College Affirmative Action and Students' Long-Term Outcomes: A Matter of the Dose*

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Abstract

Affirmative action (AA) remains one of the most contested policies, even when focusing on its effects on its intended beneficiaries. In higher education, proponents argue that AA expands access to high-quality colleges for disadvantaged students; critics argue that AA can generate student–institution mismatch and potentially harm these students. There is likely truth to both sides of the argument; instead of a dichotomous view, a more relevant discussion is the appropriate dose of AA. We exploit the combination of centralized college admissions and AA policies in China, with transparent and continuously varying (effective) doses of AA for ethnic minorities. Leveraging year-to-year variation in the effective doses of AA within county-ethnicity cells, we find that minority students receiving higher AA doses are more likely to be admitted to college in general and to elite colleges, but are more likely to enroll in lower-earning majors. In terms of long-run consumption, the dose response of AA is hump-shaped: relative to their counterpart receiving a zero AA dose, minority students receiving low AA doses (bottom quintile) experience a 15% *increase*, those receiving the middle two quintiles of AA doses experience no detectable effect, and those receiving high AA doses (top two quintiles) incur a more than 17% *decline*. Survey evidence further shows that higher AA doses are associated with poorer in-college performance and lower satisfaction with interpersonal relationships and overall college life.

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1 Introduction

Affirmative action (AA) remains one of the most contested public policies for addressing historical disadvantage and promoting equality. Putting aside the fact that AA shifts scarce resources away from non-targeted groups and focusing on the well-being of the targeted groups, views on AA are still split. Proponents argue that AA expands opportunities for historically marginalized groups; critics argue that AA can produce unintended consequences for intended beneficiaries. In the context of higher education, which we study here, the leading concern is "mismatch," where students with weak preparation may fare poorly in the challenging environment of selective colleges, and they would be better off in less-challenging colleges that better match their academic preparedness.

It is hard to settle this debate because there is likely truth to both sides of the argument: both a college's overall quality and the student-college match quality may matter for a student's outcome. Therefore, instead of taking a dichotomous view, a more relevant discussion should focus on the appropriate dose of AA. Intuitively, modest AA may expand access without substantial mismatches, while more aggressive AA could place weaker students in environments where the costs of poor fit outweigh the benefits of college quality. Despite its appeal, this dose-based perspective remains to be examined empirically due to data limitation. In many settings, AA operates through opaque or institution-specific mechanisms, e.g., holistic admissions in U.S. universities, making the magnitude of AA difficult to quantify (Bagde et al., 2016). In other settings, AA policies are transparent but with limited, typically binary, variation, as in cases of policy adoption or repeal. These limitations have left the central question of the appropriate dose of affirmative action largely unanswered.

In this paper, we take a step toward answering this question by studying a major nationwide AA program in China, the ethnic minority bonus-point policy in the College Entrance Examination (CEE), and examining how this policy affected beneficiaries' short- and long-run outcomes. The design of China's college admissions and AA policies, combined with rich administrative college enrollment data and later-life consumption data, provides us

with three important research advantages relative to most previous studies of AA.

First, AA in our setting operates through a centralized rather than institution-specific or discretionary mechanism. Minority students receive explicit bonus points added directly to their CEE scores. One's total score, in turn, determines one's priority in the transparent, centralized province-track-specific admissions mechanism. In other words, AA bonus points generate a clear and well-defined advantage for minority students, allowing us to precisely characterize how AA expands students' access to various college programs.

Second, although nominal bonus points are often fixed within county-ethnicity groups, their effective value varies continuously over time due to cohort-specific fluctuation in score distributions and admission cutoffs. As such, the same nominal bonus can generate differential advances along the total score distribution. This institutional feature creates plausibly exogenous AA dose variation within narrowly defined cells, enabling us to move beyond the dichotomous view of AA and instead study how outcomes vary with AA doses.

Third, our data follow students far beyond college entry and cover comprehensive measures of long-run economic well-being. Our data is an individual-level panel that matches administrative CEE records for 1999-2003 test-taking cohorts to their consumption data from UnionPay between 2013 and 2022, i.e., 10-23 years after high-school graduation. UnionPay is one of China's dominant payment networks, capturing a substantial share of retail transactions nationwide (Barwick et al., 2024; Lai et al., 2022), and its data provide a rich and comprehensive measure of individual consumption. Combined with detailed information on college programs and peer rankings, this data allows us to track both admitted and non-admitted students into adulthood and to analyze how variation in AA doses shapes minority students' educational trajectories and long-run economic outcomes.

Our empirical design operationalizes AA doses using year-to-year fluctuations in the effective value of bonus points within narrowly defined county-ethnicity-track cells. Specifically, we measure the AA dose as the ratio of nominal bonus points to the standard deviation of the CEE score distribution within a province-cohort-track cell, so that the same nominal

bonus can translate into different effective advantages across years. Identification comes from temporal variation in this dose within each cell that holds fixed all time-invariant characteristics of counties, ethnic groups, and exam tracks. Our estimation follows the re-centering approach by Borusyak and Hull (2023) and relies on the assumption that year-to-year variation in AA doses for a given minority in a given county is as good as random, conditional on the flexible fixed effects we include. To validate this identifying assumption, we show that, conditional on all the fixed effects, CEE rankings are not associated with within-cell variation in AA doses.

Our analysis reveals three key findings. First, higher AA doses expand access to colleges, but potentially at the cost of mismatches. A 0.1 increase in AA doses (equivalent to 10-bonus-point over mean of standard deviation of CEE scores) raises the probability of admissions to college by 2.7 percentage points (ppts) and to Tier-1 (elite) colleges by 1.1 ppts, and improves first-choice admission by 3.0 ppts. Meanwhile, A 0.1 increase in AA doses lowers students' relative ranking among peers by about 2.0 ppts (13.5% of the sample s.d.) and shifts them away from entering a top-three-earning major by 0.7 ppts and into a bottom-three-earning major by 1.8 ppts (15% of the sample mean).

Second, higher AA doses have substantial and highly non-linear effects on long-run economic outcomes. On average, higher AA doses reduce long-term consumption and income. Yet, the dose makes a critical difference: students receiving the bottom quintile of AA doses experience sizable gains, with long-run consumption increasing by 15%, those in the middle two quintiles show no detectable effects, while students receiving the top two quintiles of AA doses suffer large losses, with long-run consumption declining by more than 17%. In addition, within each quartile of CEE score distribution, the overall nonlinearity pattern is consistent. These effects are remarkably persistent, remaining stable over 10-23 years after high-school graduation, and are especially pronounced among males and students from rural areas or lower-quality high schools.

One potential concern is that the large negative consumption effects observed at high AA

doses may simply reflect differences in residential location and living costs. However, our evidence shows that higher AA doses, which decrease consumption, increase the likelihood of residing in high-cost cities. Another concern is that higher AA doses, by enabling access to better colleges and financial training, may raise financial sophistication and increase savings/investment, resulting in lower consumption. We find no support for this channel: higher AA doses are associated with lower long-run expenditure on financial products, suggesting that changes in saving/investment behavior are unlikely to explain the consumption effects we document.

Third, to better understand how AA affects students' (short-run) subjective well-being, we turn to evidence from the China College Student Survey (CCSS), which provides rich information on students' academic performance and subjective well-being. Given the relatively small sample size, we adopt a propensity score matching design to compare students with similar pre-college characteristics. The results show that higher AA doses are associated with lower in-college GPA ranking relative to peers. Moreover, students exposed to higher AA doses report significantly lower satisfaction with interpersonal relationships and overall college life.

Our paper contributes to the extensive literature on AA in higher education, where there has been a long debate about the effects of AA on its intended beneficiaries. On the one hand, a growing body of evidence shows that AA expands access to higher-quality colleges, increases college attendance and completion, and improves early- and mid-career labor market outcomes and socioeconomic mobility (Bagde et al., 2016; Estevan et al., 2019; Bleemer, 2022; Black et al., 2023; Bleemer, 2023; Akhtari et al., 2024; Bleemer, 2024; Machado et al., 2025). On the other hand, the mismatch hypothesis emphasizes a trade-off between institutional quality and academic fit, arguing that stronger AA may lead to poorer academic performance, lower persistence, and reduced degree completion when students are placed in environments for which they are underprepared (Arcidiacono et al., 2011, 2016; Arcidiacono and Lovenheim, 2016; Barrow et al., 2020; Dillon and Smith, 2020). By exploiting the

transparent and continuous variation in the effective doses of AA, our paper reconciles these seemingly conflicting views and shows that the ultimate effect of AA depends on its dose, as well as the college preparedness of its intended beneficiaries.

Existing work on AA has focused primarily on academic performance, persistence, and degree completion, with little direct evidence on students' subjective experiences on campus (Bertrand et al., 2010; Francis and Tannuri-Pianto, 2012; Arcidiacono et al., 2014; Arcidiacono and Lovenheim, 2016; Bagde et al., 2016; Bleemer, 2022). Using data from the China College Student Survey (CCSS), which contains rich information on academic outcomes as well as student satisfaction and campus life, we provide direct evidence on how the dose of AA shapes students' subjective well-being while enrolled. Complementary to existing measures, including academic and economic outcomes, this well-being measure adds to a comprehensive understanding of the effect of AA.

The remainder of the paper proceeds as follows. Section 2 describes the background. Section 3 presents a simple model to illustrate the role of AA in a student's college choice and achievement. Section 4 introduces the data and defines our AA-dose measure. Section 5 presents the empirical strategy. Section 6 reports the main results and robustness checks. Section 7 shows how the dose of AA shapes students' subjective well-being in college. Section 8 concludes. Additional materials are in the appendices.

2 Background Information

2.1 Chinese Colleges and Admissions

College Tiers Chinese higher education consists of two categories of colleges: colleges granting Bachelor's degrees, and those granting Associate degrees (vocational colleges). Within the first category, colleges are stratified into tiers. During our study period, programs in the most selective institutions, Tier-1 colleges (closely overlapping with the 115 "Project 211" universities), admitted roughly the top 14% of examinees. Within each tier,

colleges also differ by peer quality (measured, for example, by admitted students' CEE ranking), program quality, and the economic characteristics of their host cities—all of which matter for human-capital accumulation and career opportunities.

College Entrance Exam China's national college entrance examination (CEE) is the decisive gatekeeper for higher education. Each year, approximately 10 million high school graduates took the exam, typically in one of a few tracks (principally Science or Social Science). The Science track generally included physics, chemistry, and biology, while the Social Science track covered history, politics, and geography. Within the CEE system, most provinces in our sample used the uniform national exam papers, while some provinces designed their own exam papers. Nevertheless, CEE scores are comparable within a province-year-track cell.

Unlike admission systems that weigh grades, extracurriculars, and holistic reviews, a student's CEE score—the sum of her scores in her track-specific CEE tests—plays a nearly exclusive role in determining college placement, leaving little room for discretion in admissions, as we describe next.

College Admissions College admissions are centrally administered each year at the provincial level. In each province, students apply within their chosen track by submitting a rank-ordered list of college programs (college-major combinations); admissions are program-specific. In a typical year-province, the total number of college programs a student can apply to is about 20,000. Among 96 majors, we group them into 10 coarser major groups, including Agriculture, Economics, Education, Engineering, Health, History, Law, Literature, Management, and Science.

Admissions to college programs are determined by applicants' rankings based on their total CEE scores, inclusive of bonus points, and by program-specific capacity constraints, through centralized matching mechanisms that vary across provinces and over time. During our sample period, two broad classes of mechanisms were in place. Under the sequential mechanism, a variant of the Boston or immediate acceptance mechanism, programs first

admit applicants who rank them as their top choice and consider lower-ranked applicants only if seats remain. By contrast, the Chinese "parallel" mechanism allows applicants to list multiple programs within a choice band and is designed to reduce manipulability and strategic risk. Detailed descriptions of these mechanisms are provided in Wu and Zhong (2014); Chen and Kesten (2017).

These assignment rules do not generally induce truthful preference revelation, and applicants may behave strategically when constructing their rank-ordered lists. Because our data record realized admission outcomes but not applicants' submitted preference lists, we do not analyze application behavior directly. Instead, we focus on the reduced-form effects of affirmative action on college enrollment, major assignment, and subsequent outcomes, abstracting from the strategic considerations underlying students' application choices.

2.2 Minority Bonus Points

Alongside these institutional features, the central and provincial governments operate several preferential mechanisms; the most widespread is ethnic-minority CEE bonus programs.[1] Since the early 1980s, government-determined eligible ethnic minority candidates have frequently received nominal extra points (commonly in the range of 5-30 points) added to their CEE scores; the (post-bonus) total score is the sole criterion differentiating students in college admissions.

The bonus program is administered at the county-ethnicity level and typically applies uniformly to all qualifying candidates in a region, where the qualification criteria and the bonus points are set by the provincial government. Figure A.1 shows that, consistent with the intended goal of equalizing opportunities, bonus points are positively correlated with local illiteracy rates and ethnic minority shares, and negatively correlated with GDP per capita.

The nominal bonus points awarded to an ethnic minority group in a county are typically

[1] Other major programs include bonus points for athletic achievement and for winning National Academic (e.g., Math and Physics) Competition.

fixed. However, due to variation in specific exam questions, the overall CEE exam difficulty varies across years, and so does the distribution of CEE scores. As such, a fixed nominal CEE score maps into different admission advantages across province-cohorts: a given nominal bonus yields a larger (smaller) advantage in a relatively difficult-test or low-scoring (easy-test or high-scoring) province-cohort. These subtle, continuously varying effective bonus values are the main source of variation we exploit in our analysis.

In addition, we also utilize a salient institutional change that occurred in Jiangsu province. In 2001, the provincial government introduced a sharp increase in minority bonus points. Prior to 2001, ethnic minority students in Jiangsu were not eligible for any bonus under the general college admissions track. Beginning in 2001, the province implemented a uniform five-point bonus for all students officially registered as ethnic minorities. This reform marked a clear shift from zero to positive treatment for affected groups and created a discrete break in bonuses across cohorts.

In the following, we first illustrate the effect of AA through the lens of a simple model. Then, we empirically examine AA dose effects by exploiting the aforementioned institutional features: (i) a single score that largely determines admission, (ii) an expansive choice set of college-major programs, and (iii) explicit minority bonuses.

3 A Simple Model

This section presents a bare-bones model of a student's college choice and achievement. Relative to the empirical setting we study, the model is rather simplified, nevertheless, it delivers the essential idea of how AA might affect these outcomes. Extension of this model to a richer setting is relatively easy, but at the cost of heavier notation. For example, students' ability is modeled as a scalar, which can be easily extended to explicitly account for multi-dimensional abilities and students' college-major choices.

3.1 Primitives

There is a continuum of potential college enrollees of measure 1, each endowed with a group identity $g_i \in (0, 1)$ with 1 being minority, ability a_i, and preferences for different colleges. There are J colleges, each endowed with a quality q_j and a capacity n_j, with $\sum_j n_j < 1$, i.e., the number of students exceeds the total capacity. An outside option is available to all students.

Ability and Test Scores Students' ability is unknown to both students and colleges, who observe a test score s_i—an unbiased measure of a_i. The precision of s_i as a measure of a_i can be group-specific. If minorities face larger uncertainties about their ability, s_i would have a larger dispersion around a_i for $g_i = 1$.

Human Capital Production For a student i enrolled in college j, her human capital attainment is a function of her own ability a_i and the college's quality q_j, subject to a random shock $\epsilon_{ij,}$ such that

$$h_{ij} = H(q_j, a_i, \epsilon_{ij}) = \gamma_1 q_j + \gamma_2 a_i + D_h\left(q_j - a_i\right) + \epsilon_{ij}, \tag{1}$$

where $D_h\left(q_j - a_i\right)$ is a flexible function of the distance between q_j and a_i, capturing the effect of match quality in producing human capital. Most relevant to the "mismatch" argument against AA is the potential negative effect arising from "overmatch", i.e., when $q_j - a_i > 0$.

In-College Utility: The net consumption value of a college depends on college quality, student-college match, student group identity, and one's taste η_{ij}, given by

$$u_{ij} = U_{g_i}(q_j, a_i, \eta_{ij}) = \lambda_{g_i} q_j + D_u\left(q_j - a_i, g_i\right) + \eta_{ij}. \tag{2}$$

The utility function is allowed to vary by group status g. The coefficient λ_g captures the net consumption value for college quality (e.g., preference for quality net of price); the function

$D_u\left(q_j - a_i\ , g_i\right)$ captures the effect of match quality on one's utility, also allowed to vary with g.

3.2 Students' College Choices

In the centralized system, admissions are subject to college-specific cutoffs on test scores $\left\{s_j^*\right\}_j$: student i is eligible for college j if $s_i \geq s_j^*$. We present the model assuming students have rational expectations of $\{s_j^*\}_j$ and abstract from potential application mistakes arising from mis-forecast of cutoffs. As such, this simple model focuses on informational friction with respect to one's ability and match quality.

A student chooses the option yielding the highest expected payoff among the colleges she is eligible for and the outside option, i.e.,

$$\max\{\max_{j|s_i \geqslant s_j^*}\left\{\tilde{E}_{g_i}[(U_{g_i}(q_j, a_i, \eta_{ij}) + \beta H(q_j, a_i, \epsilon_{ij}))|s_i]\right\}, \tilde{E}_{g_i} V_0\left(g_i, a_i|s_i\right)\}. \tag{3}$$

In making her decision, given that ability a_i is unknown to the student, she needs to form expectations about it using information available—her test score s_i. This expectation may differ from the objective expectation; we use $\tilde{E}$ to denote the subjective expectation operator and allow it to differ by group identity. Similarly, she forms expectations about her outside option $V_0(\cdot)$, which is a function of her characteristics.

If students have correct beliefs about the distribution of their ability, but do not know their ability level when making college choices, their choices can be ex-post regrettable. If students' subjective beliefs about their own ability deviate from the objective distribution, it increases the probability of ex-post regrettable choices; specifically, an overly optimistic (pessimistic) student is more likely to choose an overmatched (undermatched) college.[2]

[2]Prior studies (Stinebrickner and Stinebrickner, 2012; Bobba and Frisancho, 2022; Aucejo and Wong, 2025; Aucejo et al., 2025) find that disadvantaged students (e.g., low-income, low-performing, or first-generation college students) have more biased (overly optimistic) beliefs about their ability.

3.3 Model Implications

This model captures the arguments on both the positive and negative sides of the AA debate. AA gives a bonus point b to a minority student and expands her choice set from $\{j|s_i \geq s_j^*\}$ to $\{j|s_i + b \geq s_j^*\}$.

On the affirmative side, AA expands a student's option set to include more higher-quality colleges, which can improve a student's achievement, through the effect of q_j on h_{ij} in Equation (1)), as well as her non-pecuniary well-being, through the effect of q_j on u_{ij} in Equation (2). On the negative side, information friction with respect to one's ability a_i can lead a student to mis-predict how well she is matched to various colleges; this can hurt her achievement, through $D_h(\cdot)$ in Equation (1)), as well as her non-pecuniary well-being, through $D_u(\cdot)$ in Equation (2).

For a given dose of AA, whether AA would improve or hurt the economic well-being of its intended beneficiaries depends on several factors. First, the relative importance of college quality and match quality for one's achievement (Equation (1)). Second, the degree of uncertainties over one's ability and/or the deviation of one's subjective belief from the truth, which govern the likelihood of ex-post regrettable decisions. Third, the relative importance of non-pecuniary consumption value of a high-quality college (λ_g in Equation (2)), which can be large in the Chinese setting.[3]

Holding these primitives fixed, the effect of AA on its intended beneficiaries varies with its dose: a larger dose b expands one's choice set to include higher-quality colleges, but it also increases the probability that a student is over-matched. We examine how the dose of AA affects one's educational and long-term economic outcomes, using our main data, and one's (in-college) non-pecuniary well-being, using our supplementary survey data.

[3]Even in the absence of information friction, a large λ_g can lead a student to choose a high-quality college with lower economic payoffs (Oreopoulos and Salvanes, 2011; Gong et al., 2019; Aucejo et al., 2023).

4 Data

We get access to students' administrative records from the College Entrance Examination (CEE) pre-merged with consumption data from the UnionPay (our data provider). For matched individuals, we observe their CEE scores, demographic characteristics, college admission outcomes, and detailed expenditure data spanning 10 to 23 years after high-school graduation.

4.1 College Entrance Examination Data

The core dataset covers the universe of students who took CEE between 1999 and 2003. For each test taker, we observe their demographics (gender, ethnicity, urban/rural hukou), exam year and county, academic track, raw CEE score and bonus points, an indicator for retaking the CEE, and a set of admission outcomes: the college-major that admitted the student, whether or not that college was the student's first choice on her preference list.

While the CEE administrative data report the bonus points awarded to each student, they do not disclose the reason for receiving the bonus. To isolate bonuses stemming from ethnic minority status, we undertook extensive archival work to collect official bonus point policies across provinces and cohorts. We contacted all provincial education departments and utilized public university and e-library archives, ultimately compiling 68 official documents. Figure A.2 displays a sample of an official document on the bonus point policy. For the remaining years or provinces, we supplemented policy information with contemporaneous media records, including news coverage and periodical archives.

Despite these efforts, complete information is not available for all regions. Our final sample excludes provinces for which bonus eligibility could not be accurately reconstructed. First, we exclude four provinces (Qinghai, Ningxia, Shanxi, and Jilin), for which official bonus policies were unavailable. Additionally, we omit several provinces where the available policies could not be reliably implemented due to structural or definitional inconsistencies: Xinjiang

(bonus depend on parents' ethnicity, which is not observed in the CEE data); Chongqing and Sichuan (bonus varies by university type); Shandong (pre-2002 bonuses applied to all first-time CEE takers); Inner Mongolia (policy description is ambiguous); and Guangxi (minority bonuses are confounded with underdevelopment-area bonuses).[4] These exclusions ensure that our constructed bonus variable captures ethnic-based AA as cleanly as possible.

4.2 Consumption and Income Data

The second main database for our analysis is the universe of credit and debit card (or "bank card") transactions in China that are settled through the UnionPay network. The UnionPay network is the only inter-bank payment network in China and is state-owned. It is the largest network in the world in terms of both the number and the value of transactions, ahead of Visa and Mastercard. From 2013 to 2022, a total of 9.5 billion bank cards were issued. The database covers over 300 merchant categories and records annual transaction values growing from $5.2 trillion in 2013 to over $19 trillion in 2022 (People's Bank of China, 2014, 2024).[5]

We observe the transaction location (city), date, merchant category, and amount for all card transactions of all individuals in our CEE sample, except for Guangdong and Tibet provinces.[6] The database also includes cardholders' demographics (gender, age, and birthplace). UnionPay bank card transactions represented about 80% of overall retail consumption in 2018 (Lai et al., 2022). To our knowledge, this dataset offers the most comprehensive account and fine-scale of consumption activity in China in temporal and spatial dimensions. It is worth noting that the use of mobile payments (e.g., WeChat Pay and Alipay) rose sharply since 2018. As a robustness check, we restrict our sample to 2013-2018, a period in which mobile payments were less popular.

Figure A.3 shows a strong positive relationship between CEE percentile rank and long-

[4]See Appendix B for details.

[5]The major merchant categories are retail; wholesale; direct sales; real estate and finance; residential and commercial service; hotel, restaurant, and entertainment; and education, health, and government service.

[6]Guangdong and Tibet are excluded because students in these provinces lack national ID numbers in the CEE data, preventing linkage to the UnionPay consumption records.

term average annual consumption, consistent with the expectation that higher academic achievement predicts better long-term economic outcomes. The slope steepens notably in the upper tail of the distribution, particularly beyond the 85^{th} percentile, mirroring the structure of our sample in which roughly 14% of students were admitted to elite colleges. This pattern suggests that returns to academic rank are especially pronounced among top performers (Jia and Li, 2021).

UnionPay also provides a subsample of income records of employees of firms that use UMS to process payroll. This dataset contains information on individuals' annual income and industry of employment. Among these individuals, the correlation between average annual consumption and income during our sample period is over 0.6.

4.3 China College Student Survey

We complement our administrative data with the Chinese College Student Survey (CCSS), a nationally representative dataset of graduating college students from 2010 to 2015.[7] The survey was conducted across 90 institutions selected to reflect China's diverse higher education landscape, including elite universities, provincial colleges, and vocational colleges. It covers roughly 40,000 students and contains rich information on CEE scores, demographic background, college and major placement, academic performance, and campus experience.

We focus on a subset of variables that capture students' academic outcomes and subjective well-being during college. In particular, we examine indicators of within-college performance (e.g., GPA percentile rank, course failure) and college life satisfaction (e.g., satisfaction with peer relationships and overall experience). These variables allow us to shed light on how AA shapes educational attainment as well as students' in-college well-being.

[7]See Jia and Li (2021) for a detail description on CCSS.

4.4 Summary Statistics

Table I presents summary statistics for the main analysis sample. Panel A reports demographic characteristics. The sample includes over 7.7 million CEE takers, of whom 41% are female, 5% are ethnic minorities, and about half come from rural areas. A majority (54%) follow the science track in high school.

Panel B documents students' CEE performance. The average raw CEE score is 426.8, with a standard deviation of 98.7. We construct a within-province-cohort-track percentile ranking to standardize student performance; the mean percentile rank is 51. Among all test takers, the average bonus points is 0.44. Among those who receive any bonus, the mean bonus points are 13.22, while the mean AA doses, defined as the ratio of awarded bonus points to the province-track-cohort standard deviation of CEE scores, are 0.16.

Panel C summarizes post-CEE admission outcomes. Seventy percent of students are admitted to college, 14% admitted to elite "Tier 1" institutions, and 46% admitted to their first-choice program. As a measure of college "quality", we use leave-one-out mean of province-cohort-track admission ranks of enrolled students within each college, normalized to a 0-100 scale, with 100 being the highest. Relative ranking captures a student's percentile rank relative to peers in the same college and major (with 100 being the highest rank), while relative score measures the difference between a student's CEE score and the average score of peers enrolled in the same college and major who took the same exam paper.

We also classify students by field of study. The variable "Top-three majors" is an indicator for whether the student enrolled in one of the three majors with the highest average long-run consumption within their college (i.e., Economics, Management, and Engineering), while "Bottom-three majors" flags the three lowest-earning majors (i.e., Health, Education, and History). Among those who were admitted into colleges, 29% (12%) were admitted by top-three (bottom-three) majors.

Panel D reports consumption and income 10 to 23 years after high-school graduation. On average, annual consumption is around 10,940 RMB, with notable variation across con-

sumption categories, where we group detailed consumption items into four categories: non-durables, durables, financial products, and leisure. The average annual income, among the subsample of approximately 120,000 individuals with income data available, is around 75,700 RMB.

5 Empirical Strategy

5.1 AA Doses

Because ethnicity-based AA in the CEE is intended to promote equity, minority status is closely intertwined with poverty, as reflected in Figure A.1, bonus points are not exogenously allocated to individuals. To identify the effect of the bonus points, we exploit year-to-year variation in the "effective value" of bonus points within narrowly defined county-ethnicity-track cells. Although the nominal bonus points awarded to an ethnic minority group in a county are fixed, the admission advantage they confer depends on the province-cohort-specific distribution of CEE scores, i.e., the effective value of a bonus point, or AA doses, differs across year-provinces.

As one measure that captures this variation, we define the AA dose as the ratio of nominal bonus points to the standard deviation of CEE scores within the corresponding province-track cell. Specifically, our AA dose measure is constructed as follows:

$$D_{jest} = \frac{Bonus\ point_{jet}}{SD_{pst}}, \tag{4}$$

where D_{jest} denotes the AA dose for ethnicity e in county j (province p), track s, and cohort t; $Bonus_point_{jet}$ is the nominal bonus awarded to the corresponding county-ethnicity-cohort cell; and SD_{pst} is the standard deviation of CEE scores in province p, track s, and cohort t. An advantage of this construction is that the variation in AA doses arises from temporal fluctuations in exam-score distributions. Figure I shows the distribution of AA-dose variation

within county across cohorts in our sample. With typical bonus points of 10 and a CEE score standard deviation of 100, a representative affirmative action dose is 0.1 (= 10/100).

In addition to our baseline AA-dose measure, we construct two alternative measures. The first is the ratio of bonus points to the difference between the "Tier-1" admission cutoff score and the mean CEE score in a given province-track-cohort cell.

$$D_{jest}^{alt} = \frac{Bonus\ point_{jet}}{Cutoff_{pst} - Avg\ Score_{pst}}. \tag{5}$$

This captures how far bonus points move a student toward the elite admission threshold. The second is a rank-based measure, defined as the number of percentile ranks a bonus point moves a student upward along the score distribution in her province-track-cohort. All three AA-dose measures are highly correlated (pairwise correlations exceeding 0.8). Our main results are similar across these AA-dose measures.

5.2 Empirical Specification

Having constructed our AA-dose measure, we estimate the effect of AA on educational and long-term economic outcomes by regressing individual outcomes on AA doses while controlling for a rich set of fixed effects and covariates. Letting Y_{ijest} denote an outcome for individual i, we estimate the following model:

$$Y_{ijest} = \beta \mathrm{D}_{jest} + \gamma \mathrm{Score}_{ijest} + \delta X'_{ijest} + \lambda_{jes} + \theta_{jst} + \epsilon_{ijest} \tag{6}$$

where D_{jest} and $Score_{ijest}$ are AA doses and raw CEE score, respectively, and X_{ijest} is a vector of baseline characteristics, including gender, age when taking the CEE, and rural residency indicator. To address zero credit- and debit-card consumption, we use a modified logarithm as suggested in Chen and Roth (2024).[8] Our main results are robust using alternative

[8]The modified logarithm in Chen and Roth (2024) is $m(y) = ln(y)$ if $y > 0$ and $m(y) = x$ if $y = 0$. We use $x = 0.5$. The interpretation is that the effect of moving y from 0 to 1 is valued the same as a 50 log-point

methods, such as Poisson pseudo maximum likelihood.

Consistent with the re-centering approach of Borusyak and Hull (2023), we include county-ethnicity-track fixed effects (λ_{jes}) to absorb any time-invariant differences across these groups. To account for unobserved local shocks that could influence students' CEE outcomes, such as year-specific variations in education policies within a county-track, we also incorporate county-cohort-track fixed effects. Once we control for individual characteristics and this rich set of fixed effects, the remaining year-to-year fluctuations in AA doses are assumed to be as good as random. To validate the exogeneity of the AA dose measure in our specification, we implement a key balance test. Specifically, conditional on the county-ethnicity-track and county-cohort-track fixed effects, we regress AA doses on students' raw CEE scores. Table A.1 shows that AA doses are uncorrelated with CEE scores, supporting the assumption that within-cell variation is orthogonal to students' academic ability.

To further explore potential nonlinearities in the effects of AA doses, we extend our baseline specification by replacing the continuous measure with quintile dummies. Specifically, we divide the distribution of AA doses into five equally sized bins and estimate separate effects for each quintile.

$$\begin{aligned} Y_{ijest} = \beta_1 \mathrm{D}_{jest}^{1^{st}Q} + \beta_2 \mathrm{D}_{jest}^{2^{nd}Q} + \beta_3 \mathrm{D}_{jest}^{3^{rd}Q} + \beta_4 \mathrm{D}_{jest}^{4^{th}Q} + \beta_5 \mathrm{D}_{jest}^{5^{th}Q} + \gamma \mathrm{Score}_{ijest} \\ + \delta X'_{ijest} + \lambda_{jes} + \theta_{jst} + \epsilon_{ijest} \end{aligned} \tag{7}$$

where $\mathrm{D}_{jest}^{1^{st}Q}$, $\mathrm{D}_{jest}^{2^{nd}Q}$, $\mathrm{D}_{jest}^{3^{rd}Q}$, $\mathrm{D}_{jest}^{4^{th}Q}$, and $\mathrm{D}_{jest}^{5^{th}Q}$ denote indicators for the lowest to the highest quintiles of AA doses. This specification allows us to assess how students are affected by different doses of AA, rather than assuming a constant marginal effect. As an alternative nonlinear specification, we also estimate a spline regression model, allowing the slope to vary across different regions of the AA-dose distribution, which provides a complementary way to visualize and quantify the dose-response relationship.

effect on the intensive margin (e.g., the same as the effect from $ln(a)$ to $ln(b)$ where $ln(b)ln(a) = 0.5$). Our results are robust using alternative x values (see details in Section 6.3).

Across our specifications, we cluster standard errors at the county-cohort-track level. In addition, to allow for potential temporal and spatial autocorrelations, we use a number of other methods for inferences, including clustering at the county-ethnicity-track, province-cohort-track, or province-ethnicity-track level. Our main results are robust.

6 Effect of AA on Student Outcomes

6.1 College Admission Outcomes

Access to College and College Quality We begin by assessing the effects of AA doses on college admission outcomes. Panel A of Table II shows that a 0.1 increase in AA doses (equivalent to 10-bonus-point over average standard deviation of CEE scores) raises the likelihood of being admitted to any college by 2.74 ppts, to a Tier-1 elite institution by 1.07 ppts, and to a student's first-choice program by 2.98 ppts. Consistently, students exposed to higher AA doses attend colleges with better peer ability. To measure peer quality in one's college, we first use each student's CEE rank in her province-track-cohort as a measure of her ability. A college's peer quality is then defined as the leave-one-out median ability of enrolled students.

Panel B shows these effects across the five AA-dose quintiles. Relative their counterpart with zero bonus point, students receiving high bonus doses (the top quintile of the AA-dose distribution) experience the largest improvements, college admission increases by 9.9 ppts, elite admission by 3.3 ppts, and first-choice admission by 8.8 ppts.

Ranking Relative to Peers Next, we turn to within-college peer environments by examining students' relative academic standing. We construct two complementary measures: (1) relative ranking, defined as a student's CEE percentile rank minus the average CEE rank of peers in the same college-major cell, and (2) relative score, defined as the difference in raw CEE scores between the student and the peer average (restricted to those who took the same format of the exam). Panel A of Table III shows that higher AA doses are associated with

worse within-college positioning. A 0.1 increase in AA doses lowers one's ranking relative to peers by about 2.0 percentile points and relative score by 3.3 points, approximately 13.5% and 7.5% of their respective sample standard deviations.

These effects exhibit substantial heterogeneity across the distribution of AA doses. As Panel B indicates, students receiving the highest quintile of AA doses are placed into colleges where they rank far behind their peers: their relative rank falls by 5.75 ppts and relative score by over 9 points. In contrast, those receiving the bottom quintile of AA doses are relatively comparable to their peers. These patterns suggest that higher AA doses leads to larger overmatches of AA beneficiaries to colleges where they are relatively underprepared.

Enrolled Majors Finally, we explore how AA doses shape students' major choices. Figure II plots how AA doses affect a student's likelihood of enrolling in different majors, against the average consumption level associated with each major observed in the entire sample. The downward-sloping pattern shows that higher AA doses steer students away from high-consumption (high-return) majors like Economics, Management, and Engineering, and toward lower-return fields such as Health, Education, and History. This pattern is consistent with findings in previous studies (e.g., Arcidiacono et al. (2011); Arcidiacono and Lovenheim (2016)).

Panel A of Table IV shows that a 0.1 increase in AA doses reduces the probability of enrolling in a top-three major, defined by the average consumption level of graduates in that major, by 0.7% and increases the likelihood of entering one of the bottom-three majors by 1.8%.

The nonlinear specification in Panel B again highlights a clear dose-response pattern. Students in the top quintile of AA doses are 6.5-ppt more likely to enroll in lower-quality major.

6.2 Long-Run Economic Outcomes

Main results. As shown in Table V, a 0.1 increase in AA doses reduces average annual consumption by approximately 11%. This suggests that, on average, AA-induced academic mismatches outweigh gains in college quality, resulting in long-term economic losses.

However, the average effect masks important nonlinear dose effects. As shown in Panel B, relative to their counterpart with zero bonus points, students receiving the lowest quintile of AA doses experience a 15% *gain* in long-term consumption, while those receiving the top two quintiles of AA doses experience a 17-42% reduction. These findings highlight that the ultimate effect of AA largely depends on its doses: moderate AA doses benefit its intended beneficiaries while excessive AA doses can hurt them.

Heterogeneous treatment effects. Next, we examine how the effects of AA doses vary by students' CEE scores. Figure III reveals that within each quartile of CEE score distribution, the overall pattern is consistent: moderate AA doses tend to improve long-run outcomes, but higher doses yield opposite effects.

Next, in Table VI, we explore heterogeneous effects by demographics: gender, rural/urban residence, and high-school quality (measured by school-average CEE scores). While precise results vary across subgroups, the general nonlinear shape is preserved, reaffirming that excessive AA doses impose long-term costs across diverse populations.

Dynamics. Finally, we assess whether the negative impacts of AA doses persist or fade over time. Figure A.4 traces consumption differences by years since graduation and finds no evidence of convergence. This suggests that the mismatch effects are not merely short-lived shocks but represent lasting changes in human capital and career trajectory.

6.3 Alternative Explanations and Robustness Tests

Ruling out alternative explanations. Two alternative explanations may challenge our interpretation. First, one may argue that AA doses shift students into more selective colleges, where one becomes more financially sophisticated, save/invest more and thus consume less. To test this savings/investment-based mechanism, Table VII analyzes financial investment outcomes (e.g., spending on insurance, stocks, and bonds). We find a pattern that mirrors our consumption results: investment also declines with AA doses, suggesting that differences in saving/investment decisions are unlikely to explain our findings on consumption.

The second alternative story is that bonus recipients may be more likely to return to their hometowns, where living costs are lower. In this scenario, their reduced consumption would reflect lower local prices rather than lower economic well-being. Table A.2 refutes this interpretation: higher AA doses actually increase the likelihood that students settle in Tier-1 and Tier-2 (higher-cost) cities, while reducing their probability of returning to their (low-cost) birth counties. Thus, the decline in consumption likely reflects lower economic attainment rather than cost-of-living differences.

As a more direct piece of evidence, Table A.3 analyzes the income profiles within the subsample of individuals with income data. Due to the small sample size, we divide AA doses into terciles and replace county fixed effects with province fixed effects for the sake of power. The nonlinear pattern in income mirrors the consumption pattern: high doses predict income losses.

Robustness checks. As an alternative, we capture nonlinear patterns using spline regressions. Figure A.5 and Table A.4 use piecewise linear splines to capture the relationship between AA doses and consumption. The results show that consumption declines are statistically significant and steep only after the dose surpass a threshold around 0.1 to 0.2, consistent with the quintile-based estimates.

Table A.5 further verifies that our results are robust across three alternative measures of

doses: bonus points standardized by the standard deviation of CEE scores (our baseline), bonus points relative to the admission gap to elite universities, and the implied increase in CEE rank percentile. All three yield similar nonlinear patterns.

To ensure that our results are not sensitive to how we handle zero consumption values, Table A.6 applies the Chen and Roth (2024) transformation and tests multiple calibration values ($K = 0, 0.3, 1, 3$). The estimated effects are stable across all specifications, consistently showing more pronounced negative impacts at higher levels of AA doses.

One concern is that students who rarely use UnionPay cards may be underrepresented in our consumption sample. To address this potential sample selection bias, Table A.7 presents Heckman two-step correction estimates, using the number of banks and ATMs per 10,000 residents in students' birth cities as exclusion restrictions. The second-stage results reveal that our main conclusions remain robust after correcting for potential non-random card usage.

7 Effect on College Experience

We next examine how AA doses shape students' experiences during college, using rich survey evidence from the China College Student Survey (CCSS). While much of the AA literature focuses on access to college and academic performance, students' in-college experiences are central to understanding how AA affects one's (short-term) utility, and via its effect on peer interactions and campus life, shapes one's social network and potentially long-term outcomes. Table VIII presents evidence on both academic outcomes and subjective evaluations of college life.

Panel A focuses on academic performance. Higher AA doses are associated with significantly worse academic standing within college. Column (1) shows that a 0.1 increase in AA doses raises the probability of ranking below the median within one's cohort by 2.8% (around 11.7% relative to the sample mean). Although the positive estimate for course fail-

ure is imprecisely estimated (column 2), the overall pattern indicates that students receiving stronger AA doses tend to struggle academically relative to their peers. These results are consistent with the mismatch hypothesis: while higher AA doses facilitate entry into more selective institutions, it may place students in environments where academic demands exceed their preparation, leading to weaker relative performance.

Panel B turns to students' subjective well-being and campus life. Higher AA doses are associated with lower satisfaction with one's own GPA (column 1), social activities (column 2, although insignificant), interpersonal relationships (column 3), and overall college life (column 4). The magnitudes are economically meaningful, e.g., a 0.1 increase in AA doses reduces overall satisfaction by roughly 16.4% of the mean of the outcome. Taken together, these patterns suggest that academic mismatch extends beyond grades to affect broader aspects of students' college experiences, including their sense of belonging and well-being on campus.

Importantly, these findings help bridge our short-run and long-run results. Lower academic standing and reduced satisfaction with college life can plausibly affect human capital accumulation, peer networks, and non-cognitive skills, all of which matter for later economic outcomes. The CCSS evidence therefore sheds light on a key mechanism through which higher doses of AA may generate persistent effects for intended beneficiaries: higher AA doses enable these students to enroll in high-quality colleges, where they may, however, struggle both academically and socially.

8 Conclusion

There has been an extensive dichotomous debate about AA in higher education: whether AA helps or harms its intended beneficiaries. This paper argues that such a dichotomous framing obscures a more fundamental question: what is the appropriate dose of AA? In this paper, we provide new evidence that the ultimate effect of AA depends critically on its dose.

Exploiting transparent and continuously varying effective AA doses within China's centralized admissions system, we show that stronger AA substantially expands access to colleges in general and to elite colleges. At the same time, higher AA doses systematically worsen within-college match quality, shifting students toward less economically rewarding majors. In the long run, AA exhibits a pronounced non-linear effect on economic well-being: modest AA doses generate sizable gains in long-term consumption, while strong doses produce persistent losses. This hump-shaped pattern reconciles the long-standing debate between the affirmative and negative sides of the argument.

Beyond academic placement and long-run economic outcomes, we document that AA doses shape students' experiences during college. Evidence from the China College Student Survey reveals that higher AA doses are associated with poorer academic standing and lower satisfaction with interpersonal relationships and overall college life. These results highlight an often-overlooked dimension of mismatch: AA can affect not only measurable academic outcomes, but also students' subjective well-being and social integration on campus. Together with our long-run findings, the CCSS evidence suggests that the costs of excessive AA may operate through sustained losses in academic achievement and social life that accumulate over time.

Several avenues remain open for future research. First, richer longitudinal data could shed light on how academic and social mismatch evolves over time and whether early in-college frictions persist or attenuate in the long run. Second, future work could extend the analysis to other dimensions of welfare, such as wealth accumulation, occupational trajectories, or non-market outcomes, to further assess the broader consequences of AA doses.

References

Akhtari, Mitra, Natalie Bau, and Jean-William Laliberté, "Affirmative action and precollege human capital," *American Economic Journal: Applied Economics*, 2024, *16* (1), 1–32.

Arcidiacono, Peter and Michael Lovenheim, "Affirmative action and the quality–fit trade-off," *Journal of Economic Literature*, 2016, *54* (1), 3–51.

_ , Esteban Aucejo, Patrick Coate, and V Joseph Hotz, "Affirmative action and university fit: Evidence from Proposition 209," *IZA Journal of Labor Economics*, 2014, *3* (1), 7.

_ , Esteban M Aucejo, and V Joseph Hotz, "University differences in the graduation of minorities in STEM fields: Evidence from California," *American Economic Review*, 2016, *106* (3), 525–562.

_ , _ , Hanming Fang, and Kenneth I Spenner, "Does affirmative action lead to mismatch? A new test and evidence," *Quantitative Economics*, 2011, *2* (3), 303–333.

Aucejo, Esteban M and Kelvin Wong, "The effect of feedback on student performance," *Journal of Public Economics*, 2025, *241*, 105274.

_ , Jacob French, and Basit Zafar, "Estimating students' valuation for college experiences," *Journal of Public Economics*, 2023, *224*, 104926.

_ , _ , Paola Ugalde Araya, and Basit Zafar, "Understanding gaps in college outcomes by first-generation status," Technical Report, National Bureau of Economic Research 2025.

Bagde, Surendrakumar, Dennis Epple, and Lowell Taylor, "Does affirmative action work? Caste, gender, college quality, and academic success in India," *American Economic Review*, 2016, *106* (6), 1495–1521.

Barrow, Lisa, Lauren Sartain, and Marisa De La Torre, "Increasing access to selective high schools through place-based affirmative action: Unintended consequences," *American Economic Journal: Applied Economics*, 2020, *12* (4), 135–163.

Barwick, Panle Jia, Shanjun Li, Deyu Rao, and Nahim Bin Zahur, "The healthcare cost of air pollution: evidence from the world's largest payment network," *Review of Economics and Statistics*, 2024, pp. 1–52.

Bertrand, Marianne, Rema Hanna, and Sendhil Mullainathan, "Affirmative action in education: Evidence from engineering college admissions in India," *Journal of Public Economics*, 2010, *94* (1-2), 16–29.

Black, Sandra E, Jeffrey T Denning, and Jesse Rothstein, "Winners and losers? The effect of gaining and losing access to selective colleges on education and labor market outcomes," *American Economic Journal: Applied Economics*, 2023, *15* (1), 26–67.

Bleemer, Zachary, "Affirmative action, mismatch, and economic mobility after California's Proposition 209," *The Quarterly Journal of Economics*, 2022, *137* (1), 115–160.

_ , "Affirmative action and its race-neutral alternatives," *Journal of Public Economics*, 2023, *220*, 104839.

_ , "Top Percent Policies and the Return to Postsecondary Selectivity," *Working paper*, 2024.

Bobba, Matteo and Veronica Frisancho, "Self-perceptions about academic achievement: Evidence from Mexico City," *Journal of Econometrics*, 2022, *231* (1), 58–73.

Borusyak, Kirill and Peter Hull, "Nonrandom exposure to exogenous shocks," *Econometrica*, 2023, *91* (6), 2155–2185.

Chen, Jiafeng and Jonathan Roth, "Logs with zeros? Some problems and solutions," *The Quarterly Journal of Economics*, 2024, *139* (2), 891–936.

Chen, Yan and Onur Kesten, "Chinese college admissions and school choice reforms: A theoretical analysis," *Journal of Political Economy*, 2017, *125* (1), 99–139.

Dillon, Eleanor Wiske and Jeffrey Andrew Smith, "The consequences of academic match between students and colleges," *Journal of Human Resources*, 2020, *55* (3), 767–808.

Estevan, Fernanda, Thomas Gall, and Louis-Philippe Morin, "Redistribution without distortion: Evidence from an affirmative action programme at a large Brazilian university," *The Economic Journal*, 2019, *129* (619), 1182–1220.

Francis, Andrew M and Maria Tannuri-Pianto, "Using Brazil's racial continuum to examine the short-term effects of affirmative action in higher education," *Journal of Human Resources*, 2012, *47* (3), 754–784.

Gong, Yifan, Lance Lochner, Ralph Stinebrickner, and Todd R Stinebrickner, "The consumption value of college," Technical Report, National Bureau of Economic Research 2019.

Jia, Ruixue and Hongbin Li, "Just above the exam cutoff score: Elite college admission and wages in China," *Journal of Public Economics*, 2021, *196*, 104371.

Lai, Wangyang, Shanjun Li, Yanyan Liu, and Panle Jia Barwick, "Adaptation mitigates the negative effect of temperature shocks on household consumption," *Nature Human Behaviour*, 2022, *6* (6), 837–846.

Machado, Cecilia, Germán Reyes, and Evan Riehl, "The direct and spillover effects of large-scale affirmative action at an elite Brazilian university," *Journal of Labor Economics*, 2025, *43* (2), 000–000.

Oreopoulos, Philip and Kjell G Salvanes, "Priceless: The nonpecuniary benefits of schooling," *Journal of Economic Perspectives*, 2011, *25* (1), 159–184.

People's Bank of China, "General Overview of the Payment System's Operation in 2013," 2014.

_ , "General Overview of the Payment System's Operation in 2023," 2024.

Stinebrickner, Todd and Ralph Stinebrickner, "Learning about academic ability and the college dropout decision," *Journal of Labor Economics*, 2012, *30* (4), 707–748.

Wu, Binzhen and Xiaohan Zhong, "Matching mechanisms and matching quality: Evidence from a top university in China," *Games and Economic Behavior*, 2014, *84*, 196–215.

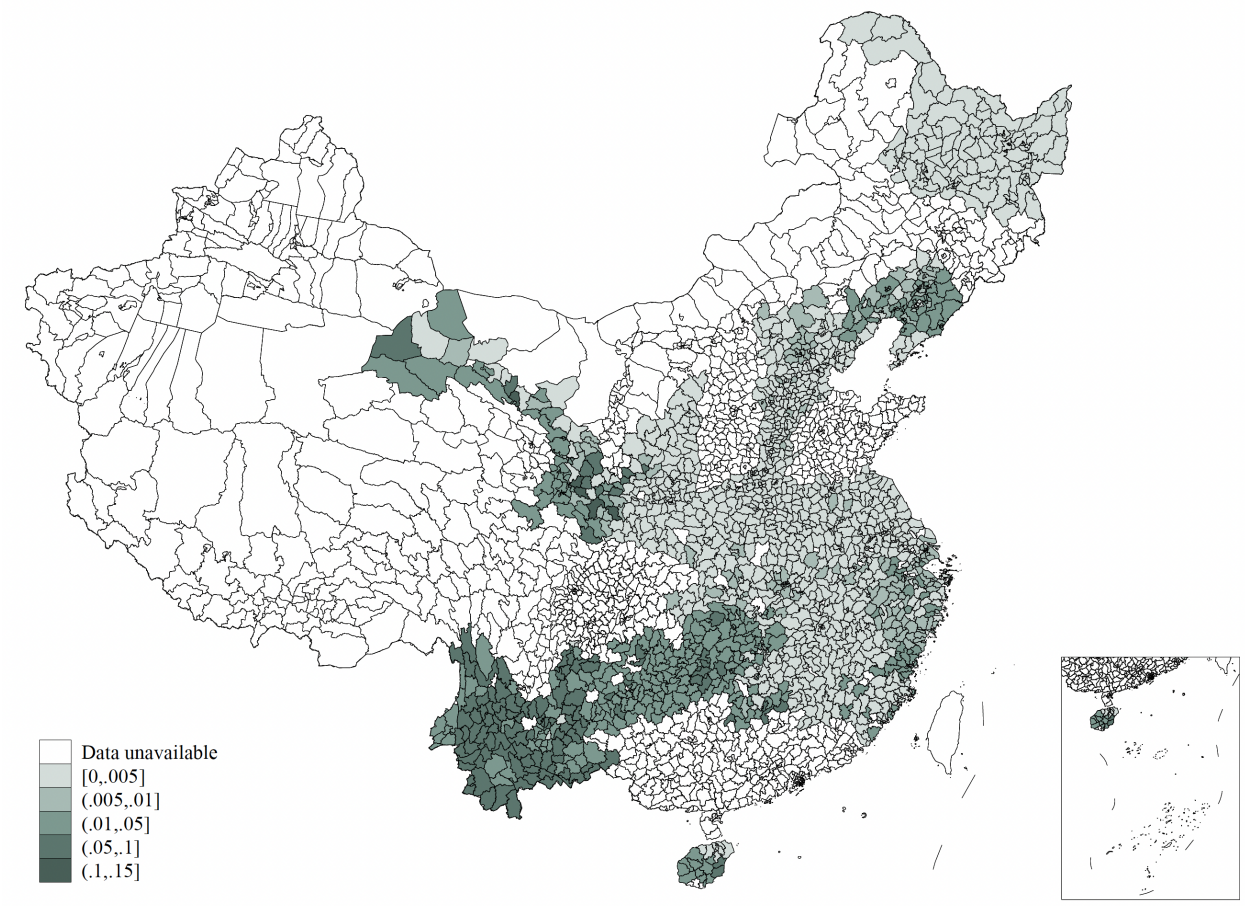


Figure I
Spatial Distribution of Standard Deviation of AA Doses

Notes: This figure shows the spatial distribution of the standard deviation of AA doses at the birth-county level for the 1999-2003 cohorts. Darker green shading indicates greater within-county variation in AA doses across cohorts. White areas denote regions without usable data, either because entire provinces are excluded from the sample or because a small number of counties within sampled provinces lack observations due to zero bonus recipients during 1999-2003 or non-standard birth-county identifiers that cannot be reliably mapped.

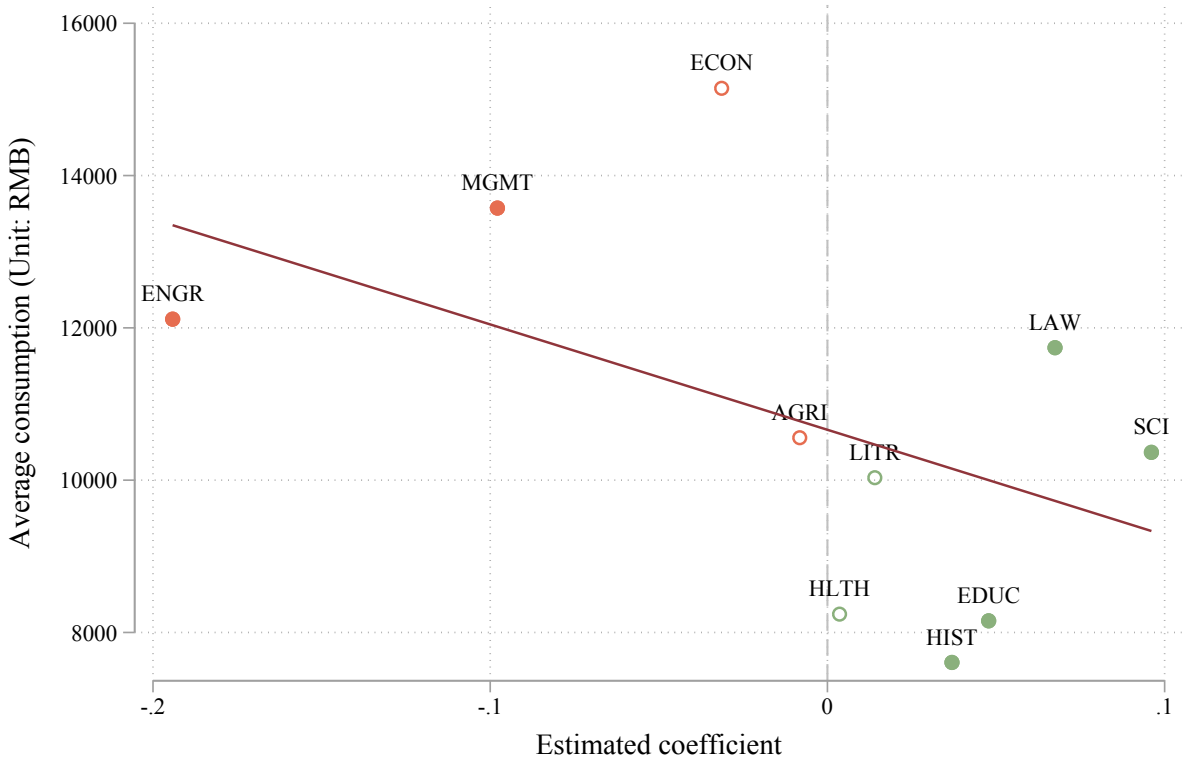


Figure II
Impact of AA Doses on Major Selection

Notes: This figure relates the estimated effect of AA doses on major choice to the average consumption levels associated with those majors. The x-axis reports point estimates of the effect of AA doses on the probability of choosing each major using Equation (6), while the y-axis shows the average annual consumption (in RMB) of individuals admitted to that major. Abbreviations for majors are as follows: ECON (Economics), MGMT (Management), ENGR (Engineering), LAW (Law), AGRI (Agriculture), SCI (Science), LITR (Literature), HLTH (Health), EDUC (Education), and HIST (History). Solid circles denote estimates that are statistically significant at the 10% level, and hollow circles indicate non-significant estimates. The red line plots the fitted linear relationship between the major-specific coefficients and average consumption.

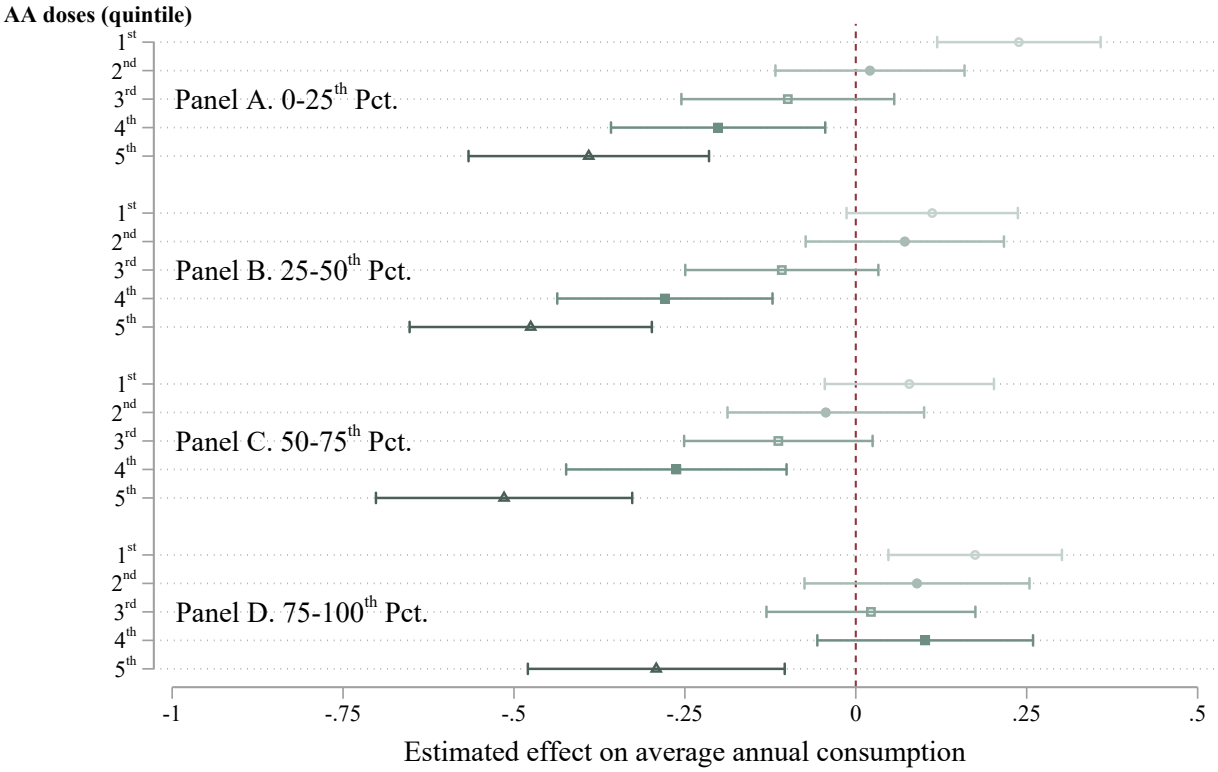


Figure III
Non-linear Effect Across CEE Rank Groups

Notes: This figure shows the heterogeneous non-linear effects of AA doses on average annual consumption in later-life across within-province-cohort-track CEE percentile rank groups. Estimates are based on Equation (7), augmented with interactions between five AA-dose quintiles and four rank-group indicators (0-25$^{\text{th}}$, 25-50$^{\text{th}}$, 50-75$^{\text{th}}$, and 75-100$^{\text{th}}$ percentiles). Dots denote point estimates, and horizontal bars indicate 95% confidence intervals.

Table I: Summary Statistics

Variable	Observations	Mean	Std. Dev.
Panel A: Demographic characteristics			
Female (=1)	7,748,286	0.41	0.49
Age when taking CEE	7,748,286	19.03	1.11
Rural (=1)	7,748,286	0.52	0.50
Minority (=1)	7,748,286	0.05	0.21
Science track (=1)	7,748,286	0.54	0.50
Humanity track (=1)	7,748,286	0.27	0.44
Comprehensive track (=1)	7,748,286	0.19	0.39
Panel B: CEE performance			
CEE score	7,748,286	426.83	98.72
Rankings	7,748,207	51.00	29.47
Bonus points	7,748,286	0.44	2.63
AA doses (Conditional on Bonus>0)	257,309	0.16	0.08
Panel C: Admission outcomes			
Admission (=1)	7,748,286	0.70	0.46
Admitted by elite colleges (=1)	7,748,286	0.14	0.34
Admitted by first choice (=1)	7,741,680	0.46	0.50
College quality	5,390,549	62.24	23.99
Relative ranking	5,392,166	-0.04	14.78
Relative score	3,984,911	1.64	44.15
Top-three majors (=1)	5,392,204	0.29	0.45
Bottom-three majors (=1)	5,392,204	0.12	0.32
Panel D: Consumption & Income			
Average annual consumption (RMB)	7,748,020	10938.76	33758.56
Durables (RMB)	7,748,063	4289.51	17952.50
Non-durables (RMB)	7,747,874	572.07	1592.32
Financial products (RMB)	7,748,245	1718.34	7965.60
Leisure (RMB)	7,748,219	27.51	124.04
Other consumption (RMB)	7,747,906	4490.01	14962.8
Average annual income (RMB)	76,923	118,753.9	229,717.6

Notes: In this table, each observation corresponds to an individual test taker. Panel A presents demographic characteristics. *Rural* indicates students from rural areas, *Minority* denotes students from minority ethnicity, *Science track*, *Humanity track*, and *Comprehensive track* represent the academic track chosen in high school. Panel B reports CEE performance measures, including raw CEE scores, percentile rankings within province-cohort-track cells, nominal bonus points, and AA doses conditional on receiving positive bonus points. Panel C summarizes college admission outcomes. *Admission*, *Admitted by elite colleges*, and *Admitted by first choice* indicates that students are admitted by any colleges, elite colleges, and their first choice on the preference list, respectively. *College quality* is leave-one-out mean of province-cohort-track admission ranks of enrolled students in each college, normalized to a 0-100 scale, with 100 being the highest. *Relative ranking* captures a student's percentile rank relative to peers in the same college and major (with 100 being the highest rank), while *Relative score* measures the difference between a student's CEE score and the average score of peers enrolled in the same college and major who took the exam in the same format. *Top-three majors* and *Bottom-three majors* are indicators for whether the student enrolled in one of the three majors with the highest and lowest average long-run consumption within their college. Variables from *College quality* to *Major quality* are only available for students who are admitted by any colleges. Panel D reports long-run economic outcomes based on UnionPay transaction records, including average annual consumption and its components, as well as average annual income for the subsample with available payroll information. Monetary values are expressed in RMB.

Table II: Impact of AA Doses on Admission results

	(1) Admission	(2) Admitted by elite colleges	(3) Admitted by first choice	(4) College quality
Panel A: Linear effect				
AA doses	0.274***	0.107***	0.298***	22.578***
	(0.028)	(0.021)	(0.029)	(1.481)
Panel B: Non-linear effect				
1^{st} quintile	0.051***	0.003	0.040***	2.041***
	(0.006)	(0.004)	(0.006)	(0.292)
2^{nd} quintile	0.023***	0.005	0.059***	1.640***
	(0.007)	(0.005)	(0.008)	(0.354)
3^{rd} quintile	0.040***	0.015***	0.055***	2.683***
	(0.007)	(0.005)	(0.006)	(0.382)
4^{th} quintile	0.046***	0.026***	0.056***	5.586***
	(0.007)	(0.007)	(0.008)	(0.440)
5^{th} quintile	0.099***	0.033***	0.088***	5.675***
	(0.009)	(0.006)	(0.010)	(0.430)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
Obs.	7,732,412	7,732,412	7,725,811	5,378,375

Notes: This table presents the linear and nonlinear effect of AA doses on college admission. The dependent variables in Columns (1)-(4) are indicators for college admission, elite college admission, first-choice admission, and college quality, respectively. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table III: Impact of AA Doses on Relative Ranking to Peers

	(1) Relative ranking	(2) Relative score
Panel A: Linear effect		
AA doses	-20.01***	-32.72***
	(0.99)	(4.17)
Panel B: Non-linear effect		
1^{st} quintile	-0.94***	-0.82
	(0.20)	(1.01)
2^{nd} quintile	-1.57***	-2.84***
	(0.23)	(0.92)
3^{rd} quintile	-2.40***	-5.25***
	(0.26)	(0.85)
4^{th} quintile	-4.22***	-8.10***
	(0.29)	(1.37)
5^{th} quintile	-5.75***	-9.31***
	(0.35)	(1.19)
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
Obs.	5,380,036	3,974,360

Notes: This table shows the linear and nonlinear effect of AA doses on competition environment in college. *Relative ranking* is the difference between the individual's percentile rank and the average percentile rank of peers, while *Relative score* is the difference between the individual's CEE score and the average score of peers taking the same exam format. In both cases, the individual is excluded from the peer average. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table IV: Impact of AA Doses on Major Choice

	(1) Top-three majors	(2) Bottom-three majors
Panel A: Linear effect		
AA doses	-0.069*	0.179***
	(0.037)	(0.033)
Panel B: Non-linear effect		
1^{st} quintile	-0.018***	0.006
	(0.007)	(0.005)
2^{nd} quintile	0.001	0.006
	(0.008)	(0.006)
3^{rd} quintile	-0.001	0.015**
	(0.009)	(0.007)
4^{th} quintile	-0.010	0.028***
	(0.011)	(0.010)
5^{th} quintile	-0.021	0.065***
	(0.013)	(0.011)
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
Obs.	5,381,027	5,381,027

Notes: This table displays the linear and nonlinear effect of AA doses on major selection. *Top-three majors* and *Bottom-three majors* are indicators for whether the student enrolled in one of the three majors with the highest and lowest average long-run consumption within their college. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table V: Impact of AA Doses on Later-life Consumption

	(1) Consumption	(2) Durables	(3) Non-durables	(4) Leisure
Panel A: Linear effect				
AA doses	-1.109***	-0.299	-0.843***	-0.267***
	(0.235)	(0.186)	(0.184)	(0.094)
Panel B: Non-linear effect				
1^{st} quintile	0.154***	0.040	0.103***	-0.005
	(0.054)	(0.044)	(0.039)	(0.021)
2^{nd} quintile	0.030	0.054	0.023	-0.011
	(0.062)	(0.049)	(0.050)	(0.021)
3^{rd} quintile	-0.076	0.073	-0.041	0.014
	(0.066)	(0.046)	(0.048)	(0.021)
4^{th} quintile	-0.175**	-0.014	-0.097	-0.012
	(0.076)	(0.066)	(0.062)	(0.031)
5^{th} quintile	-0.426***	-0.166***	-0.345***	-0.146***
	(0.085)	(0.062)	(0.065)	(0.034)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
Obs.	7,672,623	7,672,665	7,672,480	7,672,821

Notes: This table reports estimates of the effect of AA doses on later-life average annual consumption and its components. The dependent variables in Columns (1)-(4) are average annual total consumption and expenditures on durable goods, non-durable goods, and leisure, respectively. To address zero observations, we apply a log transformation with a calibrated extensive margin value, following the approach of Chen and Roth (2024). In our baseline specification, we set $K = 0.1$. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table VI: Heterogeneity by Student Characteristics

	(1)	(2)	(3)
	Dependent variable: Average consumption		
Variable (X):	Female	Rural	HS Quality
Panel A: Linear effect			
AA doses	-1.721***	-0.241	-4.891***
	(0.240)	(0.260)	(0.626)
AA doses × X	1.525***	-1.128***	0.010***
	(0.126)	(0.134)	(0.002)
Panel B: Non-linear effect			
1^{st} quintile × X	0.183***	-0.021	-0.000
	(0.040)	(0.060)	(0.000)
2^{nd} quintile × X	0.237***	-0.139***	0.001
	(0.041)	(0.053)	(0.001)
3^{rd} quintile × X	0.256***	-0.235***	0.001***
	(0.039)	(0.059)	(0.001)
4^{th} quintile × X	0.362***	-0.205***	0.003***
	(0.040)	(0.048)	(0.000)
5^{th} quintile × X	0.308***	-0.311***	0.002***
	(0.054)	(0.052)	(0.001)
1^{st} quintile	0.068	0.155***	0.167
	(0.057)	(0.057)	(0.173)
2^{nd} quintile	-0.073	0.126*	-0.315
	(0.064)	(0.075)	(0.272)
3^{rd} quintile	-0.191***	0.099	-0.652***
	(0.069)	(0.080)	(0.229)
4^{th} quintile	-0.319***	-0.023	-1.228***
	(0.078)	(0.085)	(0.200)
5^{th} quintile	-0.548***	-0.178***	-1.355***
	(0.087)	(0.094)	(0.257)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
Obs.	7,672,623	7,672,623	7,672,623

Notes: This table reports estimates of heterogeneous effects of AA doses on average annual consumption. Columns (1)-(3) examine heterogeneity by gender (*Female*), household registration status (*Rural*), and high school quality (*High school average CEE score*), respectively. High school quality is measured by the average CEE ranking of students from that high school in the first year it appears in the sample. **X** in columns (1)-(3) denotes *Female*, *Rural*, and *High school average CEE score*, respectively. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table VII: Impact of AA Doses on Financial Products

	(1) Financial products	(2) Insurance	(3) Bonds & stocks
Panel A: Linear effect			
AA doses	-0.571***	-0.083	-0.586***
	(0.170)	(0.089)	(0.156)
Panel B: Non-linear effect			
1^{st} quintile	0.040	0.069***	-0.016
	(0.040)	(0.022)	(0.034)
2^{nd} quintile	-0.006	-0.012	-0.013
	(0.041)	(0.025)	(0.038)
3^{rd} quintile	-0.062	0.004	-0.078**
	(0.046)	(0.025)	(0.039)
4^{th} quintile	-0.122**	-0.040	-0.115**
	(0.055)	(0.029)	(0.050)
5^{th} quintile	-0.208***	-0.016	-0.212***
	(0.059)	(0.028)	(0.053)
Controls	YES	YES	YES
YES			
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
Obs.	7,672,846	7,672,885	7,672,839

Notes: This table reports estimates of the effect of AA doses on later-life expenditure on financial products. The dependent variables in Columns (1)-(3) are average annual expenditure on all financial products, insurance, and bonds & stocks, respectively. To address zero observations, we apply a log transformation with a calibrated extensive margin value, following the approach of Chen and Roth (2024). All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

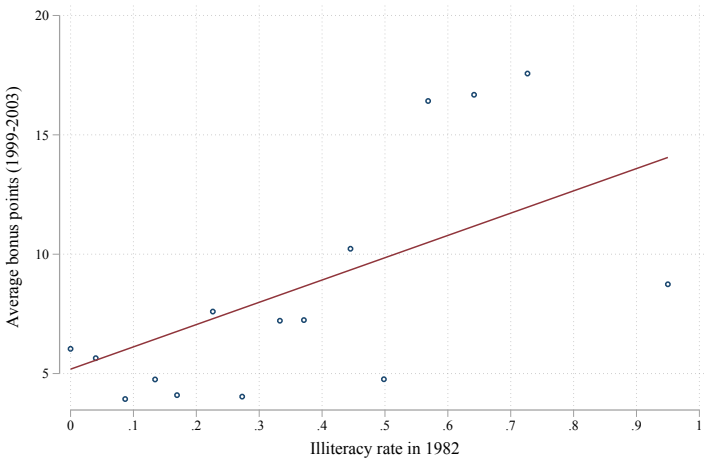
Table VIII: Impact of AA Doses on Performance and Satisfaction in College (CCSS)

	(1)	(2)	(3)	(4)
Panel A: Academic Outcomes				
	Below median rank	**Fail in courses**		
AA doses	0.275**	0.225		
	(0.139)	(0.145)		
Mean of Y	0.24	0.45		
Obs.	3,817	3,776		
R2	0.17	0.23		
Panel B: Subjective Well-being				
	Sat. with: GPA	**Sat. with: Social**	**Sat. with: Relations**	**Overall Sat.**
AA doses	-0.252*	-0.080	-0.162*	-0.180*
	(0.138)	(0.113)	(0.097)	(0.109)
Mean of Y	0.22	0.16	0.10	0.11
Obs.	3,817	3,817	3,817	3,817
R2	0.14	0.14	0.15	0.14

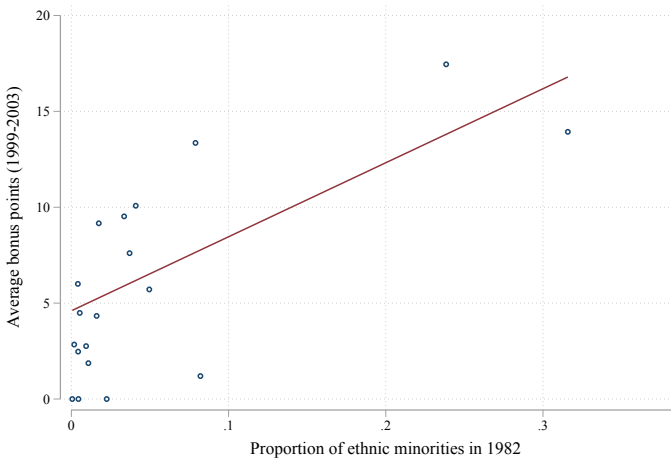
Notes: This table reports estimates of effects of AA doses on performance and subjective well-being in college using the China College Student Survey data. The variable-of-interest is the AA doses at the ethnicity-birth-city-cohort level. *Below median rank* is a dummy variable equal to 1 if the student's cumulative GPA rank is below the median within their class. *Fail in courses* indicates whether the student failed at least one course during college. The dependent variables in Panel B, *Sat. with GPA*, *Social*, *Relations*, and *Overall*, are dummy variables indicating satisfaction levels above the neutral point. These are constructed from original survey items regarding satisfaction with academic performance, social activities, interpersonal relationships, and overall campus life, respectively. The original responses are based on a 5-point scale (1 = "highly dissatisfied", 5 = "highly satisfied"). Each dummy variable equals 1 if the original score is greater than 3, and 0 otherwise. To ensure comparability, we restrict the sample to cells that contain at least one individual with positive bonus points. Each cell comprises individuals who share the identical birth city, CEE cohort, academic track, gender, hukou status, and retake status. All specifications control for individual CEE scores and cell fixed effects. * p<0.1, ** p<0.05, *** p<0.01.

Appendices. For Online Publication Only

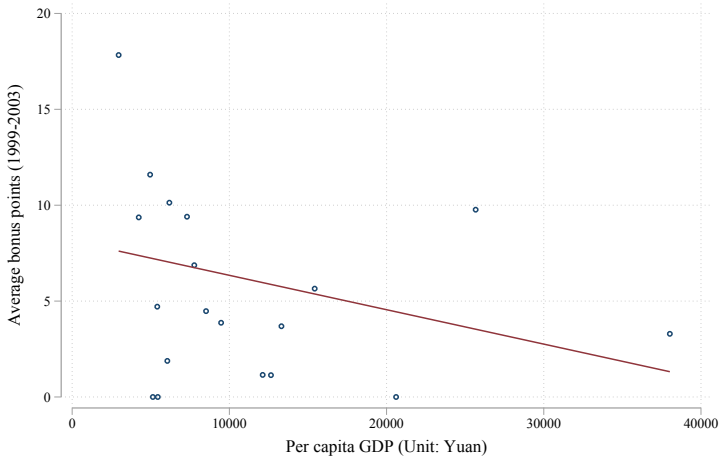
Appendix A: Figures and Tables



(a) Illiteracy rate in 1982



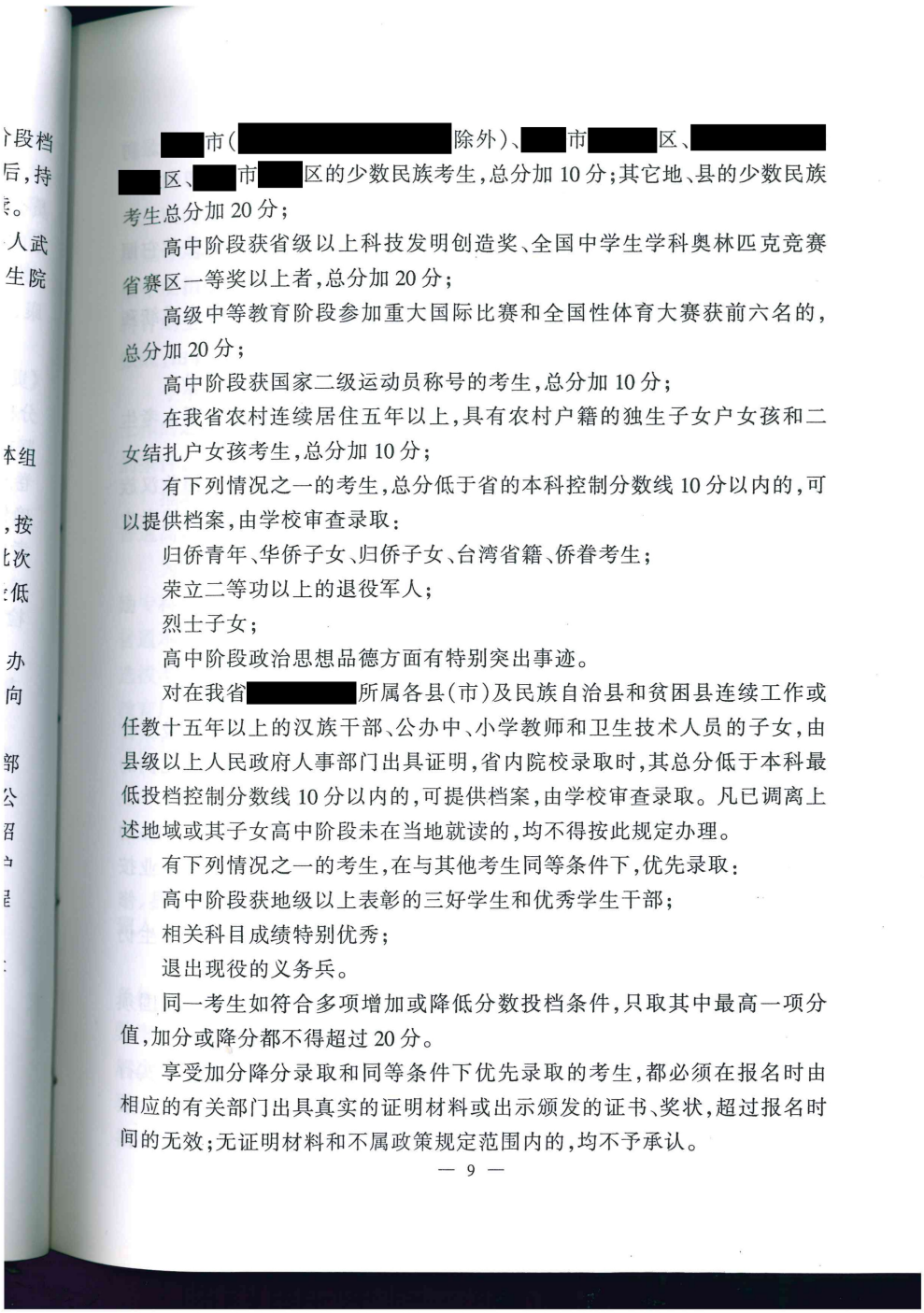
(b) Proportion of minorities in 1982



(c) GDP per capita

Figure A.1
Correlations Between Bonus Points and County Characteristics

Notes: This figure shows correlations between average bonus points for the 1999-2003 exam cohorts and county-level socioeconomic characteristics. In Panels (a) and (b), the *illiteracy rate* and the *share of ethnic minorities* are constructed from the 1982 National Population Census, restricting the sample to individuals aged 16 and above. Panel (c) relates average bonus points to *per capita GDP*, measured at the provincial level and assigned to the corresponding counties.



[redacted]市([redacted]除外)、[redacted]市[redacted]区、[redacted]区、[redacted]市[redacted]区的少数民族考生,总分加 10 分;其它地、县的少数民族考生总分加 20 分;

高中阶段获省级以上科技发明创造奖、全国中学生学科奥林匹克竞赛省赛区一等奖以上者,总分加 20 分;

高级中等教育阶段参加重大国际比赛和全国性体育大赛获前六名的,总分加 20 分;

高中阶段获国家二级运动员称号的考生,总分加 10 分;

在我省农村连续居住五年以上,具有农村户籍的独生子女户女孩和二女结扎户女孩考生,总分加 10 分;

有下列情况之一的考生,总分低于省的本科控制分数线 10 分以内的,可以提供档案,由学校审查录取:

归侨青年、华侨子女、归侨子女、台湾省籍、侨眷考生;

荣立二等功以上的退役军人;

烈士子女;

高中阶段政治思想品德方面有特别突出事迹。

对在我省[redacted]所属各县(市)及民族自治县和贫困县连续工作或任教十五年以上的汉族干部、公办中、小学教师和卫生技术人员的子女,由县级以上人民政府人事部门出具证明,省内院校录取时,其总分低于本科最低投档控制分数线 10 分以内的,可提供档案,由学校审查录取。凡已调离上述地域或其子女高中阶段未在当地就读的,均不得按此规定办理。

有下列情况之一的考生,在与其他考生同等条件下,优先录取:

高中阶段获地级以上表彰的三好学生和优秀学生干部;

相关科目成绩特别优秀;

退出现役的义务兵。

同一考生如符合多项增加或降低分数投档条件,只取其中最高一项分值,加分或降分都不得超过 20 分。

享受加分降分录取和同等条件下优先录取的考生,都必须在报名时由相应的有关部门出具真实的证明材料或出示颁发的证书、奖状,超过报名时间的无效;无证明材料和不属政策规定范围内的,均不予承认。

— 9 —

Figure A.2
Archival Example of an Official Admission Bonus Policy Document

Notes: This figure presents an archival example of an official CEE bonus-point policy document from our policy database.

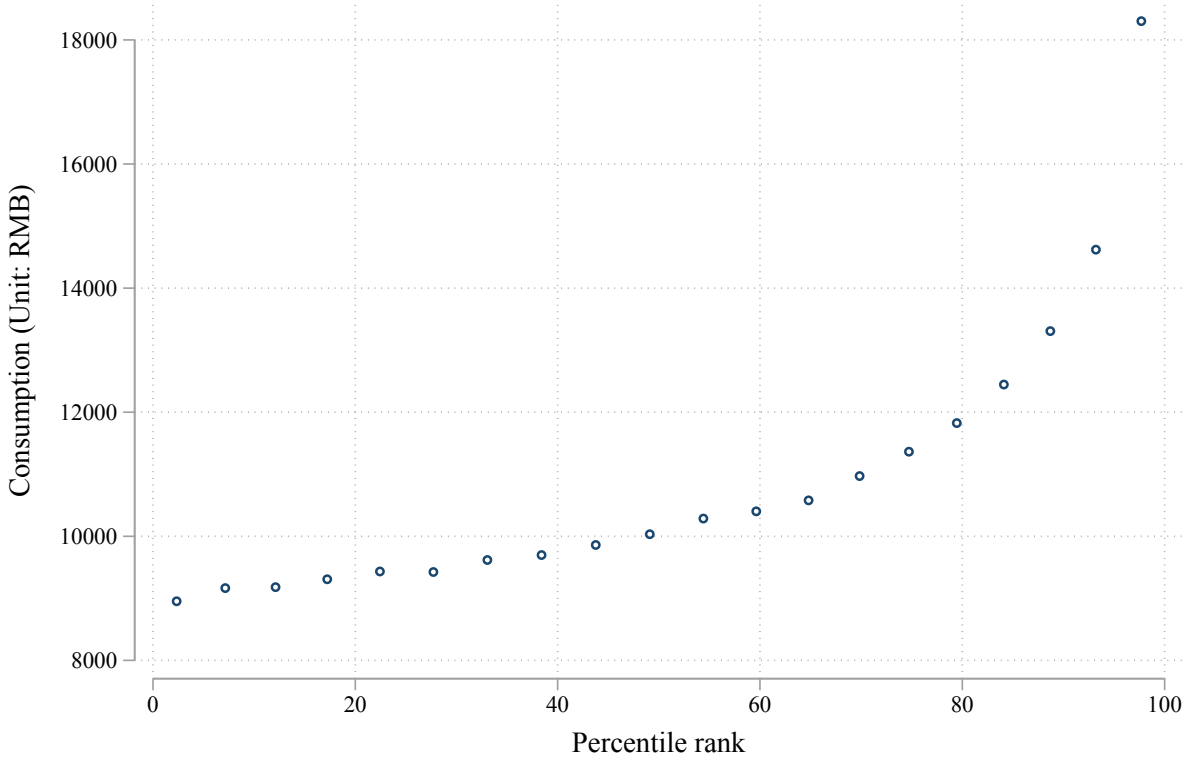


Figure A.3
Correlation Between CEE Rank and Consumption

Notes: This figure plots the raw relationship between the within-province-cohort-track percentile rank (%) and later-life average annual consumption (RMB).

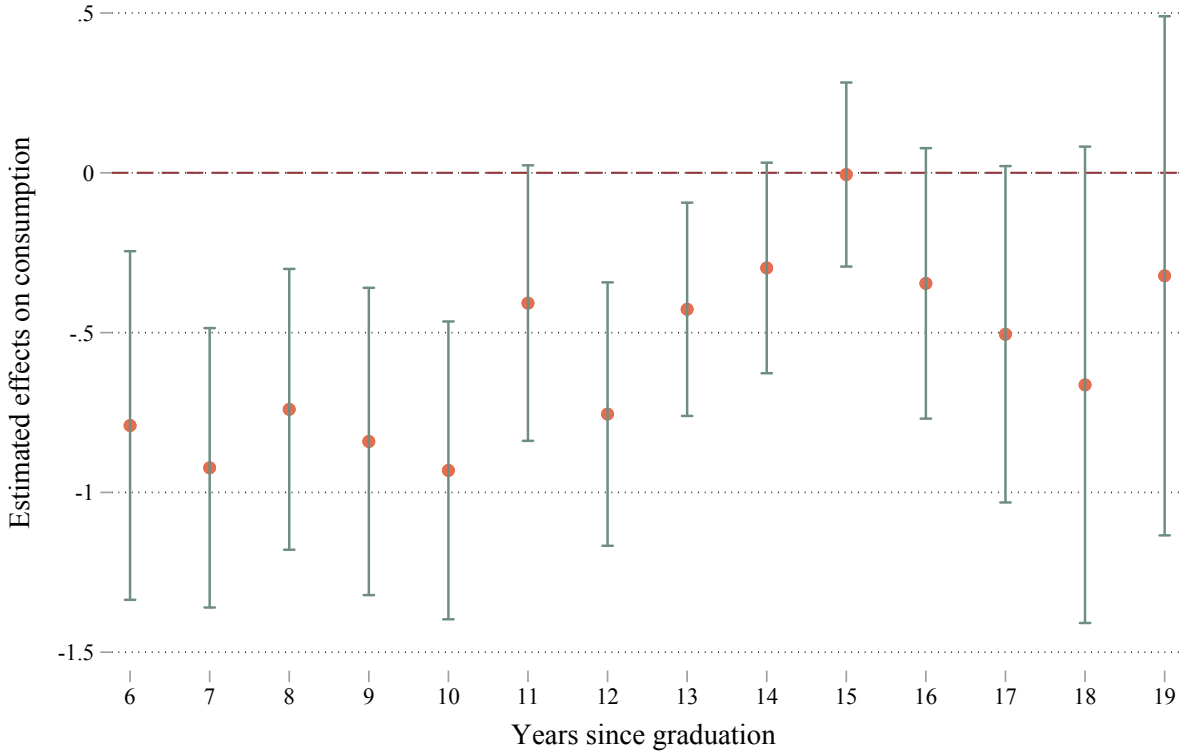


Figure A.4
Dynamic Effects

Notes: This figure reports point estimates and confidence intervals for the effects of AA doses on later-life average annual consumption (in log) by years since high-school graduation. All specifications include a full set of individual-level controls (female, age when taking CEE, rural), as well as county-ethnicity-track and county-cohort-track fixed effects.

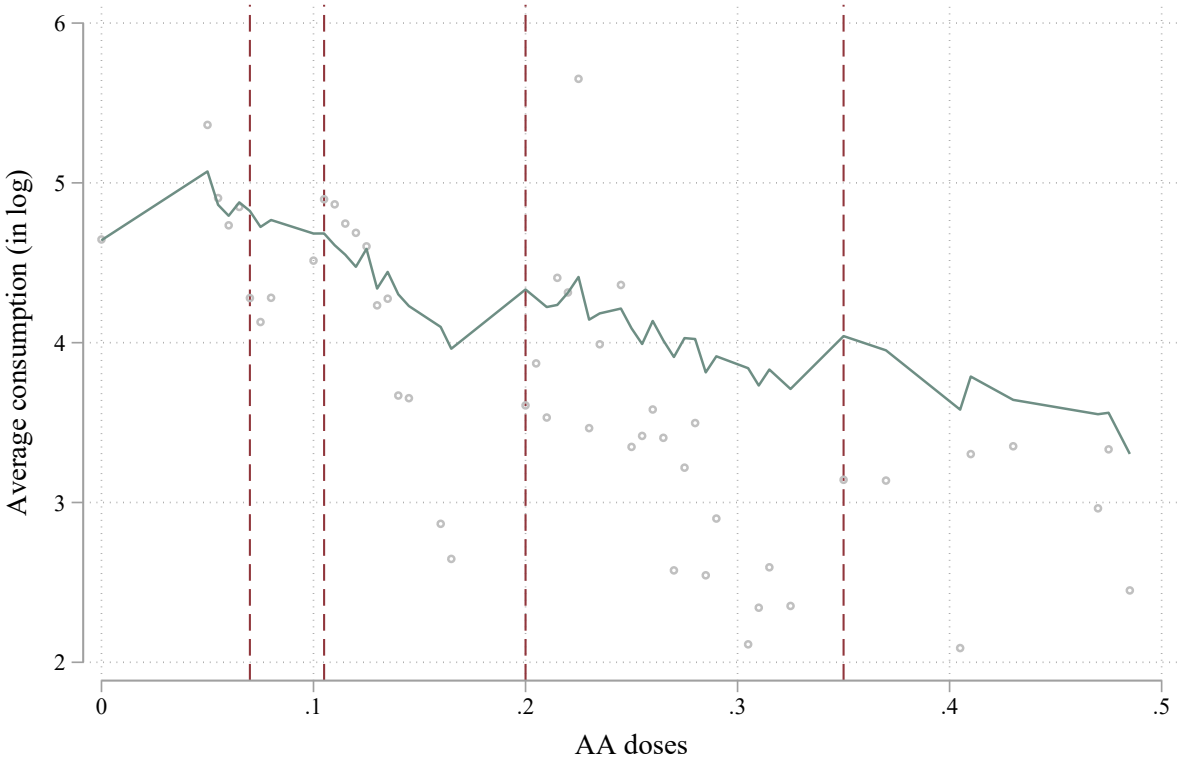


Figure A.5
Non-linear Relationship Between AA Doses and Consumption: Spline Estimates

Notes: This figure shows the relationship between AA doses and later-life average annual consumption (in log). Scatter points plot raw average consumption by bins of AA doses. The solid lines depict fitted values from a piecewise linear spline regression in which AA doses are partitioned into five segments using four pre-specified knots. Based on the distribution of the data, the knots are set at 0.07, 0.105, 0.20, and 0.35, as indicated by the dashed vertical lines.

Table A.1: Assessing the Randomness of AA Doses

	(1)	(2)	(3)
	Dependent variable: CEE rank (without bonus)		
AA doses	-23.426***	1.171	1.324
	(1.712)	(1.365)	(4.287)
County-ethnicity-track FE	NO	YES	YES
County-cohort-track FE	NO	NO	YES
Obs.	7,733,613	7,733,613	7,733,613
R2	0.29	0.30	0.22

Notes: This table assesses the potential endogeneity of AA doses by regressing students' original CEE ranks on the AA doses they receive. Column (1) reports the unconditional correlation without fixed effects. Column (2) adds county-ethnicity-track fixed effects, and Column (3) further includes county-cohort-track fixed effects. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2: Impact of AA Doses on Residential Location Choice

	(1) Log(Residential GDP)	(2) Tier 1-2 City	(3) Return to Birth City
Panel A: Linear effect			
AA doses	0.177*	0.043	-0.056*
	(0.101)	(0.037)	(0.033)
Panel B: Non-linear effect			
1^{st} quintile	-0.037**	-0.027***	0.019***
	(0.017)	(0.007)	(0.006)
2^{nd} quintile	0.057**	0.008	-0.020**
	(0.022)	(0.008)	(0.008)
3^{rd} quintile	0.074***	0.017**	-0.017**
	(0.023)	(0.008)	(0.008)
4^{th} quintile	0.003	-0.010	0.001
	(0.033)	(0.011)	(0.009)
5^{th} quintile	0.044	0.023*	-0.023**
	(0.034)	(0.013)	(0.012)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
Obs.	5,248,213	5,248,298	5,250,107

Notes: This table reports estimates of the effects of AA doses on individuals' residential location choices. An individual's residential city is defined as the location with the highest frequency of UnionPay transactions during 2013–2022. The dependent variables are as follows: Column (1) reports the logarithm of the residential city's average GDP over 2013–2022; Column (2) is an indicator for residing in a Tier 1 or Tier 2 city; and Column (3) is an indicator for residing in one's birth city. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A.3: Impact of AA Doses on Income

	(1) Income
Panel A: Linear effect	
AA doses	-0.185
	(0.577)
Panel B: Non-linear effect	
1^{st} tercile	0.026
	(0.108)
2^{nd} tercile	0.068
	(0.051)
3^{rd} tercile	-0.378*
	(0.226)
Controls	YES
province-ethnicity-track FE	YES
province-cohort-track FE	YES
Obs.	75,581

Notes: This table reports estimates of effects of AA doses on average annual income. Income data are available only for a subsample of individuals whose salaries are processed directly through UnionPay payroll systems. To ensure sufficient variation and statistical power within each group, we categorize individuals with positive bonus points into terciles rather than quintiles. All specifications include a set of controls (female, age when taking CEE, rural) and province-ethnicity-track and province-cohort-track fixed effects. Standard errors are clustered at the province-ethnicity-track level and reported in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A.4: Robustness: Piecewise Linear Spline Estimates of AA Doses on Consumption

	(1) Consumption	(2) Durables	(3) Non-durables	(4) Fin. Products	(5) Leisure
AA doses (Knot 0-0.07)	2.298**	0.477	1.485**	0.528	-0.072
	(0.920)	(0.748)	(0.655)	(0.687)	(0.356)
AA doses (Knot 0.07-0.105)	-4.532**	1.402	-2.599*	-1.641	0.159
	(2.109)	(1.629)	(1.544)	(1.645)	(0.701)
AA doses (Knot 0.105-0.2)	-2.186***	-0.819	-1.488**	-1.249***	-0.033
	(0.757)	(0.637)	(0.678)	(0.483)	(0.335)
AA doses (Knot 0.2-0.35)	-1.731*	-1.735**	-1.808**	-0.375	-1.281***
	(1.041)	(0.759)	(0.780)	(0.6764)	(0.363)
AA doses (Knot $>$ 0.35)	-2.787	-1.431	-2.520	0.570	-0.246
	(2.504)	(1.833)	(1.972)	(1.616)	(0.937)
Controls	YES	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES	YES
Obs.	7,672,623	7,672,665	7,672,480	7,672,846	7,672,821

Notes: This table reports the estimated coefficients from a piecewise linear spline regression of log(average annual consumption) on AA doses. The AA-dose variable is divided into four segments based on the knots at 0.07, 0.105, 0.2, and 0.35, allowing the slope to vary across these intervals. Each coefficient represents the slope of the specific spline segment. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.5: Robustness: Alternative AA-dose measures

	(1)	(2)	(3)
	Dependent variable: Average consumption		
	Dose measure 1	Dose measure 2	Dose measure 3
Panel A: Linear effect			
AA doses	-1.109***	-0.009***	0.005
	(0.235)	(0.003)	(0.005)
Panel B: Non-linear effect			
1^{st} quintile	0.154***	0.136**	0.092*
	(0.054)	(0.055)	(0.050)
2^{nd} quintile	0.030	-0.031	0.027
	(0.062)	(0.058)	(0.048)
3^{rd} quintile	-0.076	-0.143**	0.010
	(0.066)	(0.064)	(0.048)
4^{th} quintile	-0.175**	-0.123*	-0.109**
	(0.076)	(0.068)	(0.049)
5^{th} quintile	-0.426***	-0.134**	-0.134***
	(0.085)	(0.062)	(0.051)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
Obs.	7,672,623	7,672,623	7,672,623

Notes: This table reports the impact of AA doses on annual average total consumption using alternative measures of dose. *Dose 1* is the baseline measure, defined as the ratio of bonus points to the standard deviation of CEE scores. *Dose 2* is constructed as bonus points divided by the gap between the elite-university cutoff score and the mean CEE score. *Dose 3* measures the increase in percentile rank induced by bonus points. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.6: Robustness: Alternative calibration values

	(1) $K = 0$	(2) $K = 0.3$	(3) $K = 1$	(4) $K = 3$
Panel A: Linear effect				
AA doses	-1.093***	-1.143***	-1.261***	-1.599***
	(0.233)	(0.241)	(0.259)	(0.315)
Panel B: Non-linear effect				
1^{st} quintile	0.152***	0.158***	0.172***	0.212***
	(0.053)	(0.055)	(0.059)	(0.071)
2^{nd} quintile	0.030	0.029	0.028	0.025
	(0.061)	(0.063)	(0.068)	(0.083)
3^{rd} quintile	-0.074	-0.080	-0.093	-0.130
	(0.065)	(0.067)	(0.073)	(0.088)
4^{th} quintile	-0.172**	-0.181**	-0.203**	-0.264**
	(0.075)	(0.077)	(0.082)	(0.098)
5^{th} quintile	-0.420***	-0.437***	-0.475***	-0.585***
	(0.084)	(0.087)	(0.093)	(0.114)
Controls	YES	YES	YES	
County-ethnicity-track FE	YES	YES	YES	
County-cohort-track FE	YES	YES	YES	
Obs.	7,672,623	7,672,623	7,672,623	7,672,623

Notes: To address zero observations, we apply a log transformation with a calibrated extensive margin value, following the approach of Chen and Roth (2024). This table assesses the robustness of our main results to different calibrations of the extensive margin. We explore four values: 0, 0.3, 1, and 3. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.7: Robustness: Heckman two-step correction

	(1)	(2)	(3)	(4)	(5)
Panel A: Second step					
	Consumption	Durables	Non-durables	Fin. Products	Leisure
AA doses	-1.222***	-2.121***	0.125**	-1.404***	0.680***
	(0.041)	(0.082)	(0.051)	(0.069)	(0.041)
Obs.	6,896,652	6,896,640	6,896,504	6,896,796	6,896,767
Panel B: First step: Card usage					
AA doses	-0.203***				
	(0.015)				
No. of banks	0.059***				
	(0.001)				
No. of ATMs	0.065***				
	(0.001)				

Notes: This table applies the Heckman two-step procedure to address sample selection arising from the fact that consumption is observed only for individuals with bank card usage. In the first stage, in addition to the baseline controls, we use the number of banks and ATMs per 10,000 residents in an individual's birth city as exclusion restrictions. All specifications include a set of controls (female, age when taking CEE, rural) and county-ethnicity-track and county-cohort-track fixed effects. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.8: Summary Statistics (CCSS)

Variable	Observations	Mean	Std. Dev.
Panel A: Demographic characteristics			
Female (=1)	3817	0.50	0.50
Rural (=1)	3817	0.24	0.43
Retake (=1)	3817	0.16	0.37
CEE scores	3817	519.13	69.33
AA doses	3817	0.02	0.06
Panel B: Academic Outcomes			
Below median rank	3817	0.24	0.43
Fail in courses	3778	0.45	0.50
Panel C: Subjective Well-being and Campus Life			
Sat. with GPA	3817	0.22	0.41
Sat. with social activities	3817	0.16	0.37
Sat. with interpersonal relationships	3817	0.10	0.30
Overall satisfied	3817	0.11	0.31

Notes: This table reports summary statistics for the CCSS sample. To ensure comparability, the sample is restricted to cells that contain at least one individual with positive bonus points. Each cell consists of individuals who share the same birth city, birth cohort, academic track (liberal arts versus science), gender, hukou status (rural versus urban), and retake status.

Appendix B: Construction of Bonus Policies and Data Sources

While the original CEE dataset contains records of actual bonus points rewarded to students and various "bonus tags," these tags were not registered using a standardized coding system. The coding schemes varied significantly across provinces and even shifted within the same province across different years. Consequently, it is impossible to identify the specific rationale for each bonus awarded based solely on the raw data tags. To isolate the effects of ethnicity-based affirmative action, we conducted a comprehensive search to collect original policy documents from 1999 to 2003 to cross-reference with the individual-level bonus data.

Data collection. Given the limited internet infrastructure during the 1999-2003 period and the subsequent deletion of early digital records, most policy information was not readily available. We employed several channels to reconstruct the policy database:

1. **Library Archives and Yearbooks:** We manually consulted physical copies of Educational Examination Yearbooks held in various libraries to obtain policies for Yunnan, Hubei, Hunan, Jiangsu, Liaoning, Shandong (supplemented by channel 2 for the year 2002), and Tianjin (supplemented by channel 2 for the year 2003).

2. **Digital Media and Periodical Databases:** We retrieved information from archived news webpages and digitized paper magazines indexed in CNKI, Duxiu, and ChaoXing. This channel covered Beijing, Shanghai, Hebei, Henan, Heilongjiang, Jiangxi, and Zhejiang.

3. **Official Government Gazettes:** Policy documents for Guangxi and Shaanxi were obtained via official government portals.

4. **Direct Requests to Authorities:** We contacted provincial Education Examinations Authorities to request copies of historical documents, specifically the "Notifications on the Enrollment of Higher Education Institutions". Through this method, we secured documents for Anhui, Fujian, Guizhou, Hainan, Inner Mongolia, Sichuan, Chongqing, and Xinjiang.

5. **Inference from Proximate Years:** For Gansu, where 1999-2003 documents remained unavailable, we compared the earliest available policy (2004) with the actual

distribution of bonus points, ethnicity, and birth counties. The consistency in the data distributions confirmed that the policy remained unchanged during our sample period.

6. **Unresolved Cases:** Despite our efforts, including formal requests to all provincial departments of education that did not yield information through channels 1-3, we were unable to obtain detailed historical policy documents for Ningxia, Qinghai, Jilin, and Shanxi due to a lack of response or archival loss.

Categorization of Bonus Policies. Based on these documents, admission bonus policies can be categorized into several standard types common across most provinces. Each province established specific eligibility thresholds and determined the magnitude of the reward, which generally ranged from a 5-point to a 30-point increase in candidates' total CEE scores, or a priority in admission status.

1. **Ethnic Minority:** Bonus points awarded to students of ethnic minority backgrounds. This category is the central focus of our study.

2. **Honors and Leadership:** This category rewards students who have been awarded prestigious honorary titles, such as "Merit Students" or "Excellent Student Cadres" at the provincial or municipal level.

3. **Academic and Scientific Achievement:** Points for winners of scientific invention awards or rankings in Academic Olympiad competitions.

4. **Athletic Excellence:** Bonuses for students who achieved rankings in high-level sporting events or possessed National Athlete certificates.

5. **Social Merit and Sacrifice:** Special consideration for children of martyrs or individuals recognized for "acts of bravery".

6. **Regional and Overseas Connections:** Preferential treatment for returned overseas Chinese, children of overseas Chinese, and students from Hong Kong, Macao, or Taiwan.

7. **Military Service:** Bonus points for retired military personnel who received specific commendations.

In addition to these general categories, some provinces implemented unique local policies during our sample period. For example, Shandong province awarded a 10-point bonus to all current-year high school graduates prior to 2002, while re-takers were ineligible for this specific incentive. Candidates were required to submit formal supporting documents issued

by relevant authorities at the time of college entrance examination registration. These documents had to fall within the specific timeframes prescribed by provincial policy, typically achievements or certifications obtained during the three years of high school. Furthermore, according to the general regulations of the Ministry of Education, bonus points were not cumulative. Candidates qualifying for multiple bonus categories could only claim the one that provided the maximum point value.

Typology of Minority Bonus Policies. Based on our archival research, we categorized the provincial ethnic minority bonus policies into five distinct types:

1. **Universal Coverage:** All ethnic minority students within the province receive the same bonus without additional conditions (e.g., Beijing, Shanghai, Shaanxi, Jiangxi, and Henan).

2. **Region-Based:** Bonus points vary by residency, where students from designated "concentrated minority areas" receive higher bonuses than those in "scattered areas" (e.g., Zhejiang, Liaoning, Hubei, Hunan, Hebei, Guizhou, Hainan, and Gansu).

3. "Ethnicity-Based": AA doses are determined primarily by the specific ethnic group (e.g., Xinjiang).

4. **Hybrid (Ethnicity and Region):** Bonuses are contingent upon both the student's specific ethnicity and their registered residency (e.g., Yunnan and Fujian).

5. **Selection-Based:** Higher bonuses are granted only if students apply to local provincial universities or specialized "Nationalities Universities"[9] (e.g., Tianjin, Jiangsu, Anhui, and Heilongjiang).

Sample Restrictions and Exclusions. Although we obtained policy documents for almost all provinces, we excluded several provinces from our analysis due to data limitations or policy-induced endogeneity:

- **Xinjiang:** According to provincial policy, eligibility for the maximum minority bonus was contingent upon whether both parents belonged to a specific group of eleven designated ethnic minorities. Students with only one parent from these eleven groups were eligible for a significantly lower bonus. Since our data does not contain parental ethnicity information, we could not accurately isolate these minority-specific bonus items from other potential rewards.

[9]These institutions are specifically established to serve ethnic minority populations and often have lower admission thresholds or higher incentives for minority applicants.

- **Chongqing and Sichuan:** In these provinces, bonus varied based on the tier of the university to which the student was admitted. For instance, in 2003, Sichuan awarded a 25-point bonus to candidates from concentrated minority areas if they were admitted to first-tier universities, but a 50-point bonus if admitted to other institutions. This mechanism creates a direct correlation between AA doses and student ability, introducing significant endogeneity.

- **Shandong:** Prior to 2002, Shandong province granted a universal 10-point bonus to all current-year high school graduates. The abolition of this policy in 2002 created a confounding of policy effects, making it difficult to disentangle the impact of minority-specific benefits from the removal of the general graduate bonus.

- **Inner Mongolia:** The official policy for major minority groups (Mongolian, Daur, Oroqen, and Ewenki) utilized qualitative language, stating that students could be "admitted with a lowered score threshold where appropriate" rather than specifying a fixed point value. Consequently, the actual recorded bonuses for minorities in this region range from 1 to 141 points, reflecting a highly non-standardized implementation that is unsuitable for our dose-based measure.

- **Guangxi:** The bonus policy in Guangxi is characterized by a complex overlap of ethnic, geographic, and developmental criteria, making it distinct from a purely ethnicity-based affirmative action program. Specifically, the province provides bonuses not only to students in 15 autonomous minority counties but also to those in 33 designated mountainous counties. Furthermore, candidates from border counties receive an additional 10-point reduction in admission thresholds on top of existing regional bonuses. Crucially, these preferences apply to all candidates regardless of ethnicity (including Han students) within these jurisdictions. Consequently, the policy represents a hybrid of ethnic, border-area, and poverty-alleviation incentives, which prevents the clean isolation of a minority-specific treatment effect from general regional subsidies.

Variable Construction and Data Cleaning. We constructed our measure of minority AA doses by cross-referencing individual data (i.e., ethnicity, hukou, birth county, and actual bonus points) with the rules identified in the policy documents. We removed observations where the recorded bonus exceeded the theoretical minority bonus, which suggest the student claimed a higher, non-minority-related item. We allowed for actual bonuses to be lower than theoretical values. This accounts for cases where students were eligible but the bonus was not activated or required additional review that was not passed. Discrepancies may also arise because birth county does not perfectly align with the student's actual

CEE registration location. We allowed for cases where the actual bonus recorded in the dataset was lower than the theoretical maximum. This discrepancy is primarily attributed to several institutional and administrative factors. Policy documents specify that even for eligible candidates, preferential treatment is subject to "institutional review and merit-based selection". This requirement implies that the bonus is not automatically applied by the system but instead requires formal verification by the admitting university. Consequently, if a candidate's original score is already high enough to meet the admission threshold without the bonus, or if the student did not proactively complete the verification process, the bonus may not be reflected in the final enrollment record. Besides, Students may sit for the exam in a different administrative region aside from their Hukou region. In such cases, candidates who move from a concentrated minority area to a region with lower bonus typically lose eligibility for the higher bonuses tied to their original Hukou location. While several provinces (Hainan, Hunan, and Gansu) allow Han students in minority concentrated areas to receive bonuses, we exclude them from the baseline to maintain a clean focus on minority groups. Re-including them does not alter our results. In certain provinces, the bonus magnitude is contingent upon the candidate's choice of institution. For example, in 2003, Anhui provided a base 5-point bonus for all ethnic minority candidates, which increased to 20 points if the candidate applied to a Nationalities University as their first-tier choice. To address potential selection bias, we assigned all minority candidates in these provinces the minimum guaranteed bonus (e.g., 5 points in the case of Anhui) regardless of their actual institutional preference. Given that only a negligible fraction of candidates in our sample opted for these specific institutions, this conservative adjustment does not qualitatively alter our primary findings.