623	17623
R^2	0.63	0.51	0.50	0.49	0.32	0.44	0.57	0.72	0.58	0.48	0.50

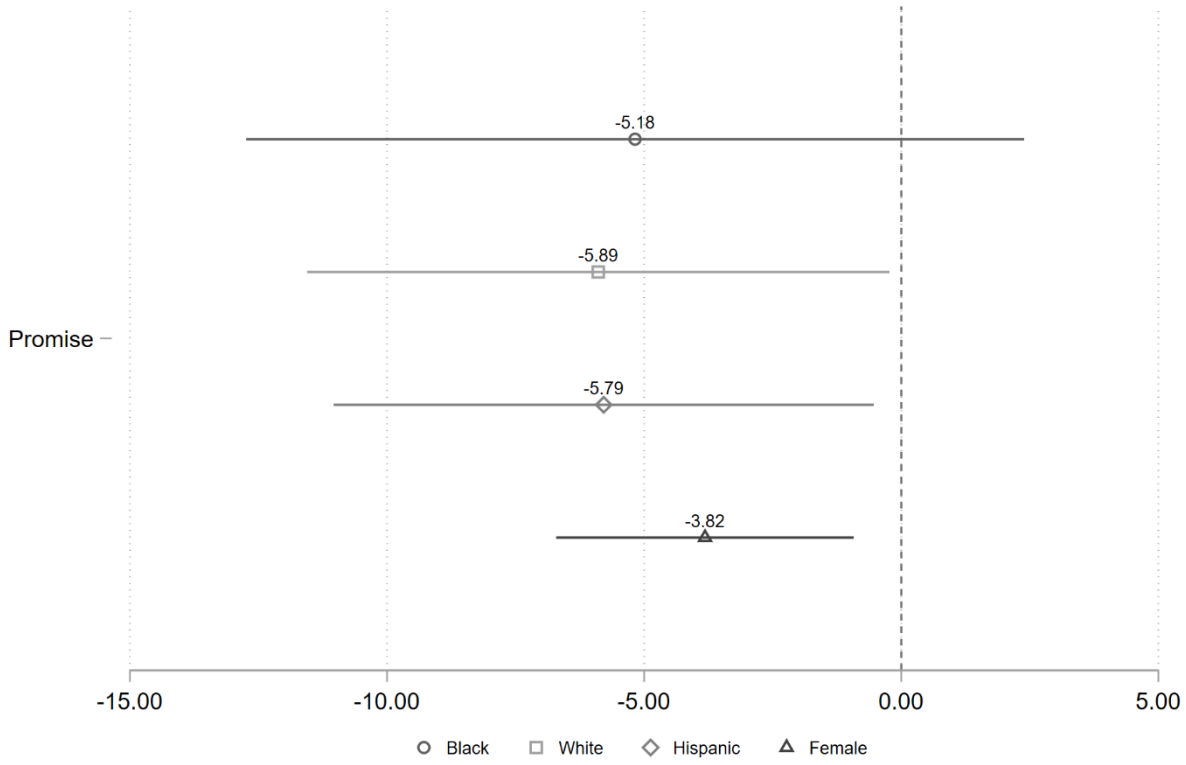
Notes: Authors' calculations. The sample includes all counties in the Southern Census region, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008).
** / ** / *** signifies if the Promise coefficient is statistically significant at 10 / 5/ 1%. Each point estimate represents an ASVAB sub-test including General Science "GenSci", Arithmetic Reasoning "Arith", Work Knowledge "Word", Paragraph Comprehension "Para", Numerical Operations "Num Ops", Coding, Automotive and Shop Information "Auto". Mathematics Knowledge "Math", Electronics Information "Electronic", and Mechanical Comprehension "Mech".*

Table 3: Estimated effects of free community college on applications

	(1) Overall Apps	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	37.36	14.54	8.20	0.47	12.87**	1.28
	(39.99)	(17.27)	(14.05)	(5.00)	(5.69)	(1.73)
	[1.000]	[1.000]	[1.000]	[1.000]	[0.166]	[1.000]
ln(Pop)	-554.16	-249.42	-209.28	-9.98	-75.30	-10.18
	(391.35)	(174.83)	(165.90)	(12.50)	(47.88)	(10.13)
ln(Med Inc)	257.42	43.52	109.26	33.15	59.25	12.25
	(154.33)	(44.55)	(81.07)	(15.30)	(35.22)	(3.62)
Unemp	-3.18	0.67	-3.05	-0.07	-1.18	0.45
	(5.39)	(1.21)	(3.15)	(1.26)	(0.81)	(0.39)
Poverty	5.86	1.69	2.43	0.03	1.66	0.04
	(3.70)	(1.07)	(1.70)	(0.43)	(0.88)	(0.13)
Intercept	4491.40	2805.09	1484.28	-155.95	358.44	-0.46
	(3391.97)	(1894.77)	(1249.17)	(244.29)	(379.13)	(116.89)
Outcome mean	89.47	44.06	16.11	14.06	13.64	1.60
Outcome s.d.	(202.02)	(92.62)	(46.94)	(31.72)	(34.52)	(5.57)
Obs	18879	18879	18879	18879	18879	18879
R^2	0.98	0.97	0.95	0.96	0.98	0.84

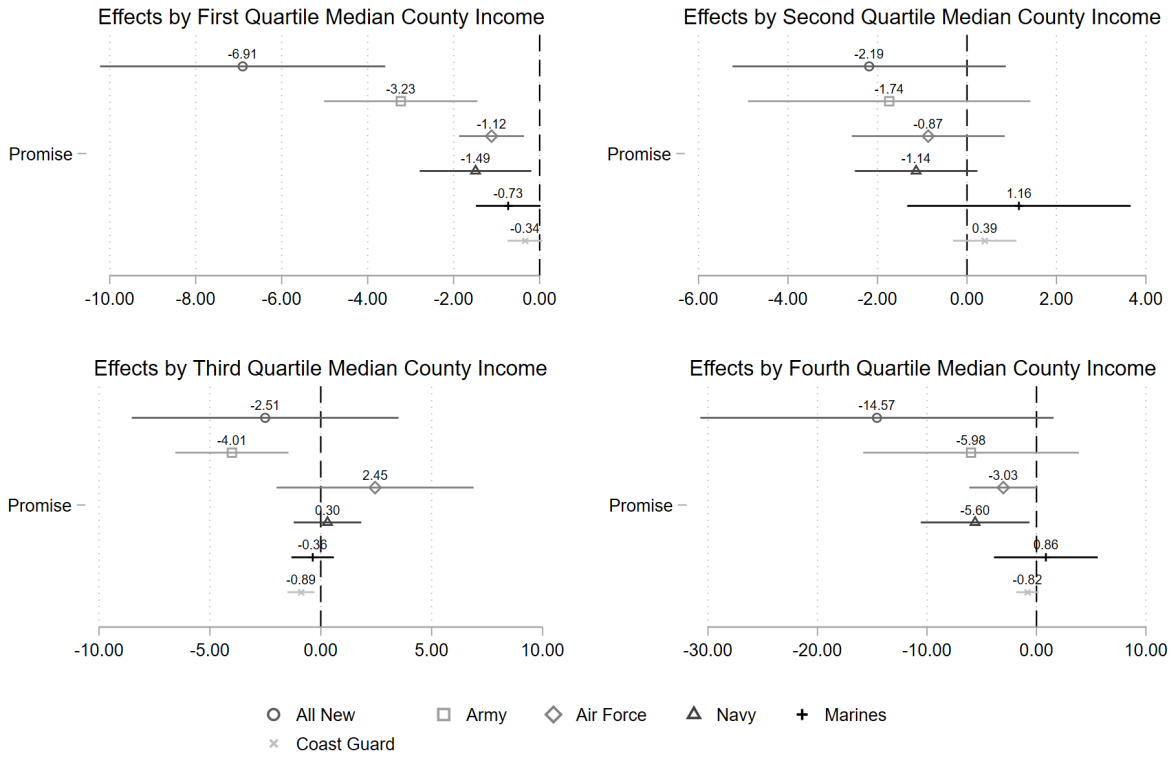
Notes: Authors' calculations. The sample includes all counties in the Southern Census region, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008).
** / ** / *** signifies if the Promise coefficient is statistically significant at 10 / 5/ 1%.*

Figure 3. Effect on Overall Enlistment by Demographic



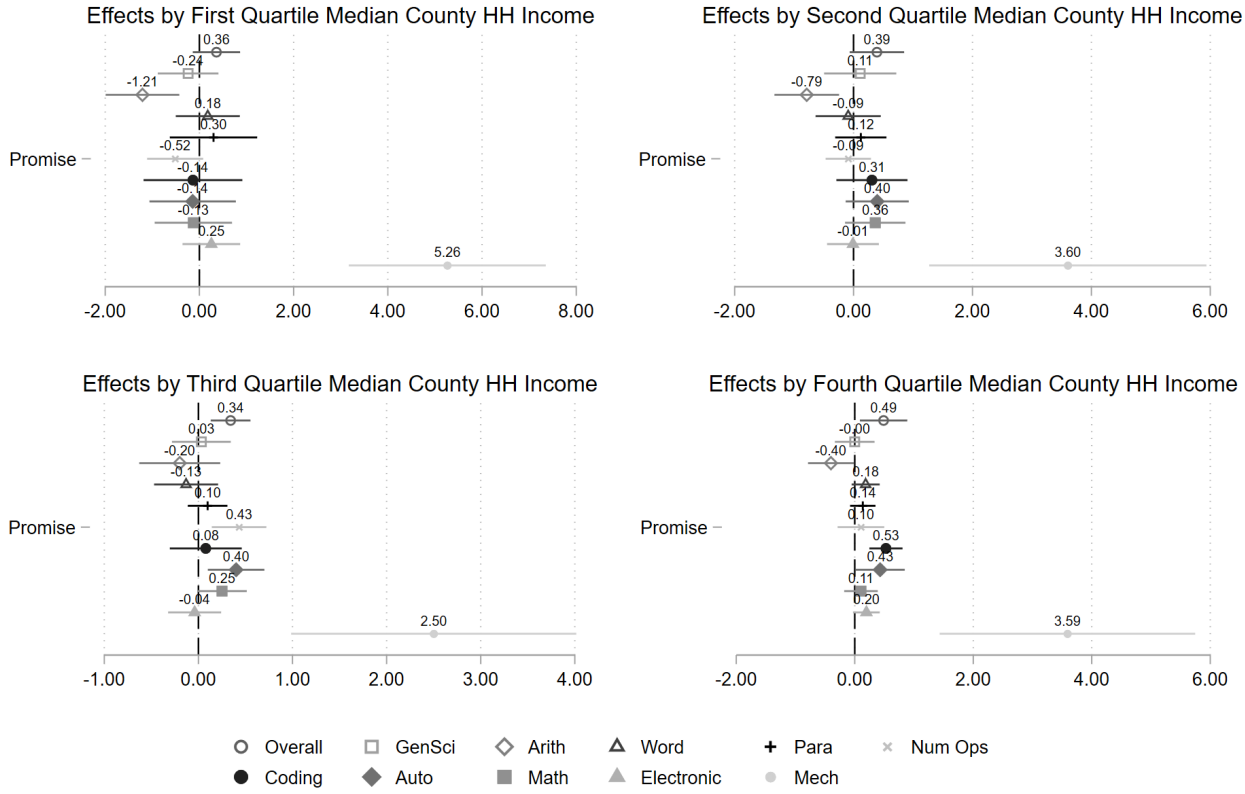
Notes: Coefficient plot estimates using the main specification conditional on each demographic group. The outcome variable is number of enlistments per county. Controls include county fixed effects, year fixed effects, log county population, log county median income, county unemployment rate, and percent of county population under the poverty line.

Figure 4. Effects of Tennessee Promise on Enlistment by Service and Median County Household Income



Notes: Coefficient plot estimates using the main specification conditional on each median county household income quartile. The outcome variable is number of enlistments per county. Controls include county fixed effects, year fixed effects, log county population, log county median income, county unemployment rate, and county percent of population under the poverty line.

Figure 5. Effects of Tennessee Promise on Enlistee ASVAB Subtest by Median County Household Income



Notes: Coefficient plot estimates using the main specification conditional on each median county household income quartile and ASVAB subtest. First quartile is lowest income while fourth quartile is highest income. The outcome variable is number of enlistments per county. Controls include county fixed effects, year fixed effects, log county population, log county median income, county unemployment rate, and county percent of population under the poverty line. Each point estimate represents an ASVAB sub-test including General Science "GenSci", Arithmetic Reasoning "Arith", Work Knowledge "Word", Paragraph Comprehension "Para", Numerical Operations "Num Ops", Coding, Automotive and Shop Information "Auto". Mathematics Knowledge "Math", Electronics Information "Electronic", and Mechanical Comprehension "Mech".

APPENDIX

This appendix reports supplementary detail about student focus groups, focus group participants, and regression results from alternative specifications of Equation (1). First, we include below a relevant excerpt of the semi-structured script for student focus groups.

Now we're going to roll back the clock even further. Think about yourself at this time last year, or even last fall. We're going to talk about the information you received and tasks you completed before going to college in order to get here.

1. *Where did you get information about college while you were in high school?*
2. *What were the most helpful sources of information when [deciding whether or not to go to college / applying to college / applying for financial aid]?*
3. *Was there information or a resource that you didn't have access to that would've been helpful?*
4. *How do you determine which sources of information and support about college and career are trustworthy?*
5. *Thinking back to when you [applied to college/applied for financial aid/registered for coursework], how was the process similar to how you expected it would be? How was it different?*
6. *Were there requirements or things that surprised you as you were considering going to college during high school?*

Students were not prompted to describe their thoughts about military enlistment as a substitute or complement to enrolling in college. They offered these sentiments independently, oftentimes in response to items 1-2.

Table A.1 describes the ten focus group settings and 60 participants. Six institutions were public community colleges, three were Tennessee Colleges of Applied Technology (sub-baccalaureate institutions offering postsecondary certificates and diplomas, but not associate's or higher degrees), and one was a public 4-year institution where Tennessee Promise funds could be used. The ten settings covered a wide range of urbanicity and institution size. Focus groups included 3 – 9 students at each institution, and participants were fairly representative of Tennessee college students, in terms of gender and race.[12]

Estimating samples for our main results included all counties in the Southern Census region, omitting any with their own Promise programs. Tables A.2 – A.4 report Equation (1) results for enlistments, average ASVAB scores, and applications when we narrow the sample to the Southeast division of states, and Tables A.5 – A.7 report results when we broaden to all counties in the U.S. Point estimates for the $Promise_{ct}$ indicator are negative and statistically significant in all three samples, and of a larger magnitude in the Southeast and U.S. samples. Results for ASVAB scores are likewise very similar across samples. Finally, estimated effects on applications are of varying magnitudes but similarly imprecise across Southeast, Southern, and U.S. samples.

Looking across these three estimating samples, we conclude that our takeaways are largely robust to narrower and broader geographic specifications. Our main estimated effects on

[12] Focus group students were 60% female and 28% Black, African-American, or Hispanic, compared with 60% female and 27% non-white in Tennessee community colleges, and 57% female, 29% non-white across all public postsecondary institutions in the state (THEC, 2019).

enlistments might be conservative when evaluated against the South rather than the Southeast or the rest of the U.S.

Finally, Tables A.8 and A.9 report regression results from a differenced version of the Equation (1) levels specification:

$$\Delta y_{sct} = \delta_t + \delta_1 Promise_{ct} + \boldsymbol{\delta_n \Delta X_{ct}} + u_{sct} \quad \text{(A2)}$$

Rather than level outcomes for enlistments and average ASVAB scores, Equation (A1) estimates the effect of Promise availability on the change in those outcomes. County fixed effects are omitted through differencing, and other controls in $\boldsymbol{X_{ct}}$ are differenced as well. We leave $Promise_{ct}$ as a level indicator of program availability, so that $\hat{\delta}_1$ represents the estimated effect of Promise on typical growth in enlistments or average ASVAB scores. Results will help to quantify the time-varying treatment effects we observe in Figure 2 event study estimates.

Turning first to Table A.8, we estimate that access to tuition-free community college through Promise shifts the year-to-year change in enlistments down by 8.5 recruits. This is of a very similar magnitude as the Table 1 estimated effect on level enlistments, but represents a larger cumulative decline in recruits that is consistent with Figure 2. Looking across branches of the military, we estimate that the largest annual declines were in the Army and Navy, although the former is not statistically significant.

Table A.9 reports Equation (A1) results for average ASVAB scores. We find that Promise has no significant effect on the average change in overall ASVAB score for a county's enlistees, with small declines in several subtests offset by growth in average Numeric Operations and Mechanical Comprehension subtests.

Total enlistments in a county are the equilibrium outcome of military needs, managed through quotas and recruiting efforts, and interest in enlisting among the (largely young) men

and women living in that country. This equilibrium changes very little from one year to the next, and in specifications like Equation (1), this means that county fixed effects alone explain over 90% of the variation in enlistment outcomes. With very little variation left to be explained by $Promise_{ct}$, our major empirical concern is that results will be over-fit and sensitive to minor changes in specification. Results presented in this appendix for alternative samples and a differenced specification help to assuage those concerns and lead us to believe that our main Table 1 results are conservative estimates of the potential effect of tuition-free community college on total enlistments.

Table A.1 Description of focus group sample

Sector	Urbanicity	Enrollment	Total Participants	Race/Ethnicity	Gender
Public, 2-year	Suburb: Large	10,000 - 19,999	9	Black/African-American (1); White (8)	Female (6); Male (3)
Public, 2-year	Suburb: Large	5,000 - 9,999	7	Black/African-American (1); Hispanic (1); White (5)	Female (6); Male (1)
Public, 2-year	Rural: Fringe	5,000 - 9,999	2	White (2)	Female (1); Male (1)
Public, Technical	Rural: Fringe	0 - 999	9	White (9)	Female (2); Male (7)
Public, 2-year	City: Small	1,000 - 4,999	3	Black (3)	Female (1); Male (2)
Public, 2-year	City: Small	5,000 - 9,999	9	White (9)	Female (5); Male (4)
Public, Technical	City: Large	1,000 - 4,999	6	Black/African-American (3); White (3)	Female (4); Male (2)
Public, 2-year	City: Large	5,000 - 9,999	6	Black/African-American (3); White (3)	Female (5); Male (1)
Public, 4-year	City: Midsize	10,000 - 19,999	6	Black/African-American (5); White (1)	Female (5); Male (1)
Public, Technical	City: Large	1,000 - 4,999	3	White (3)	Female (1); Male (2)

Note: Institutional sector and urbanicity are derived from IPEDS 2016-2017. Two- and four-year college sizes are derived from IPEDS 2016-2017. Technical college size is derived from THEC 2017 Factbook.

Table A.2: Estimated effects of free community college on enlistment (Southeast states)

	(1) All New	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	-11.54***	-6.46***	-2.55*	-0.34	-1.30	-0.89***
	(3.23)	(1.88)	(1.39)	(1.74)	(0.80)	(0.30)
	[0.002]	[0.002]	[0.053]	[0.164]	[0.067]	[0.005]
ln(Pop)	226.97***	101.14***	51.69***	25.91***	41.37***	6.85**
	(37.72)	(19.77)	(9.94)	(8.60)	(7.41)	(2.67)
ln(Med Inc)	-48.62**	-49.47**	-9.84	3.31	2.06	5.31
	(20.76)	(19.95)	(7.57)	(4.27)	(7.44)	(3.56)
Unemp	1.53**	1.71***	0.23	0.19	-0.39	-0.20*
	(0.62)	(0.62)	(0.21)	(0.22)	(0.26)	(0.12)
Poverty	0.50	0.35	-0.00	-0.04	0.09	0.10*
	(0.54)	(0.23)	(0.20)	(0.11)	(0.15)	(0.06)
Intercept	-2109.28***	-658.42**	-492.65***	-326.95***	-493.97***	-137.28***
	(484.98)	(263.26)	(132.71)	(120.06)	(106.64)	(46.96)
Obs	9594	9594	9594	9594	9594	9594
R^2	0.98	0.95	0.94	0.92	0.96	0.80

*Notes: Authors' calculations. The sample includes all counties in the Southeastern Census division, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A.3: Estimated effects of free community college on ASVAB scores (Southeast states)

	(1) Overall	(2) GenSci	(3) Arith	(4) Word	(5) Para	(6) Num Ops	(7) Coding	(8) Auto	(9) Math	(10) Electronic	(11) Mech
Promise	0.56***	0.11	-0.29**	0.10	0.09	0.23**	0.45***	0.44***	0.20**	0.12	4.10***
	(0.11)	(0.11)	(0.14)	(0.11)	(0.08)	(0.11)	(0.15)	(0.12)	(0.09)	(0.09)	(0.63)
	[0.001]	[0.146]	[0.04]	[0.153]	[0.132]	[0.04]	[0.006]	[0.001]	[0.039]	[0.101]	[0.001]
ln(Pop)	-0.87*	-1.68***	-0.58	-1.66***	0.08	0.04	-1.51**	-3.40***	-2.48***	-1.10***	3.56*
	(0.45)	(0.64)	(0.48)	(0.49)	(0.38)	(0.57)	(0.62)	(0.59)	(0.53)	(0.41)	(2.15)
ln(Med Inc)	0.75*	0.34	0.98**	0.66	0.45	0.58	-0.17	0.82	0.35	0.64	2.81
	(0.45)	(0.66)	(0.49)	(0.50)	(0.46)	(0.53)	(0.58)	(0.66)	(0.64)	(0.46)	(1.88)
Unemp	-0.01	-0.02	0.03*	-0.04*	0.00	0.07***	-0.02	-0.01	0.00	-0.02	-0.12
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.09)
Poverty	-0.01	0.01	0.00	-0.00	-0.00	0.01	-0.01	-0.00	-0.01	-0.00	-0.08
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.05)
Intercept	53.93***	69.44***	48.79***	64.47***	47.83***	47.60***	71.66***	79.85***	79.09***	58.88***	-28.31
	(6.60)	(8.90)	(6.60)	(6.88)	(5.67)	(8.47)	(9.76)	(8.93)	(8.47)	(5.86)	(30.75)
Obs	9366	9366	9366	9366	9366	9366	9366	9366	9366	9366	9366
R^2	0.65	0.54	0.43	0.47	0.33	0.40	0.61	0.74	0.61	0.47	0.48

*Notes: Authors' calculations. The sample includes all counties in the Southeastern Census division, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A.4: Estimated effects of free community college on applications (Southeast states)

	(1) Overall Apps	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	5.60	-3.08	-0.81	0.75	7.77*	0.96
	(27.24)	(10.13)	(8.85)	(5.21)	(4.53)	(1.67)
	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]
ln(Pop)	-84.36	18.46	-44.94	-41.02**	-13.87	-2.99
	(91.62)	(43.35)	(37.15)	(18.10)	(18.35)	(6.42)
ln(Med Inc)	123.22	-2.93	39.47	32.96	40.34	13.38**
	(98.63)	(45.94)	(37.88)	(22.57)	(32.26)	(5.46)
Unemp	-4.29	0.42	-2.08	-0.53	-1.39	-0.71**
	(3.14)	(1.63)	(1.37)	(0.62)	(0.93)	(0.29)
Poverty	-0.37	-0.17	-0.28	-0.05	-0.01	0.15
	(1.16)	(0.64)	(0.36)	(0.33)	(0.32)	(0.11)
Intercept	137.10	-4.71	218.62	211.20	-193.70	-94.31
	(1389.91)	(620.25)	(568.70)	(335.97)	(321.52)	(67.76)
Obs	9758	9758	9758	9758	9758	9758
R^2	0.97	0.96	0.92	0.91	0.94	0.88

*Notes: Authors' calculations. The sample includes all counties in the Southeastern Census division, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A5: Estimated effect of free community college on enlistment (U.S.)

	(1) All New	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	-16.32**	-5.82**	-8.36***	-0.73	-0.99	-0.42**
	(6.36)	(2.82)	(2.58)	(1.66)	(1.43)	(0.20)
	[0.027]	[0.041]	[0.008]	[0.283]	[0.244]	[0.041]
ln(Pop)	279.34***	122.54***	78.38***	33.70***	44.02***	0.69
	(67.85)	(36.39)	(24.66)	(9.49)	(13.34)	(1.94)
ln(Med Inc)	-167.33**	-85.91**	-36.84**	-24.16***	-24.26*	3.84*
	(71.27)	(40.22)	(15.96)	(9.36)	(13.94)	(2.10)
Unemp	3.04	2.50	0.22	0.53	-0.26	0.06
	(3.61)	(1.78)	(0.97)	(0.38)	(0.79)	(0.11)
Poverty	-3.24*	-1.51	-0.94*	-0.32	-0.45	-0.02
	(1.89)	(0.99)	(0.57)	(0.20)	(0.31)	(0.04)
Intercept	-1381.29**	-491.29**	-502.69*	-116.90*	-223.21	-47.19
	(677.41)	(237.88)	(273.53)	(68.12)	(172.29)	(32.22)
Obs	38399	38399	38399	38399	38399	38399
R^2	0.98	0.97	0.96	0.97	0.98	0.81

*Notes: Authors' calculations. The sample includes all U.S. counties, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A.6: Estimated effects of free community college on ASVAB scores (U.S.)

	(1) Overall	(2) GenSci	(3) Arith	(4) Word	(5) Para	(6) Num Ops	(7) Coding	(8) Auto	(9) Math	(10) Electronic	(11) Mech
Promise	0.37***	0.15	-0.42***	0.06	0.12*	-0.16	0.35***	0.46***	0.27***	0.10	2.80***
	(0.09)	(0.09)	(0.13)	(0.09)	(0.07)	(0.11)	(0.12)	(0.11)	(0.09)	(0.08)	(0.61)
	[0.001]	[0.064]	[0.003]	[0.16]	[0.064]	[0.089]	[0.005]	[0.001]	[0.004]	[0.119]	[0.001]
ln(Pop)	-0.75***	0.64*	0.50*	-1.03***	0.05	-1.28***	-0.24	-1.87***	-1.50***	-0.65***	-2.13
	(0.27)	(0.38)	(0.29)	(0.26)	(0.22)	(0.32)	(0.39)	(0.34)	(0.28)	(0.23)	(1.30)
ln(Med Inc)	1.39***	0.66**	1.52***	0.66**	0.24	1.32***	0.92**	1.03***	0.97***	0.52**	6.04***
	(0.27)	(0.33)	(0.31)	(0.27)	(0.25)	(0.39)	(0.38)	(0.35)	(0.32)	(0.24)	(1.26)
Unemp	0.02***	0.01	0.02**	-0.01	0.00	0.00	0.03**	0.04***	0.02	-0.01	0.13**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)
Poverty	-0.01*	-0.02**	0.00	-0.01	0.00	0.03***	-0.02	-0.00	-0.01	-0.01	-0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)
Intercept	46.21***	38.66***	30.48***	57.28***	50.35***	56.17***	44.99***	60.14***	61.75***	54.92***	7.35
	(3.88)	(5.12)	(4.41)	(3.95)	(3.67)	(5.14)	(5.55)	(4.99)	(4.47)	(3.51)	(19.12)
Obs	35521	35521	35521	35521	35521	35521	35521	35521	35521	35521	35521
R^2	0.62	0.51	0.43	0.48	0.28	0.40	0.58	0.75	0.61	0.46	0.50

*Notes: Authors' calculations. The sample includes all U.S. counties, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A7: Estimated effect of free community college on applications (U.S.)

	(1) All New	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	49.16	23.59	1.12	6.68	16.16***	1.61
	(38.23)	(16.10)	(11.93)	(6.40)	(5.60)	(1.64)
	[0.485]	[0.485]	[0.644]	[0.485]	[0.025]	[0.485]
ln(Pop)	-645.23*	-306.54*	-185.36	-43.82*	-91.93**	-17.58*
	(335.32)	(161.64)	(134.42)	(26.53)	(44.09)	(9.01)
ln(Med Inc)	125.44	30.56	45.07	19.91	17.62	12.30**
	(111.18)	(49.13)	(54.81)	(16.82)	(26.72)	(5.71)
Unemp	-1.47	-0.87	-2.54	1.98	-0.36	0.32
	(4.25)	(1.54)	(1.82)	(1.78)	(0.63)	(0.31)
Poverty	4.28	1.63	1.43	0.22	1.09*	-0.10
	(3.49)	(1.71)	(1.05)	(0.66)	(0.66)	(0.10)
Intercept	7024.18**	3648.53**	1883.36*	385.68	1016.00***	90.60
	(3134.90)	(1686.95)	(1119.15)	(286.00)	(370.19)	(99.58)
Obs	39088	39088	39088	39088	39088	39088
R^2	0.98	0.97	0.96	0.95	0.98	0.84

*Notes: Authors' calculations. The sample includes all U.S. counties, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1 according to traditional p-values.*

Table A8: Estimated effect of free community college on changes in enlistment (Southern states)

	(1) All New	(2) Army	(3) Navy	(4) AF	(5) Marines	(6) C. Guard
Promise	-8.51**	-2.16	-3.98**	-1.30**	-0.95**	-0.11
	(4.20)	(1.93)	(1.60)	(0.64)	(0.45)	(0.10)
	[0.069]	[0.1]	[0.069]	[0.069]	[0.069]	[0.1]
Log Pop	43.46	24.92**	-11.91	19.86**	1.83	8.76*
	(59.19)	(10.27)	(38.83)	(8.10)	(14.81)	(4.73)
Log MedInc	-15.86	-17.36	2.83	-2.65	1.19	0.12
	(20.91)	(18.38)	(4.34)	(4.15)	(4.47)	(1.45)
Unemp Rate	5.47*	3.61*	0.61*	0.14	0.93	0.18
	(2.95)	(2.04)	(0.32)	(0.41)	(0.67)	(0.15)
Poverty %	-1.67	-0.88	-0.38	-0.14	-0.28*	0.00
	(1.18)	(0.62)	(0.42)	(0.09)	(0.15)	(0.03)
Intercept	3.98*	2.06*	1.38**	0.31	0.38	-0.15*
	(2.31)	(1.13)	(0.69)	(0.27)	(0.31)	(0.09)
Obs	17102	17102	17102	17102	17102	17102
R^2	0.15	0.15	0.10	0.07	0.13	0.08

*Notes: Authors' calculations. The sample includes all counties in the Southern Census region, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1*

Table A9. Estimated effect of free community college on changes in ASVAB scores (Southern states)

	(1) Overall	(2) GenSci	(3) Arith	(4) Word	(5) Para	(6) Num Ops	(7) Coding	(8) Auto	(9) Math	(10) Electronic	(11) Mech
Promise	0.08	-0.03	0.02	-0.02	0.00	0.10***	0.10	0.06	-0.00	-0.01	0.60***
	(0.05)	(0.06)	(0.06)	(0.05)	(0.03)	(0.04)	(0.07)	(0.05)	(0.06)	(0.04)	(0.19)
	[0.49]	[1.00]	[1.00]	[1.00]	[1.00]	[0.067]	[0.526]	[0.673]	[1.00]	[1.00]	[0.018]
ln(Pop)	-0.15	0.61	1.08*	-0.34	-0.58	0.31	-0.91	-0.75	-0.60	-0.43	0.14
	(0.52)	(0.73)	(0.65)	(0.63)	(0.53)	(0.61)	(0.77)	(0.78)	(0.76)	(0.54)	(2.42)
ln(Med Inc	-0.48	-1.04**	-0.12	-0.33	-0.37	0.19	-1.25**	-1.06*	-0.68	-0.37	0.19
	(0.35)	(0.47)	(0.43)	(0.40)	(0.40)	(0.38)	(0.52)	(0.55)	(0.51)	(0.37)	(1.69)
Unemp	0.00	-0.02	-0.00	-0.02	0.01	-0.01	0.01	0.02	0.01	-0.01	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.08)
Poverty	-0.00	-0.01	-0.01	-0.00	0.01	0.01	-0.00	0.01	-0.01	-0.00	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.05)
Intercept	-0.06***	0.04***	-0.05***	0.03***	0.01	-0.02*	-0.12***	-0.26***	-0.08***	0.02**	-0.19***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.05)
Obs	15878	15878	15878	15878	15878	15878	15878	15878	15878	15878	15878
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02

*Notes: Authors' calculations. The sample includes all counties in the Southern Census region, excluding those with their own Promise programs. Standard errors are in parentheses. Sharpened two-stage q-values are shown in brackets (Benjamini, Krieger, and Yekutieli, 2008; Anderson, 2008). *** p<.01, ** p<.05, * p<.1*