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A MATTER OF THE DOSE

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ABSTRACT

Extensive discussion centers around the question of whether affirmative action (AA) in higher education "works," despite AA being in practice a continuous policy instrument. We study the dose effects of AA on its intended beneficiaries by exploiting the ethnic minority bonus-point policy in China's centralized college admissions system, where targeted students receive explicit point advantages. Exploring cohort-level fluctuations in exam score distributions that generate plausibly exogenous variation in the effective dose of AA, we show that higher AA doses increase recipients' admissions to colleges and elite colleges, but lower their academic rankings, shift them toward lower-earning majors, and reduce their satisfaction with college life. From data linking college entrance exam (CEE) records to comprehensive card transaction records 10–23 years after CEE, we find that low AA doses increase long-term consumption by 19%but high doses reduce it by 25%. Such non-monotonic dose responses exist across expenditure categories, including child-related expenditure, suggesting potential impacts on future generations. Heterogeneity analysis reveals that while the positive effects of low AA doses persist across student groups, students from stronger academic backgrounds are more resilient to the negative effects of high AA doses. Overall, our results suggest that careful calibration of AA policies is crucial for achieving their intended goals.

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1 Introduction

Affirmative action (AA) in higher education is one of the most consequential and contested public policies worldwide (Arcidiacono and Lovenheim, 2016). Proponents emphasize that AA can expand access to high-quality colleges for historically disadvantaged groups and improve socioeconomic mobility; critics argue that AA can generate student–institution mismatches and potentially harm its intended beneficiaries. Despite decades of debate, policies are typically evaluated as if AA were a binary choice—either implemented or not—and researchers have been keen to answer the question of whether AA "works." In practice, however, AA is a continuous policy instrument: governments/colleges choose how strongly to tilt admissions criteria in favor of disadvantaged groups. Treating AA as an on/off switch obscures a central policy question: how much AA is too much, and how much is too little?

In this paper, we take a step forward by studying a major nationwide AA program in China, the ethnic minority bonus-point policy in the College Entrance Examination (CEE). Our setting has three features that make this progress feasible. First, in contrast to settings where AA operates through opaque or institution-specific mechanisms that make the magnitude of AA difficult to quantify (Bagde et al., 2016; Hoxby, 2025), AA in our setting is transparent and easy to measure. Ethnic minority students receive explicit bonus points added directly to their CEE scores; one's total score, in turn, determines one's priority in a centralized admissions procedure.

Second, although nominal bonus points are often fixed within a county–ethnicity group, their effective value varies across cohorts due to fluctuations in exam difficulty and hence in CEE score distributions, resulting in plausibly exogenous variation in the dose of AA within narrowly defined groups. This variation allows us to move beyond a dichotomous evaluation of AA and study its dose effects.

Third, our data provide comprehensive measures of students' admission, in-college, and long-term outcomes. Our main data, pre-merged at the individual level, consists of two major data sets. The first is the administrative CEE records (demographics, test scores, and admission results) for every test taker between 1999 and 2003, allowing us to measure students' immediate outcomes, i.e., college admissions. The second is the comprehensive transaction records from one of China's dominant payment networks, allowing us to track individuals' long-term economic outcomes measured by their expenditure 10 to 23 years after taking the CEE. Our supplementary data, from the China College Student Survey (CCSS), provides rich information on students' in-college performance and subjective well-being.

With these institutional and data advantages, we start our empirical analysis by measuring the dose of AA as the ratio of nominal bonus points to the standard deviation (sd) of the CEE score distribution within a province-cohort-track cell. Given the cross-cohort variation in the CEE score distribution, the same nominal bonus point can translate into different effective advantages across cohorts. Utilizing this variation, our estimation, similar in spirit to the re-centering approach by Borusyak and Hull (2023), 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, holding fixed all time-invariant characteristics of each (county, ethnicity group, exam track) cell. In addition, we include county-cohort-track fixed effects to account for unobserved local shocks that may affect students' CEE outcomes (e.g., cohort-specific changes in education policies within a given county-track).

Utilizing the variation in AA doses, we examine AA's impacts on a rich set of student outcomes. First, we find that higher doses of AA substantially expand college access but also lead to poorer academic fit. A typical AA dose—0.1 in our dose unit—raises the probability of admissions to college by 3.0 percentage points (ppts, hereafter) and to Tier-1 colleges by 1.3 ppts. However, the same increase in AA doses also puts students in colleges where they are relatively under-prepared, lowering their CEE-score ranking among peers by about 1.9 ppts; moreover, it shifts them away from higher-earning majors toward lower-earning majors.

Second, following these students 10–23 years after they took the CEE, we find that the long-term dose effects of AA are non-monotonic. Relative to their counterparts receiving no bonus point, students receiving low doses of AA (the bottom quintile of the dose distribution) experience a 19% increase in long-term consumption. In contrast, students exposed to high doses suffer large and persistent losses, with consumption falling by 11% (25%) among those in the fourth (fifth) quintile of the dose distribution. Intermediate doses generate no detectable effects. The non-monotonic dose responses exist across subcategories of expenditures, including child-related expenditure, suggesting potential impacts on future generations. High doses also reduce the variety and diversity of consumption baskets, suggesting that the long-term losses extend beyond total spending to the structure of consumption.

We find no evidence that these non-monotonic effects are driven by differences in living costs across residential locations or by substitution between consumption and savings/investment. Moreover, similar non-monotonic dose-responses are mirrored in the income data for a subsample where such information is available.

Breaking students into subgroups by their CEE score rankings, we find that while all groups benefit from low doses of AA, academically stronger students are more resilient to higher doses of AA. In particular, for those in the top quartile of the CEE score distribution, AA is largely beneficial; the negative effect occurs only at the highest quintile of AA doses. Consistently, for students from the bottom quartile of the high-school quality distribution, the effect of AA is largely negative, except at the lowest quintile of the dose distribution, where the effect is positive. These findings highlight that, for disadvantaged groups, there exists an important complementarity between pre-college education and AA at the college admission stage. In contrast, the impacts of AA do not differ significantly by gender or rural/urban hukou status.

Third, to bridge the immediate enrollment effect with the long-term consumption effect, we exploit the CCSS data and find that higher AA doses are associated with lower in-college academic standing and subjective well-being. On average, a 0.1 increase in the AA dose lowers the self-reported satisfaction with GPA by 11% and college life by 16% of the sample mean. However, the decline in both academic standing and subjective well-being is concentrated among students in the highest AA dose group, who are, for example, 5.1-ppt more likely to report lower satisfaction with college life. In contrast, students exposed to lower doses show little evidence of such difficulties. These findings suggest that while high AA doses place students in prestigious colleges, these students may struggle to adapt both academically and socially. These short-term academic and social life challenges can translate into persistent differences in human capital accumulation and long-term economic outcomes.

Finally, to the extent that AA-targeted students may crowd out non-targeted students in college admissions, we also partially examine AA's long-term effects on non-targeted students using regression-discontinuity designs around the first-tier, second-tier, and vocational-college admission cutoffs. These cutoffs generate sharp discontinuities in admission probabilities, confirming that they are meaningful margins of college access. However, we find no corresponding discontinuities in long-term consumption around any of these thresholds, which is consistent with findings from other settings (e.g. Bleemer, 2022; Barahona et al., 2023; Black et al., 2023). This suggests that, at least for marginal non-targeted students near these cutoffs, AA does not generate detectable long-term spillover effects.

While our analysis focuses on China, the lesson learned is general. Many AA systems—whether through bonus points, admission thresholds, top $x\%$ programs, or holistic evaluations—implicitly vary in strengths across institutions, cohorts, and applicants. Our results suggest that averaging over heterogeneous policy intensities can mask both sizable gains from moderate AA and substantial losses from overly aggressive implementation. The dose-response analysis we conduct provides a lens for interpreting mixed evidence from other settings and for designing AA policies to improve the outcomes for their intended beneficiaries. More broadly, it highlights the importance of calibrating redistributive policies when benefits and costs respond nonlinearly to policy intensity.

Our paper contributes to the long-standing debate about the effects of AA on its intended beneficiaries. On the positive side, a growing body of work 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 (e.g. 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 negative side, critics are concerned about "mismatches," in that AA may lower academic performance, persistence, and degree completion when students are placed in environments for which they are underprepared. This argument is supported by a series of empirical studies (e.g. Arcidiacono et al., 2011, 2016; Arcidiacono and Lovenheim, 2016; Barrow et al., 2020; Dillon and Smith, 2020). It is hard to settle this debate because there is truth to both sides of the argument: a college's overall quality and the student–college match quality are both important for a student's outcome (e.g. Arcidiacono and Lovenheim, 2016). 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.[1]

In addition, our rich data provides a comprehensive view on how AA might affect students' outcomes in the short- and long-term. Moreover, using the in-college experience survey (CCSS), we bridge students' immediate enrollment outcomes and their long-term outcomes with new evidence on how the dose of AA affects students' in-college performance and subjective well-being with respect to peer relationships and overall college life.[2] Our findings from CCSS echo those from previous studies on students' sense of belonging and social integration in college, which highlight that disadvantaged or underrepresented students may face challenges in peer relationships and campus life (Brady et al., 2020; Aucejo et al., 2023).

The remainder of the paper proceeds as follows. Section 2 describes the background. Section 3 presents a simple model to illustrate the trade-offs generated by AA. Section 4 introduces the data and defines our AA-dose measure. Section 5 presents the empirical strategy. Section 6 and Section 7 present the main results and robustness checks. Section 8 discusses the potential crowd-out effect. Section 9 concludes. The appendices contain

[1]Another unintended consequence of AA not considered here is that targeted beneficiaries may reduce their pre-college effort (Tincani et al., 2025).

[2]A growing literature uses survey-based data to study students' expectations, valuations, and non-pecuniary aspects of higher education (e.g., Zafar (2011, 2013); Wiswall and Zafar (2015); Patnaik et al. (2021)).

additional results and details.

2 Background Information

2.1 Chinese Colleges and Admissions

College Tiers Chinese higher education consists of colleges granting Bachelor's degrees and those granting Associate degrees (vocational colleges). The first category consists of three tiers, with Tier-1 colleges, closely overlapping with the 115 "Project 211" colleges, being the most selective.[3] In an average year during our sample period, the fractions of all CEE takers nationwide admitted to Tier 1, Tier 2, and the remaining colleges (Tier 3 plus vocational) are 11.6%, 17.9%, and 31.4%, respectively.[4] Within each category-tier, colleges differ by peer quality and program quality, both of which matter for human-capital accumulation.

College Entrance Exam China's annual national college entrance examination (CEE) is the decisive gatekeeper for higher education. Each year, approximately 10 million students take 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, relative to her province-year-track peers, plays a nearly exclusive role in determining college placement, leaving little room for discretion in admissions, as we describe next.

[3] "Project 211" is a strategic initiative launched by the Chinese government in 1995 to enhance the global competitiveness of selected colleges. The term "211" refers to the goal of developing approximately 100 elite colleges for the 21st century.

[4] Our data do not allow for a clear distinction between the last two groups of colleges.

College Admissions College admissions are conducted in a centralized system 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, a student's choice set includes about 2,839 programs nationwide.[5] We aggregate the 96 majors into 10 broader categories—Agriculture, Economics, Education, Engineering, Health, History, Law, Literature, Management, and Science—consistent with the one-digit major classification by the Ministry of Education of China.

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) and 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.[6] Because our data record realized admission outcomes but not applicants' submitted preference lists, we cannot analyze application behaviors and how these behaviors are affected by AA policies. Instead, we focus on the reduced-form effects of affirmative action on college enrollment,

[5] The corresponding figures are approximately 4,693 programs for Science-track students and 1,625 programs for Social-Science-track students.

[6] Students' information about their performance could also affect their application behaviors. During our sample period, three broad regimes were used in terms of when students submitted their rank-ordered lists: before taking the CEE, after taking the CEE but before the official scores were revealed, and after observing their official CEE scores. We do not find that our results differ systematically across these regimes (Section 7).

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 that award bonus points to CEE scores for qualifying candidates; the post-bonus total score is the sole criterion for evaluating students in college admissions.[7] The most widespread is ethnic-minority bonus programs: since the early 1980s, government-determined eligible ethnic minority candidates have frequently received nominal extra points, commonly in the range of 5–30 points.[8] Figure 1 shows the spatial distribution of average bonus points at the birth-county level for the 1999–2003 cohorts, conditional on receiving positive bonus points. In our sample, the average pre-bonus CEE score is 426 (s.d. is 96.1) overall, 539 among students admitted to Tier-1 elite colleges, and 411 among those admitted to non-elite colleges. In this context, a bonus of 5 to 30 points provides non-trivial advantages.

The bonus program is administered at the county–ethnicity level and typically applies uniformly to all qualifying candidates in a county, 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 average schooling and GDP per capita.[9]

The nominal bonus points awarded to an ethnic minority group in a county are typically fixed. However, due to variation in specific exam questions, the overall CEE exam difficulty

[7] Besides minority AA bonuses, other major categories include bonus points for athletic achievement and for winning national academic competition (Appendix B). One may claim bonuses only from one category.

[8] There are 55 ethnic minority groups in China, while Han is the only ethnic majority group.

[9] In Hunan, Hainan, Yunnan, and Gansu, ethnic Han residing in concentrated minority areas are also eligible for bonus points, albeit receiving lower bonus points than their ethnic minority peers in the same regions. We include these students (0.44% of our sample) as beneficiaries in our analysis, as the rationale for AA bonuses in concentrated minority areas rests on compensating for the linguistic, cultural, and economic disadvantages associated with growing up in such regions.

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 salient institutional changes that occurred in three provinces. In Jiangsu, ethnic minority students received no bonus until 2001, when the provincial government introduced a uniform 5-point bonus for all officially registered minority students. Henan implemented the same reform one year later. Hainan moved in the opposite direction: ethnic minority students residing outside minority-concentrated areas received a 10-point bonus until 2002, when the bonus was replaced by a mere tie-breaking advantage, leading to no guaranteed benefit in practice. These reforms created discontinuous changes in the preferential treatment received by otherwise identical minority students 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, with the goal of illustrating 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.[10]

[10] 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

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

where $D_h (q_j - a_i)$ is a function of the distance between q_j and a_i, capturing the effect of match quality in producing human capital. An "overmatch" occurs when $q_j - a_i \gg 0$ and an "undermatch" occurs when $q_j - a_i \ll 0$;[11] most relevant to the "mismatch" argument against AA is the potential negative effect arising from "overmatch."

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

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

[11] Dillon and Smith (2017) find that both cases are prevalent among U.S. students in general.

The coefficient λ_g captures the group-specific net consumption value for college quality (e.g., preference for quality net of price); the function $D_u(q_j - a_i, g_i)$ captures the effect of match quality on one's utility, which may 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.,

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

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.

Even 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.[12]

[12] Some studies (e.g. 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; while some other studies (e.g. Hoxby and Avery, 2012; Hoxby and Turner, 2015) find that information frictions about net tuition and the application process cause undermatches among high-achieving low-income U.S. students.

3.3 Model Implications

This model captures the arguments on both the positive and negative sides of the AA debate. On the affirmative side, AA expands a student's option set from $\{j|s_i \geq s_j^*\}$ to $\{j|s_i + b \geq s_j^*\}$. The expanded set includes 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.[13]

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.

[13]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 and Summary Statistics

4.1 Data

Our main data are students' administrative College Entrance Examination (CEE) records pre-merged with card transaction records from UnionPay.[14] These anonymized data contain individuals' CEE scores, demographic characteristics, college admission outcomes, and detailed expenditure data spanning 10 to 23 years after taking the CEE or 6 to 19 years after college for those who graduated from college.

4.1.1 College Entrance Examination Data

The CEE 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, birth county, high school, academic track, raw CEE score, bonus points, and a set of admission outcomes, including the college-major admitted to and whether the college was the student's top choice on her application list.

The CEE data have two limitations. First, we do not observe students' application lists, beyond whether a student was admitted to her top choice. This prevents us from studying AA's impact on students' application behaviors; however, it does not affect our ability to study the (reduced-form) effect of AA on students' admission and long-term economic outcomes.

Second, the CEE data report the bonus points awarded to each student but not the reason for the bonus. To overcome this data limitation and isolate bonuses due to ethnic minority status, we undertook extensive archival work to collect official bonus point policies across provinces and cohorts. We reached out to all provincial education departments for their policy documents and utilized library archives, ultimately compiling 68 official documents. Figure A.2 displays a sample of an official document on the bonus point policy. We supple-

[14]We access the anonymized data via a secure bastion server.

ment policy information with contemporaneous media records, including news coverage and periodical archives. In return, we obtain clean information on ethnic minority bonuses from 19 provinces in China (detailed in Appendix B) and focus on CEE test takers from these provinces, who account for 47.8% of all CEE test takers in an average year.

4.1.2 Card Transaction Data

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).[15] 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 after 2018. Our findings are robust when restricting our sample to 2013–2018, a period in which mobile payments were less popular.

Consumption Data UnionPay's database covers the universe of credit and debit card (or "bank card") transactions in China settled through the UnionPay network. The database includes the details of each card transaction—city, date, merchant category, and amount—and the cardholder's demographics (gender, age, and birthplace). Our baseline outcome is the average annual consumption over the sample period. We also use merchant-category information to measure the breadth and diversity of consumption. The category-count measure is the number of distinct merchant categories in which an individual has positive expenditure. The diversity measure is a normalized index based on the distribution of expenditures across

[15] 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.

merchant categories.

The UnionPay data was pre-merged with the CEE records for 83% of students; the 17%, including all students from Guangdong, were unmatched due to a lack of national ID information in the CEE records. Table A.1 compares the information available in the CEE data for the matched sample and the sample including the 17% unmatched individuals; the differences are statistically significant but not economically meaningful; furthermore, for outcomes available in the CEE data, results are highly consistent excluding or including these 17% individuals (Section 6.1). These results suggest that our findings for other outcomes available only for the matched sample are plausibly generalizable.

Income Data For a subsample (around 2%) of individuals, whose employers use UMS to process payroll, UnionPay also provides information on individuals' annual income and industry of employment.[16] There are systematic differences between this subsample and the full matched sample (Table A.2): the income subsample individuals are younger and more likely to have urban hukou and higher CEE rankings. Our analysis of income outcomes (Section 6.2.3) accounts for these differences.

4.1.3 China College Student Survey

We complement our main data with the Chinese College Student Survey (CCSS), a nationally representative survey of graduating college students from 2010 to 2015 (Jia and Li, 2021). This anonymous survey was conducted in 90 institutions selected to reflect China's diverse higher education landscape, from elite colleges to vocational colleges, covering roughly 40,000 students. Survey respondents reported their CEE scores, demographic background, college and major, and in-college performance and experience. We focus on a subset of variables that capture students' in-college performance (e.g., GPA percentile rank, course failure) and subjective well-being (e.g., satisfaction with peer relationships and overall experience).

[16]The fraction is low because, while UnionPay is a major network for consumption in China, most employers process payroll through direct bank transfers rather than through UnionPay.

These variables allow us to shed light on how AA shapes educational attainment as well as students' in-college well-being.

4.2 Variable Definitions and Summary Statistics

4.2.1 Variable Definitions

We introduce the definition of several constructed measures used in our analysis.

CEE Ranking is calculated based on a student's pre-AA-bonus CEE score relative to *all* CEE test takers in her province-track-cohort, including those excluded from our main sample. This measure is meant to capture one's pre-college ability, as we discuss in Section 5.2.

High School Quality is measured by the average CEE ranking of all students in a school's first cohort observed in our data.

College Quality is measured by the leave-one-out mean of province-cohort-track CEE ranking of *all* enrolled students in each college, including those excluded from our main sample.

College Peer Quality is defined as the leave-one-out average "ability" of peers enrolled in the same college-major-cohort, where "ability" is measured in two ways: the first uses student CEE ranking defined above, and the second uses student pre-AA-bonus CEE scores among provinces that administered the same exam paper in the same track and year. The two measures are complementary: the first measure is available for all students, but the within-province percentile rank may not be comparable across provinces; the second measure improves cross-province comparability but excludes peers from the 13 province-cohorts that used different exam papers (about 25% of enrollees in these cohorts).[17] Accordingly, the first measure of a student's relative "ability" among peers is her CEE ranking minus the leave-one-out average peer CEE ranking; the second is her pre-AA-bonus CEE score minus the leave-one-out average pre-AA-bonus CEE score of peers who used the same exam paper.

Major-Specific Earnings Potential is measured by the average major-specific consumption

[17] We verify that this exclusion is not systematically related to peers' academic ability: the regression of the exclusion dummy on percentile rank yields an insignificant and near-zero coefficient (-0.0005).

observed in our UnionPay data. Based on this measure, the top three majors are Economics, Management, and Engineering; the bottom three majors are Health, Education, and History. This classification closely aligns with the major-specific average income published in the 2023 Chinese College Graduate Employment Report by MyCOS—the leading higher education consulting firm in China and one of the world's largest of its kind.

Consumption Categories: The UnionPay data classify transactions into 304 detailed consumption subcategories. We aggregate them into five groups: durables, non-durables, leisure, financial investment, and others. Durables include long-lasting goods and related services, such as housing, appliances, electronics, furniture, automobiles, and jewelry. Non-durables cover frequently consumed goods, including groceries, dining, clothing, cosmetics, and other everyday retail purchases. Leisure captures entertainment, recreation, travel, cultural activities, and related goods. Financial investment includes insurance, stocks and mutual funds, and other financial services transactions.

4.2.2 Summary Statistics

In this subsection, we report summary statistics for our main sample, i.e., the CEE–UnionPay matched sample, excluding the 1.8% individuals receiving bonus points for reasons other than ethnic-minority status (e.g., athletes and academic Olympians). Our main results are robust when we include these individuals.

Panel A of Table 1 reports demographic characteristics of the main sample. The sample includes over 9 million CEE takers, of whom 40% are female, 4.3% are ethnic minorities, and about half come from rural areas. Around 55% of students follow the science track in high school, 27% follow the humanities track, and 19% follow the comprehensive track.

Panel B summarizes students' CEE performance. The average pre-bonus CEE score is 426.1, with a sd of 96.1. We construct a within-province-cohort-track percentile ranking to standardize student performance; the mean percentile rank is 49.8. Among all test takers, the average bonus points is 0.45, with only 3.6% of them receiving a positive bonus. Among those who receive any minority bonus, the mean bonus points are 13.1.

Panel C summarizes college admission outcomes. About 61% of students are admitted to college, 12% to Tier-1 colleges, and 41% to their top-listed program in their application. The rest of Panel C focuses on students admitted to some college. Among them, the quality of college is 62 on average and the sd is 24, reflecting a relatively large dispersion in college quality. In terms of the earnings potential of enrolled majors, 64% enroll in the top three majors and 5% in the bottom three majors.[18]

Panel D reports consumption and income 10 to 23 years after taking the CEE, deflated to 2013 values using the CPI published by the National Bureau of Statistics of China. The average annual consumption is around 10,986 RMB. The average annual income, among the subsample of individuals with income data available, is around 97,146 RMB.[19]

Figure A.3 shows a strong positive relationship between CEE percentile rank and long-term average annual consumption, suggesting that CEE rank provides a meaningful measure of one's ability both pre-college and in the long term. The slope steepens notably in the upper tail of the distribution, particularly beyond the 85$^{\text{th}}$ percentile, which coincides with the fact that roughly 12% of students were admitted to elite colleges.

5 Empirical Strategy

5.1 AA Doses

To identify the dose effect of AA, we exploit year-to-year variation in the "effective value" of bonus points within county-ethnicity-track cells, which arises from two sources. First, although the nominal bonus points awarded to an ethnic minority group in a county are typically fixed over time, the admission advantage they confer depends on the province-

[18]These proportions in our sample are very similar to those among all admitted students nationwide, including those from provinces excluded from our sample. The top-three majors are larger in size, e.g., Engineering accounts for approximately 40% of all admitted students.

[19]For this selected subsample, the average annual consumption is around 43,997 RMB. 1 RMB is around 0.15 USD.

cohort-specific distribution of CEE scores, leading to intensive-margin variation in AA doses. Second, as mentioned in Section 2.2, three provinces introduced or removed AA bonuses for some or all minority groups during our sample period, leading to extensive-margin dose variation across policy regimes.[20]

To capture this variation, we define the AA dose a student received as the ratio of her bonus points to the sd of CEE scores within her province-cohort-track. Specifically, the AA dose D_{jest} for ethnicity e in county j (province p), track s, and cohort t is given by

$$D_{jest} = \frac{\text{BonusPoint}_{jet}}{\text{SD}_{pst}}, \tag{4}$$

where BonusPoint_{jet} is the nominal bonus awarded to the corresponding county-ethnicity-cohort cell; and SD_{pst} is the sd of CEE scores in province p, track s, and cohort t. Given the AA policy, all students within a (j, e, t) cell receive the same dose.

With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1, with significant variation in AA doses within narrowly-defined groups across cohorts (the sd of AA doses among those receiving positive points is 0.08).

5.2 Empirical Specification

Having constructed our AA-dose measures, 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, with ethnicity e,[21] in county j, track s, and cohort t, we estimate models of the following form:

$$Y_{ijest} = B(D_{jest}) + \gamma \text{Rank}_{ijest} + X'_{ijest}\delta + \lambda_{jes} + \theta_{jst} + \lambda_{jes} \cdot t + \epsilon_{ijest}. \tag{5}$$

[20]Such policy reforms may lead to strategic responses in registering children's ethnicity *at birth* among parents who have such choices, i.e., Han-minority couples (Jia and Persson, 2021). However, these reforms were too late (2001–2002) for parents of children in our sample (CEE cohorts 1999–2003) to respond.

[21]There are 56 ethnicity groups, including Han and 55 minority groups.

We consider both linear and nonlinear specifications of the function $B(D_{jest})$, which captures the effect of AA dose D_{jest} (Equation 4) on the outcome. As controls, we include i's ability as measured by her (pre-AA-bonus) CEE rank within her province-year-track (Rank_{ijest}), a vector of i's baseline characteristics X_{ijest} (gender, age when taking the CEE, rural hukou indicator, and high school quality), county-cohort-track fixed effects (θ_{jst}), county-cohort-track fixed effects (θ_{jst}), and county-ethnicity-track-specific linear trends (λ_{jes}). In the following, we first describe the two specifications of $B(\cdot)$ and then explain the reasons for including these controls.

Dose Effect Specifications The **linear specification** assumes a constant marginal effect, such that

$$B(D_{jest}) = \beta D_{jest}. \tag{6}$$

In a **nonlinear specification**, we divide the distribution of positive AA doses into five equally sized bins and estimate separate effects for each quintile and specify the function $B(\cdot)$ as

$$B(D_{jest}) = \beta_1 D_{jest}^{1^{st}Q} + \beta_2 D_{jest}^{2^{nd}Q} + \beta_3 D_{jest}^{3^{rd}Q} + \beta_4 D_{jest}^{4^{th}Q} + \beta_5 D_{jest}^{5^{th}Q}, \tag{7}$$

where $D_{jest}^{1^{st}Q}$,...,$D_{jest}^{5^{th}Q}$ are indicators for the lowest to the highest quintiles of positive AA doses. The reference group consists of students who do not receive any minority bonus points. This specification allows us to assess how students are affected by different doses of AA. As an alternative nonlinear specification, we also estimate a spline regression model, allowing the slope to vary across different parts of the AA-dose distribution, which provides a complementary way to visualize and quantify the dose-response relationship.

Controls In addition to student demographics (X), Equation (5) includes a student's (pre-bonus) CEE rank and a set of fixed effects; we explain the roles of these other controls here. Recall from the model (Section 3) that a student i in cohort t has a latent ability a_i, of which test score s_{it} is an unbiased measure. Applying this logic across cohorts with year-to-year fluctuation in exam difficulties—the main source of variation that gives rise to AA dose variation—we assume a rank-preserving property of CEE tests.

Assumption 1 (Rank-Preserving Tests): Let $f_{pst} : \mathbb{R} \to \mathbb{R}$ denote the stochastic function that maps ability a into test score s in province-track-cohort cell (p, s, t). For any $a > a'$, $f_{pst}(a)$ first-order stochastically dominates $f_{pst}(a')$, for all (p, s, t).

Notice that Assumption 1 does not necessarily require the stability of CEE scores across cohorts; rather, it requires that the stochastic mapping between ability ranks and test score ranks be unaffected by year-to-year changes in exam questions. Under Assumption 1, Rank_{ijest} provides a meaningful measure of ability that is comparable within a cohort and between cohorts, conditional on the rich set of fixed effects and trends we describe next.

First, we include county-ethnicity-track fixed effects (λ_{jes}), absorbing all time-invariant differences across the policy cells in which bonus points are assigned. These include persistent differences in local economic development, school quality, ethnic composition, cultural background, minority policy implementation, and track-specific educational opportunities. These fixed effects are important because counties and ethnic groups receiving larger nominal bonuses are likely to be systematically different from those receiving smaller bonuses.

Second, the county-cohort-track fixed effects (θ_{jst}) absorb cohort-specific local shocks that are common to students in the same county and track, regardless of ethnicity. These shocks may include changes in county-level education resources, economic conditions, cohort sizes, or other policy changes that affect all students in a county-track-cohort cell. By controlling for θ_{jst}, we compare students who face the same local cohort environment and differ only in their exposure to ethnic-minority bonus policies and the effective value of these bonuses.

Finally, $\lambda_{jes} \cdot t$ allows each county-ethnicity-track cell to follow its own linear trend. This addresses the concern that minority students in a given county and track may experience gradual unobserved changes in educational preparation, socioeconomic conditions, or access to information that are correlated with both AA doses and outcomes. With these controls, identification comes from residual year-to-year fluctuations in the effective values of bonus points within narrowly defined cells, driven by changes in province-track-cohort score distributions rather than by persistent differences or smooth differential trends across groups.

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 results are robust (Table A.3).

Validation To validate our specification, we provide a series of balance tests at the level where the identifying AA dose variation arises, i.e., within a county-ethnicity-cohort-track cell. We examine whether within-cell variation in AA doses predicts the composition of predetermined student characteristics, conditional on the set of fixed effects we include. Table A.4 shows that AA doses are not systematically related to students' academic preparation, as measured by CEE percentile rank or high-school quality, nor to gender or age. The only statistically significant relationship is with rural hukou status. However, the magnitude is economically small: with a typical AA dose of 0.1, the coefficient corresponds to an increase of about 0.03 in the rural share, or roughly 5% of the sample mean. Moreover, our findings are similar between the rural- and urban-hukou subsamples (Section 6.2.2). With a cautious note on hukou status, these results suggest that the within-cell variation in AA doses is not meaningfully correlated with predetermined student characteristics.

6 Dose Effects of AA on Student Outcomes

In this section, we examine how AA doses affect college admission outcomes and long-term economic outcomes using the main data, and in-college experience using the China College Student Survey (CCSS).

6.1 College Admission-Related Outcomes

We examine college admission-related outcomes, which are contained in the CEE data, both including and excluding unmatched individuals. In the main text, we report the results for the matched sample; results are highly consistent when we include the unmatched individuals (Tables A.5, A.6, and A.7).

Access to College and College Quality Table 2 shows that higher AA doses substantially expand college access. In the linear specification (Panel A), a 0.1 increase in the AA dose (0.1 is the typical dose) raises the probability of admission to any college by 3.0 ppts, to an elite college by 1.3 ppts, and to a student's top choice on her application list by 2.9 ppts; it also raises the quality of the enrolled college by about 2.1 points. Panel B shows that these access gains are present throughout the dose distribution and are generally larger at higher doses. Relative to their counterparts receiving no bonus point, students in the highest AA-dose quintile are 8.5 ppts more likely to be admitted to any college, 2.9 ppts more likely to enter a Tier-1 college, and 7.1 ppts more likely to be admitted to their top-choice program. They also attend colleges whose quality is 5.8 points higher. As intended, AA expands access to (higher-quality) colleges for targeted students, and this effect increases with dose.

Ranking Relative to Peers These access gains, however, come with a decline in academic match quality. On average, with the preferential treatment in admissions, AA-targeted enrollees are overmatched: relative to one's peers, an average AA-targeted enrollee's CEE ranking is 3.2 ppts lower than their peers. Table 3 shows that higher AA doses exacerbate overmatch. In the linear specification (Panel A), a 0.1 increase in the AA dose lowers one's relative rank by 1.9 ppts and relative score by 3.6 points. The nonlinear estimates (Panel B) show that, relative to their counterparts receiving zero bonus points, students in the bottom (top) dose quintile are placed in programs where their ranking relative to peers is 1.1 (5.1) ppts lower.

Enrolled Majors Finally, we examine how AA doses affect enrolled majors—a margin that has been shown to have large impacts on income (e.g Arcidiacono, 2004). Using the major-specific average monthly income information in the Chinese College Graduate Employment Report, Figure 2 shows that higher AA doses tend to reduce enrollment in high-income majors such as Economics, Management, and Engineering, and increase enrollment in lower-income majors such as Education and History.

Table 4 shows a similar pattern when we use the average annual consumption in our own data to proxy for major-specific average long-term economic well-being. In the linear specification (Panel A), a 0.1 increase in the AA dose reduces the probability of enrolling in one of the top-three majors by 2.9 ppts and increases the probability of enrolling in one of the bottom-three majors by 0.4 ppts. These effects, especially the latter, are considerable, given that in the entire sample, the fractions of enrollees in the top-three and bottom-three majors are 64% and 5%, respectively. Panel B shows that, relative to students with zero AA dose, students in the fourth and fifth dose quintiles are 7.7 and 9.6 ppts less likely to enroll in a top-three major, respectively. The movement into the bottom-three majors is concentrated in the upper tail of the dose distribution. In particular, students in the top dose quintiles are 2.5 ppts more likely to enroll in a bottom-three major.[22]

6.2 Long-Term Economic Outcomes

We now examine whether the short-term access gains and match-quality losses documented above translate into long-term economic outcomes.

6.2.1 Consumption: Main Results

Overall Consumption Level Table 5 reports the effects of AA doses on average annual consumption 10 to 23 years after students took the CEE. Column (1) in Panel A shows

[22]The large increase of 2.5 ppts from a mean rate of 5% may arise because these students applied for these less selective majors in selective colleges and/or because they chose the option of "comply with major reassignment" on their application form. Given this option, instead of rejecting an applicant who scored below the cutoff of her applied major, a college reassigns the applicant to a major she qualifies for.

that a 0.1 increase in the AA dose reduces average annual consumption by about 4.0%. This pattern is observed across all major consumption subcategories (Columns (2)–(4)). This suggests that, on average, AA-induced academic mismatches outweigh gains in college quality, resulting in long-term economic losses.

The average effect, however, masks substantial nonlinearities. As shown in Panel B, relative to students receiving no bonus points, students in the lowest AA-dose quintile experience a sizable long-term gain: their average annual consumption increases by 18.5%. In contrast, students exposed to higher doses suffer large and persistent losses: consumption falls by 10.6% for students in the fourth dose quintile and by 24.5% for those in the top dose quintile. There are no detectable impacts for students in the second and third dose quintiles. The pattern is similar across consumption subcategories. As an alternative, we use piecewise linear splines to capture the relationship between AA doses and consumption. Figure A.4 shows that consumption declines are statistically significant and steep only after the dose surpasses a threshold around 0.1 to 0.2, consistent with the quintile-based estimates.

It should be noted that zeros are observed for some individuals in the UnionPay consumption data. We use a modified logarithm as suggested in Chen and Roth (2024).[23] Our main results are robust using alternative methods, such as Poisson pseudo maximum likelihood.

Our findings indicate that AA's long-term impacts depend critically on its dose: moderate doses of AA can work as intended, while large doses can backfire. This is consistent with the short-term evidence in Section 6.1. Low doses expand students' college opportunities without moving them too far from their academic match. High doses, by contrast, lead to substantial overmatch, and shift students away from higher-return majors, dominating the gains from attending higher-quality colleges. Although we do not observe individuals' final educational achievements, the large negative effects of high AA doses on consumption may arise partly through their negative effects on college completion. As we will show in Section

[23]The modified logarithm in Chen and Roth (2024) is $m(y) = ln(y)$ if $y > 0$ and $m(y) = -K$ if $y = 0$. We use $K = 0.1$. The interpretation is that the effect of moving y from 0 to 1 is valued the same as a 10 log-point effect on the intensive margin (e.g., the same as the effect from $ln(a)$ to $ln(b)$ where $ln(b) - ln(a) = 0.1$). Our results are robust using alternative K values (see details in Section 7).

6.3, this hypothesis is consistent with evidence from CCSS: students receiving high AA doses report worse in-college performance and higher course failure rates.

Variety of Consumption Beyond the level of consumption, we also examine whether AA doses affect the diversity of individuals' consumption baskets. We construct two measures of consumption diversity from the merchant category codes (MCC) assigned to each UnionPay transaction. The first measure counts the number of unique MCC codes recorded for an individual, capturing the variety of their expenditure. The second measure is a Shannon diversity index, which captures the evenness of spending across categories.[24] The results are presented in Table A.8. The estimates again reveal a non-monotonic pattern. Low AA doses modestly increase consumption variety and diversity, whereas high AA doses reduce both. In particular, students in the highest dose quintile spend on 0.34 fewer categories and have a 0.045 lower diversity index, corresponding to about 6.1% and 8.2% of their respective sample means. These results suggest that excessive AA doses reduce not only the level of later-life consumption, but also the breadth and diversity of consumption.

Upper-Tail Mobility We further examine whether AA promotes upward mobility—a major goal of AA—as measured by the probability of reaching the upper tail of the long-term consumption distribution. Table A.9 shows no evidence that AA increases the likelihood of reaching top-quintile consumption: estimates from both the linear specification and the non-linear specification are indistinguishable from zero. In contrast, AA has a clearer effect on the probability of reaching above-median consumption, mirroring the finding in Table 5: low (high) AA doses increase (decrease) the probability of achieving above-median consumption.

Child-Related Expenditures Finally, for suggestive evidence of the effect of AA on future generations, we zoom into child-related expenditures, which are explicit categories in the UnionPay data. Fertility is not observed in our data; to proceed, we focus on expenditures

[24] Shannon Diversity Index is calculated as $H = -\sum_{i=1}^{N} p_i \ln(p_i)$, where p_i denotes the expenditure share of category i.

after age 30, when individuals are more likely to be parents. Table 6 shows that high AA doses reduce child-related expenditures by 7.8% in the fourth and 14.2% in the fifth quintile of the dose distribution. Breaking down these expenditures, we find that the decline exists for both children's clothing and education. In contrast, there are no significant impacts on child-related spending arising from lower AA doses. These results suggest that excessive AA doses may cause harm that extends to future generations by reducing AA recipients' spending on children.

6.2.2 Consumption: Heterogeneity

The previous results suggest that the dose of AA matters; this subsection examines how these dose effects vary by student characteristics.

Academic Background As shown in previous studies (e.g. Carlana et al., 2024), the effect of AA varies by beneficiaries' pre-college achievement. We examine this heterogeneity using two academic background variables: pre-college achievement and high school quality.

In Panel (a) of Figure 3, we divide students into four quartile groups based on their own CEE score ranking within province-cohort-track cells. For all groups, AA yields a positive effect at low doses (the bottom quintile in the dose distribution) and no detectable effect in the next two quintiles of the dose distribution. As doses increase, the effect differs across groups. For students in the bottom two quartiles of the CEE ranking, higher doses generate sizable losses. For students in the third quartile, the negative effects are less pronounced: the fourth dose quintile no longer has a negative effect, although the highest dose quintile still reduces consumption. Students in the top quartile of the CEE-rank distribution are even more resilient to higher AA doses: the fourth dose quintile has a positive effect on consumption, and only the highest dose quintile generates a negative effect.[25] This pattern suggests that higher-ability students benefit more from the expanded choice set created by

[25] The dose effect differences between the lowest and the highest CEE-rank quartiles are statistically significant for the third and fourth AA-dose quintiles.

AA and are less likely to be severely overmatched when placed in higher-quality colleges. Nevertheless, even for these students, an excessive AA dose can still be harmful.

Similarly, we divide students into four quartile groups based on the quality of their high schools. Panel (b) of Figure 3 shows that, again, the lowest quintile of doses yields benefits for all. At higher doses, however, the pattern diverges. Most noticeably, the effect of AA turns negative for students from the lowest-quality high schools once the dose goes beyond the lowest quintile. In contrast, students from the top two groups of high schools experience positive effects from low doses and null effects from high doses.[26]

Demographics In Table 7, we explore heterogeneous effects by gender (Column (1)–(3)) and rural/urban hukou status (Columns (4)–(6)). For both males and females, the overall patterns are very similar, with the only significant difference appearing in the second quintile of the dose distribution, where females experience positive effects while males experience (insignificant) negative effects. Point estimates suggest that, relative to urban-hukou students, rural-hukou students benefit more from low doses and suffer less from high doses of AA; however, none of these differences are significant.

6.2.3 Alternative Explanations

Two alternative explanations may challenge our interpretation. First, one may argue that high AA doses put students in higher-quality colleges, where they become financially more sophisticated, leading them to save or invest more and thus consume less. To test this savings or investment-based mechanism, Table 8 analyzes financial investment outcomes that are observed in the UnionPay data (e.g., expenditure on insurance, stocks, and bonds). We find a pattern mirroring our overall consumption results: investment declines with AA doses, suggesting that differences in saving/investment decisions are unlikely to explain our findings on consumption.

[26]The dose effect differences between the lowest- and highest-quality high-school quartiles are statistically significant for the third through the fifth dose quintiles.

A 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.10 finds no support for this interpretation: if anything, 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, though both effects fail to reach conventional levels of statistical significance. Thus, the decline in consumption likely reflects lower economic attainment rather than cost-of-living differences.

6.2.4 Income

Direct income information is available for a subsample of individuals whose salaries are processed through UnionPay. Because the subsample is much smaller than the main consumption sample, we group positive AA doses into terciles rather than quintiles to preserve statistical power. Table A.11 analyzes the income profiles.[27] The estimates are imprecise, but the point estimates are broadly consistent with the consumption results: the sign on income is positive for the low and middle doses and negative for the high dose.

We also use this income subsample to construct a predicted-income measure for the full matched sample. Specifically, we estimate a LASSO regression on the subsample with observed income, using consumption, individual characteristics (gender, ethnicity, rural hukou status, birth city, track, CEE ranking, and high school quality) as predictors. The fitted values from this model are then used to construct predicted income for all individuals in the full sample. Table 9 reports the corresponding predicted-income results. The pattern closely mirrors our consumption estimates: students in the lowest AA-dose quintile have higher predicted income, while those in the highest quintile have significantly lower predicted income.

Taken together, results from the income subsample and the predicted-income results from

[27]Table A.2 shows that individuals with observed income data are systematically different from the full matched sample. We apply sampling weights when estimating the effects of AA doses on income. These weights reweight the income subsample to match the full CEE population along group-level distributions of CEE rank, high-school quality, age, gender, and rural hukou status.

the full matched sample reinforce our consumption results: high AA doses decrease long-term economic well-being.

6.3 College Experience

Finally, we examine how AA doses affect 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 A.12 presents the summary statistics for the key variables.

Because the CCSS sample only labels individuals as Han, one of the top six most populous ethnic minorities, or "other ethnic groups", the treated group is too small to support our baseline specification with a rich set of fixed effects. We therefore adopt an exact matching approach. Specifically, we match students with zero bonus points to those with positive bonus points within narrowly defined demographic cells, including birth city, CEE cohort, academic track, gender, and hukou status. We restrict the final sample to cells that contain at least one individual who received positive bonus points. Additionally, due to the limited sample size, we divide AA doses into terciles rather than quintiles when examining nonlinear effects to improve statistical power.

The CCSS covers graduating college students from 2010 to 2015, who are in different cohorts than our main sample; moreover, being a survey rather than administrative records, it does not allow for the calculation of students' CEE percentile rankings within province-cohort-track cells. We therefore reconstruct AA doses ($\tilde{D}_{rest}$) as the ratio between the bonus points and the standard deviation of pre-AA-bonus CEE scores calculated within the CCSS sample. We then estimate the following specification to provide suggestive evidence on how

AA doses influence academic performance and subjective well-being:

$$Y_{irest} = \beta \tilde{D}_{rest} + \gamma \text{Score}_{irest} + \eta_{m(i)} + \epsilon_{irest}, \tag{8}$$

where Y_{irest} denotes an outcome for individual i in birth city r, ethnicity e, track s, and cohort t, $\tilde{D}_{rest}$ represents the AA dose measure within the CCSS sample, and Score_{irest} is i's pre-AA-bonus CEE score. The term $\eta_{m(i)}$ represents cell fixed effects, where each cell m is uniquely defined by a combination of birth city (r), cohort (t), academic track (s), gender, and hukou status. This structure ensures that β is identified from variation between treated and control students within highly comparable groups. Standard errors are robust to heteroskedasticity.

The first two columns of Table 10 present the estimated effects of AA doses on academic outcomes. In the linear specifications (Panel A), a 0.1 increase in AA doses raises the probability of in-college performance ranking below the median by 3.4 ppts (Column (1)) and failing a course by 0.25 ppts (Column (2)). More importantly, the non-linear analysis in Panel B shows that the negative effects are driven entirely by students in the highest dose category. These results indicate that students receiving excessive AA doses tend to struggle academically, which is consistent with the mismatch hypothesis.

Columns (3) to (6) of Table 10 turn to students' subjective well-being. The linear effects in Panel A are all insignificant. However, Panel B shows that students in the highest dose category have significantly lower satisfaction with interpersonal relationships (by 4.4 ppts) and college life overall (by 4.7 ppts). In contrast, students in lower terciles do not exhibit a statistically significant reduction in satisfaction.

Taken together, these patterns suggest that at high doses of AA, academic mismatch extends beyond grades to affect broader aspects of students' college experiences, including their sense of belonging and well-being on campus. These findings help bridge our short-term and long-term 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 targeted students: enabling them to enroll in high-quality colleges, where they may, however, struggle both academically and socially.

7 Robustness Checks

Zero Consumption To ensure that our results are not sensitive to how we handle zero consumption values, Table A.13 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 selection into the UnionPay consumption sample may vary with access to local banking infrastructure. To address this issue, in Table A.14, we re-estimate our main nonlinear specification excluding individuals whose residential cities fall in the bottom quartile of the sample distribution in terms of bank-branch or ATM penetration. The estimates remain stable: low AA doses generate positive or insignificant effects, while the highest AA-dose group consistently experiences sizable consumption losses. These results suggest that our main findings are unlikely to be driven by differential UnionPay coverage in cities with weaker banking infrastructure.

Another concern is that the use of mobile payments (e.g., WeChat Pay and Alipay) rose sharply after 2018. In Table A.15, we restrict our sample to 2013–2018, a period in which mobile payments were less popular. The results are quantitatively similar to those in our main estimates.

Dynamics We assess whether the negative impacts of AA doses persist or fade over time. Instead of using average consumption over the entire period, we apply the specification in

Equation (5) to total consumption for each separate year between 2013 and 2022. Figure A.5 plots these point estimates and their corresponding 95% confidence intervals, tracing AA's consumption effects by years since taking the CEE, ranging from 10 to 23 years. We find no evidence of fading out. This suggests that the mismatch effects are not merely short-lived shocks but represent lasting impacts on human capital and career trajectory.

College Application Regimes Students' information about their performance could affect their application behaviors and thus their long-term outcomes. During our sample period, two broad regimes existed with respect to when students submitted their rank-ordered lists: before taking the CEE and after taking the CEE (either before or after the official scores were revealed). We examine whether AA dose effects differ across these regimes. As shown in Table A.16, we find no systematic heterogeneity in AA dose effects across application regimes. This suggests that the long-term dose-response patterns are not driven by a particular application-timing rule.

Bonus for Other Reasons In our main analysis, we exclude individuals receiving bonus points for reasons other than ethnic-minority status (e.g., athletes and academic Olympians). Table A.17 shows that our AA dose effects are unaffected if we include these individuals.

8 Effects on Non-targeted Students

Our analysis so far focuses on the effect of AA on its intended beneficiaries. A natural concern is that AA may also affect non-targeted students through the reallocation of scarce college seats. In a centralized admissions system with capacity constraints, bonus points awarded to minority students may shift admission slots away from majority students. If these displaced students lose access to higher quality programs, AA may generate costs for non-targeted students in addition to its direct effects on targeted students. This possibility is important for welfare evaluation and for interpreting the distributional effects of AA.

Although a comprehensive analysis is beyond this paper, we examine whether such crowd-out effects are detectable in the long run.

We focus on students who receive zero bonus points, the non-targeted majority group in our setting, and examine those close to key admission thresholds. The intuition is that if AA displaces non-targeted students from higher-tier colleges, the long-term consequences should be most visible among students near the relevant admission cutoffs, where a small change in score can alter access to a college tier.

To quantify the displacement effect of AA, we first compute the number of available seats for each college tier within each province-year-track cell, defined as the number of students whose final post-bonus CEE score exceeds each tier-specific score cutoff. Then, we compute, for each college tier, the number of students whose pre-AA-bonus CEE score rank falls below the admission cutoff but whose final total CEE score rank rises above it. These students move above the cutoff solely due to their bonus points, pushing an equal number of non-targeted students from above the cutoff to below it. Based on this calculation, AA bonus points placed 6,931 students from below to above the Tier-1 college cutoff; the corresponding numbers are 12,264 for the Tier-2 college cutoff and 9,504 for the vocational college cutoff; these are also the numbers of non-targeted students displaced from each tier.

More formally, we implement regression-discontinuity designs around the three admission thresholds mentioned above. Let $\ell \in \{\text{Tier-1}, \text{Tier-2}, \text{vocational}\}$ index the admission margin. For individual i from county j, track s, and cohort t, we estimate

$$\begin{aligned} Y_{ijst} = {} & \beta_\ell \cdot 1\{C^\ell_{pst} - R_{ijst} \geq 0\} \\ & + \gamma^-_\ell \cdot (C^\ell_{pst} - R_{ijst}) \cdot 1\{C^\ell_{pst} - R_{ijst} < 0\} \\ & + \gamma^+_\ell \cdot (C^\ell_{pst} - R_{ijst}) \cdot 1\{C^\ell_{pst} - R_{ijst} \geq 0\} + X'_{ijst}\delta + \mu_{pst} + \eta_j + \varepsilon_{ijst}. \end{aligned} \tag{9}$$

Here, Y_{ijst} denotes the outcome of interest, including admission outcomes and long-term consumption; C^ℓ_{pst} is the number of available seats at tier l in province p, track s, and cohort t, computed as the number of students whose final CEE score exceeds the tier-specific cutoff score; R_{ijst} is the student's final total CEE rank within the province-track-cohort cell. The running variable measures how far the student's rank falls from the admission cutoff, $C^{\ell}_{pst} - R_{ijst}$. We restrict the sample to students within a bandwidth of 1,000 ranks on either side of the cutoff.[28] The slope coefficients γ^{+} and γ^{-} allow the relationship between the running variable and the outcome to differ on each side of the cutoff. The vector X_{ijst} includes predetermined student characteristics (gender, age when taking the CEE, rural hukou status, and high-school quality). We also include province-cohort-track fixed effects μ_{pst}. The coefficient β_{ℓ} captures the reduced-form discontinuity in the outcome at cutoff ℓ. When Y_{ijst} is an admission outcome, β_{ℓ} measures the jump in admission probability; when Y_{ijst} is long-term consumption, it measures the jump in consumption when crossing the cutoff.

Figure 4 confirms that these cutoffs are meaningful margins of college access. Crossing the first-tier cutoff sharply increases the probability of admission to an elite college by 43%; this increase is 25% at the Tier-2 cutoff and 8% at the vocational college cutoff. These discontinuities validate the institutional relevance of the thresholds and show that students near the cutoffs are precisely those whose college opportunities are most sensitive to small changes in admission priority. However, we find no corresponding discontinuities in long-term consumption. Figure 4 shows that the average annual consumption does not display a statistically significant break at any of these three cutoffs; the point estimates for consumption are small and statistically insignificant (see Table A.18).

These results suggest that AA does not generate detectable long-term crowd-out costs for marginal non-targeted students near key admission thresholds. One possible explanation is that students displaced from a higher tier may still have access to close substitutes in the adjacent lower tier. Alternatively, they may become relatively stronger students within the lower-tier college pool and/or be admitted to better majors, which partly offsets the loss of access to higher-tier colleges. Taken together, the results suggest that the main policy

[28] A bandwidth of 1,000 ranks corresponds approximately to 3 score points. Our results are robust to alternative bandwidth choices of 500 and 1,500 ranks.

trade-off in our setting, given the relatively small size of the targeted group, lies less in the long-term crowd-out of non-targeted students and more in the calibration of AA intensity for targeted students themselves.

9 Conclusion

This paper argues that evaluating affirmative action (AA) as a binary policy obscures a central dimension of policy design. In practice, AA operates as a continuous instrument, and its consequences depend critically on how strongly it is implemented. Using plausibly exogenous variation in the effective strength of bonus points in China's centralized college admissions system, we show that the effects of AA on its intended beneficiaries depend on its dose.

In the short run, higher AA doses expand access to selective colleges but worsen academic fit, lowering students' relative performance, altering major choice, and reducing satisfaction with peer relationships and college life. In the long run, low doses of affirmative action generate substantial and persistent gains, while high doses produce large and lasting losses in their own economic well-being and potential negative impacts on future generations. These findings provide indirect support for the Chinese government's recent policies to reduce and standardize AA bonus points in college admissions.[29]Moreover, heterogeneity analysis suggests that for disadvantaged groups, there exists important complementarity between pre-college education and AA at the college admission stage.

Our findings help reconcile long-standing debates in the AA literature. Evidence of positive effects and concerns about mismatch are not mutually exclusive; both can arise, depending on the dose of AA. By averaging over heterogeneous policy doses, binary evaluations may mask both the benefits of moderate AA and the costs of excessive implementation.

Although our analysis focuses on China, the policy logic is broadly applicable. Many

[29] The State Council issued the *Opinion on Further Reducing and Standardizing Bonus Point Categories and Values in the CEE* in 2014; since then, a growing number of provinces have reduced ethnic minority bonus points.

affirmative action systems—whether based on bonus points, admission thresholds, or holistic evaluations—implicitly vary in strength across institutions, cohorts, and applicants. Our results suggest that careful calibration of these policies is crucial for achieving their intended goals. More broadly, the paper underscores a general lesson for redistributive policy design: when benefits and costs respond nonlinearly to policy intensity, effectiveness depends not only on whether a policy is adopted, but on how it is calibrated.

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.

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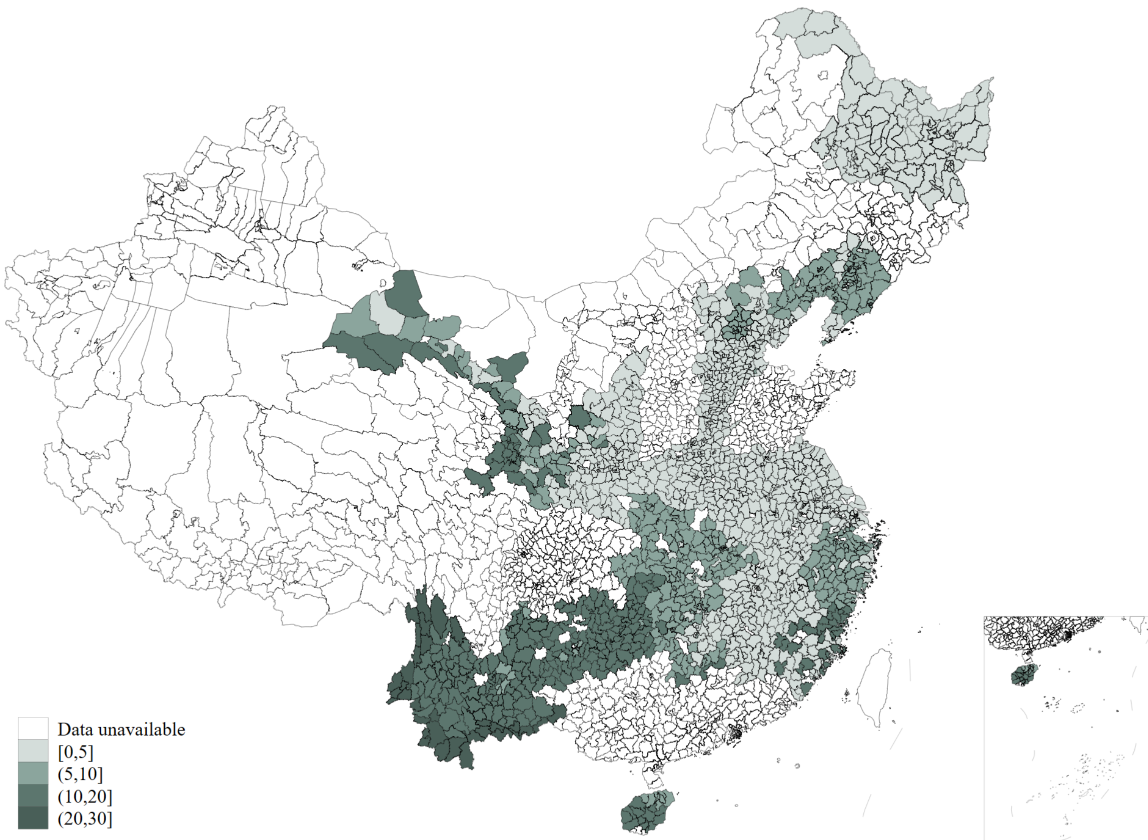


Figure 1
Spatial Distribution of Bonus Scores

Notes: This figure shows the spatial distribution of average bonus points at the birth-county level for the 1999–2003 cohorts, conditional on receiving positive bonus points. For each county, we first calculate the mean bonus points among students with positive bonuses and then match counties to administrative boundary codes for mapping. Darker green shading indicates higher average bonus points. White areas denote regions without usable data. If an entire province is white, the province is excluded from the analysis sample. Within sampled provinces, a county may be white because no students from that county took the CEE in our data, or because birth-county information is missing, miscoded, or cannot be reliably matched to administrative boundary codes.

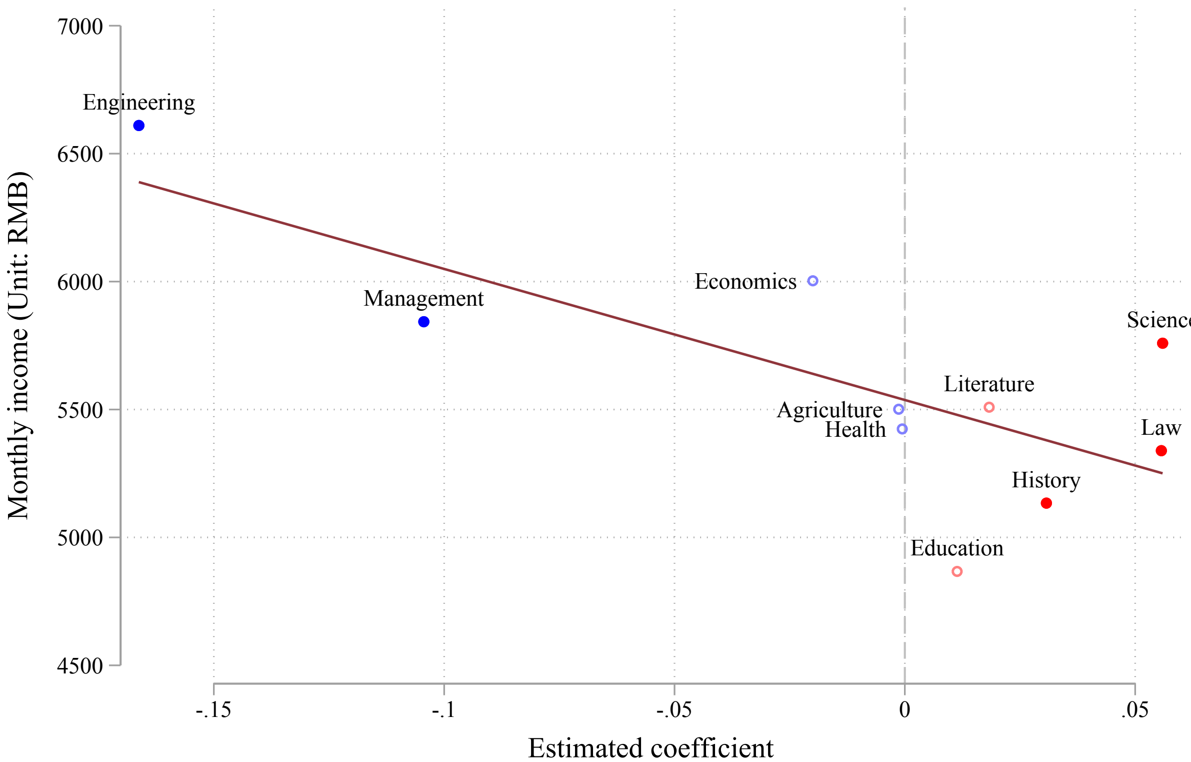
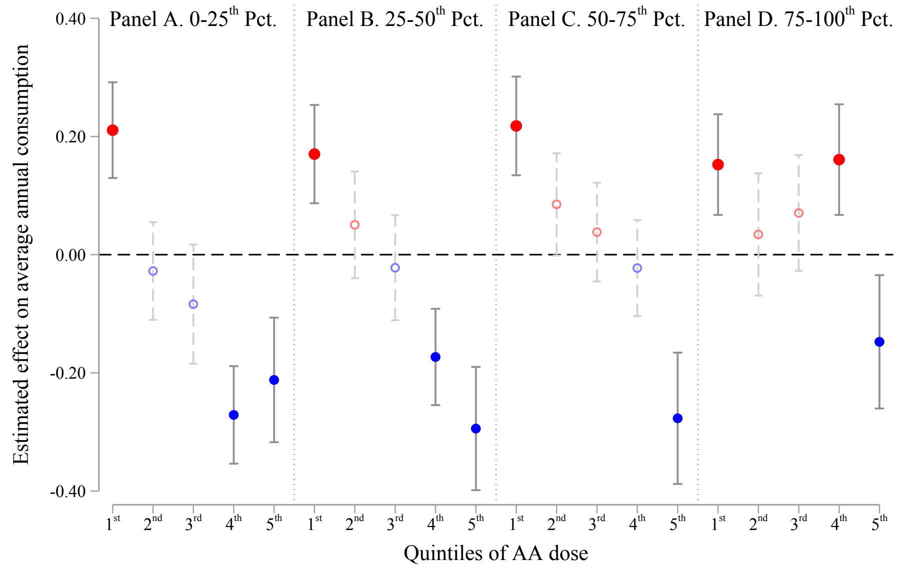
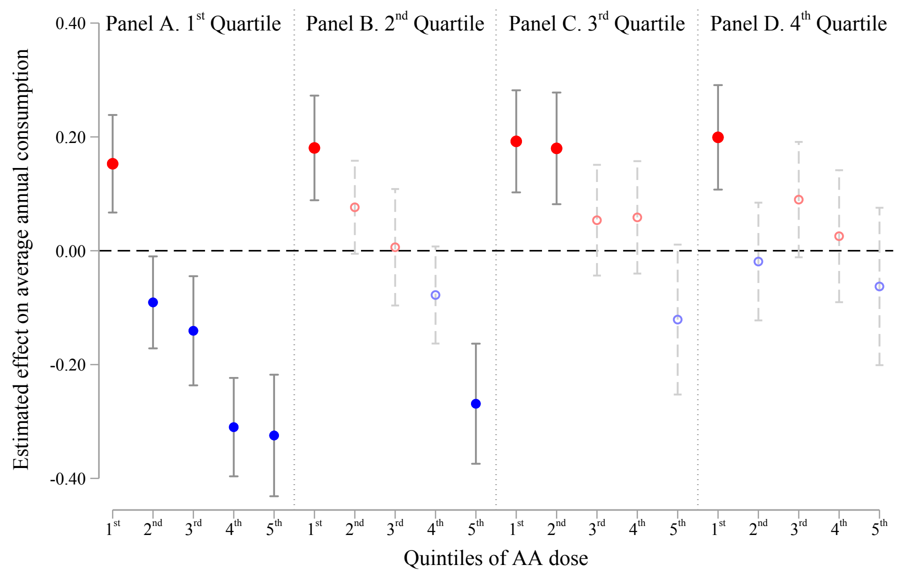


Figure 2
Impact of AA Doses on Major Choices

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 (5), while the y-axis represents the average income across majors, with data sourced from the 2023 Chinese College Graduate Employment Report published by MyCOS. Solid circles denote estimates that are statistically significant at the 10% level, and hollow circles indicate non-significant estimates. The solid line plots the fitted linear relationship between the major-specific coefficients and average income.



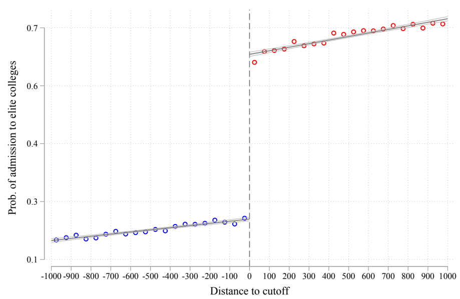
(a) Non-linear AA-Dose Effect Across CEE Score Rank Groups



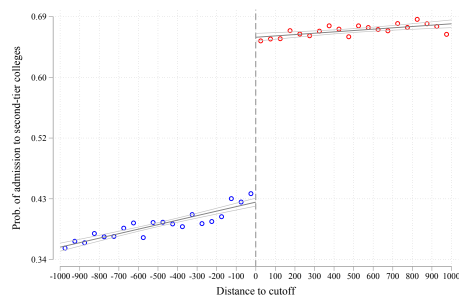
(b) Non-linear AA-Dose Effect Across High School Quality Groups

Figure 3
Non-linear AA-Dose Effects on Consumption: Heterogeneity by Academic Rank and High School Quality

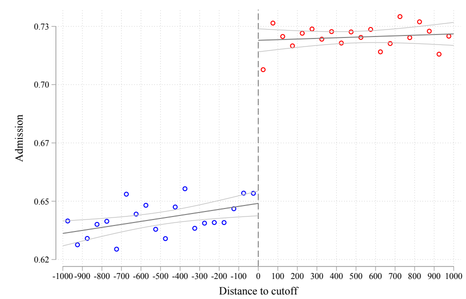
Notes: This figure shows the heterogeneous non-linear effects of AA doses on average annual consumption in later-life across different subgroups. Panel (a) presents heterogeneity by within-province-cohort-track CEE percentile rank, with estimates based on interactions between five AA-dose quintile indicators and four rank-group indicators (0–25$^{\text{th}}$, 25–50$^{\text{th}}$, 50–75$^{\text{th}}$, and 75–100$^{\text{th}}$ percentiles). Panel (b) presents heterogeneity by high school quality, with estimates based on interactions between five AA-dose quintile indicators and four high school quality quartile groups. Dots denote point estimates, and horizontal bars indicate 95% confidence intervals.



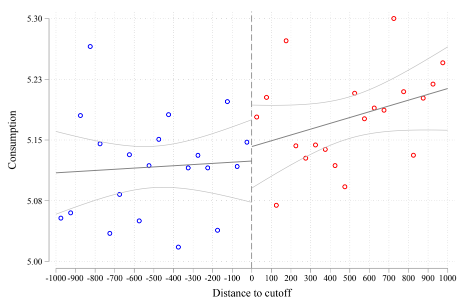
(a) Admission to elite colleges



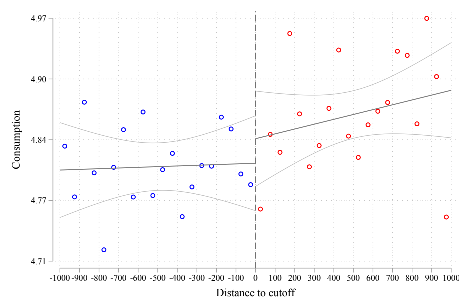
(b) Admission to second-tier colleges



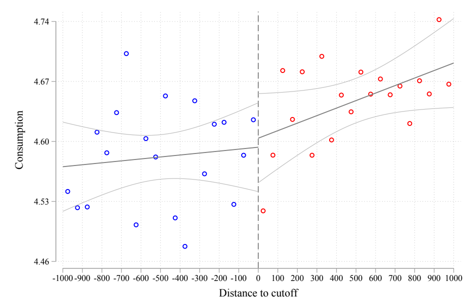
(c) Admission to any colleges



(d) Elite cutoff: Average consumption



(e) Second-tier cutoff: Average consumption



(f) Vocational cutoff: Average consumption

Figure 4
Regression Discontinuity Estimates at College Tier Cutoffs

Notes: This figure presents regression discontinuity plots around the elite college cutoff (left column), second-tier college cutoff (middle column), and vocational college cutoff (right column). The top row shows the probability of admission to each tier, and the bottom row shows the average annual consumption. The horizontal axis is the running variable rv, defined as the admission quota minus the student's final rank within the province-year-track cell. Each dot represents the mean outcome within a bin of the running variable. The sample is restricted to students who receive zero bonus points.

Table 1: Summary Statistics

Variable	Observations	Mean	Std. Dev.
Panel A: Demographic characteristics			
Female	9,063,509	0.40	0.49
Age when taking CEE	9,063,509	19.00	1.11
Rural	9,063,509	0.54	0.50
Minority	9,063,509	0.04	0.20
Science track	9,063,509	0.55	0.50
Humanity track	9,063,509	0.27	0.44
Comprehensive track	9,063,509	0.19	0.39
High school quality	9,063,509	49.12	16.49
Panel B: CEE performance			
CEE score	9,063,509	426.13	96.14
Rankings	9,063,509	49.77	28.82
Bonus points	9,063,509	0.45	2.69
Bonus points (Conditional on Bonus>0)	322,586	13.11	6.17
AA doses	9,063,509	0.006	0.033
AA doses (Conditional on Bonus>0)	322,586	0.16	0.08
Panel C: Admission outcomes			
Admitted	9,063,509	0.61	0.49
Admitted by elite colleges	9,063,509	0.12	0.32
Admitted by top-listed choice	9,063,509	0.41	0.49
College quality	5,585,492	61.96	24.13
Relative ranking	5,587,763	-0.14	14.95
Relative score	4,141,265	1.85	44.59
Top-three majors	5,587,763	0.64	0.48
Bottom-three majors	5,587,763	0.05	0.21
Panel D: Consumption & Income			
Average annual consumption (RMB)	9,063,509	10,986.3	34,283.4
Durables (RMB)	9,063,509	4,340.7	18,449.4
Non-durables (RMB)	9,063,509	572.9	1,614.5
Leisure (RMB)	9,063,509	27.6	127.6
Financial Investment (RMB)	9,063,509	1,741.5	8,163.3
Average annual income (RMB)	143,311	97,145.8	947,673.2

Notes: In this table, each observation corresponds to a test taker. Panel A presents demographic characteristics. *Rural* indicates students holding a rural *hukou*, *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 pre-AA-bonus 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 top choice* indicate that students are admitted by any colleges, elite colleges, and their top choice on the preference list, respectively. *College quality* is leave-one-out mean of province-cohort-track CEE ranking of enrolled students in each college. *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-term consumption. Variables from *College quality* to *Bottom-three majors* are only available for students who are admitted by any college. Panel D reports long-term economic outcomes based on UnionPay transaction records, including average annual consumption, as well as average annual income for the subsample with available payroll information. The smaller number of observations for *College quality*, *Relative ranking*, *Top-three majors*, and *Bottom-three majors* reflects that these variables are defined only for students admitted to college. *Relative score* has fewer observations because it is further restricted to admitted students whose college peers took the same exam format, allowing pre-AA-bonus CEE scores to be compared. The smaller sample for *Average annual income* reflects that income data are available only for individuals whose employers process payroll through UnionPay systems.

Table 2: Impact of AA Doses on Admission Outcomes

	(1) Admission	(2) Admitted by elite colleges	(3) Admitted by top choice	(4) College quality
Panel A: Linear effect				
AA doses (0.1 unit)	0.030***	0.013***	0.029***	2.080***
	(0.002)	(0.002)	(0.002)	(0.100)
Panel B: Non-linear effect				
1^{st} quintile	0.051***	0.009***	0.032***	2.039***
	(0.005)	(0.003)	(0.004)	(0.248)
2^{nd} quintile	0.027***	0.011**	0.038***	1.339***
	(0.004)	(0.004)	(0.004)	(0.209)
3^{rd} quintile	0.035***	0.022***	0.046***	2.711***
	(0.005)	(0.003)	(0.004)	(0.246)
4^{th} quintile	0.068***	0.031***	0.058***	5.258***
	(0.005)	(0.004)	(0.005)	(0.271)
5^{th} quintile	0.085***	0.029***	0.071***	5.761***
	(0.006)	(0.005)	(0.006)	(0.299)
Mean of dependent var.	0.61	0.12	0.41	61.96
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509	5,585,492

Notes: This table presents the linear and nonlinear effect of AA doses on college admission. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. 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 (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 3: Impact of AA Doses on Relative Ranking to Peers

	(1) Relative ranking	(2) Relative score
Panel A: Linear effect		
AA doses (0.1 unit)	-1.858***	-3.595***
	(0.075)	(0.294)
Panel B: Non-linear effect		
1^{st} quintile	-1.141***	-2.507***
	(0.169)	(0.631)
2^{nd} quintile	-1.661***	-4.252***
	(0.158)	(0.688)
3^{rd} quintile	-2.395***	-5.778***
	(0.166)	(0.544)
4^{th} quintile	-4.002***	-9.157***
	(0.208)	(0.841)
5^{th} quintile	-5.138***	-6.524***
	(0.242)	(0.961)
Mean of dependent var. (sd)	-0.14 (14.95)	1.86 (44.59)
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES
Obs.	5,587,763	4,141,265

Notes: This table shows the linear and nonlinear effect of AA doses on competition environment in college. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. *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 (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 4: Impact of AA Doses on Major Choices

	(1) Top-three majors	(2) Bottom-three majors
Panel A: Linear effect		
AA doses (0.1 unit)	-0.029***	0.004***
	(0.003)	(0.001)
Panel B: Non-linear effect		
1^{st} quintile	-0.031***	-0.001
	(0.006)	(0.003)
2^{nd} quintile	-0.007	0.001
	(0.005)	(0.002)
3^{rd} quintile	-0.025***	-0.001
	(0.006)	(0.003)
4^{th} quintile	-0.077***	0.008**
	(0.009)	(0.004)
5^{th} quintile	-0.096***	0.025***
	(0.010)	(0.005)
Mean of dependent var.	0.64	0.05
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES
Obs.	5,587,763	5,587,763

Notes: This table displays the linear and nonlinear effect of AA doses on major selection. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. *Top-three majors* and *Bottom-three majors* are indicators identifying whether a student enrolled in one of the three majors with the highest or lowest average long-term consumption levels, respectively. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 5: Impact of AA Doses on Long-term Consumption

	(1) Consumption	(2) Durables	(3) Non-durables	(4) Leisure
Panel A: Linear effect				
AA doses (0.1 unit)	-0.040**	-0.009	-0.033**	-0.005
	(0.018)	(0.015)	(0.014)	(0.007)
Panel B: Non-linear effect				
1st quintile	0.185***	0.048	0.113***	0.021
	(0.040)	(0.031)	(0.028)	(0.015)
2nd quintile	0.034	0.012	0.016	0.006
	(0.039)	(0.038)	(0.033)	(0.016)
3rd quintile	-0.002	0.016	0.041	0.029*
	(0.047)	(0.034)	(0.034)	(0.015)
4th quintile	-0.106**	-0.018	-0.075**	0.006
	(0.042)	(0.037)	(0.035)	(0.019)
5th quintile	-0.245***	-0.077*	-0.211***	-0.064***
	(0.059)	(0.043)	(0.045)	(0.022)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509	9,063,509

Notes: This table reports estimates of the effect of AA doses on later-life average annual consumption and its components. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. 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 $K = 0.1$. Table A.13 presents robustness tests using alternative calibration values. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 6: Impact of AA Doses on Expenditure on Children

	(1) Expenditure on children	(2) Education	(3) Clothing
Panel A: Linear effect			
AA doses (0.1 unit)	-0.034***	-0.010	-0.024**
	(0.013)	(0.008)	(0.010)
Panel B: Non-linear effect			
1^{st} quintile	0.007	-0.021	0.015
	(0.026)	(0.019)	(0.020)
2^{nd} quintile	-0.003	-0.012	0.011
	(0.028)	(0.021)	(0.019)
3^{rd} quintile	-0.017	-0.005	-0.003
	(0.029)	(0.020)	(0.024)
4^{th} quintile	-0.078**	-0.050**	-0.031
	(0.034)	(0.022)	(0.028)
5^{th} quintile	-0.142***	-0.008	-0.133***
	(0.044)	(0.025)	(0.037)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
County-ethnicity-track $\times$ linear time trend	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509

Notes: This table reports estimates of the effect of AA doses on expenditure on children. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. The dependent variables in columns (1)–(3) are total expenditure on children, expenditure on children's education, and expenditure on children's clothing, respectively. Since children's expenditures are only meaningful once individuals have reached parenthood age, we focus on expenditures recorded after age 30. 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 (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 7: Heterogeneity Impact of AA Doses by Student Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
		Dependent variable: Average consumption				
Sample:	Female	Male	p-value for (1)=(2)	Urban	Rural	p-value for (3)=(4)
Panel A: Linear effect						
AA doses (0.1 unit)	-0.006	-0.060***	0.13	-0.000	0.013	0.72
	(0.027)	(0.023)		(0.028)	(0.023)	
Panel B: Non-linear effect						
1^{st} quintile	0.154***	0.199***	0.56	0.112**	0.143**	0.73
	(0.056)	(0.053)		(0.052)	(0.072)	
2^{nd} quintile	0.129**	-0.022	**0.05**	0.049	0.144**	0.24
	(0.059)	(0.050)		(0.056)	(0.059)	
3^{rd} quintile	0.021	-0.022	0.63	0.106	0.106*	0.99
	(0.064)	(0.061)		(0.070)	(0.059)	
4^{th} quintile	-0.071	-0.126**	0.53	-0.041	0.019	0.53
	(0.069)	(0.054)		(0.080)	(0.052)	
5^{th} quintile	-0.212**	-0.249***	0.76	-0.223**	-0.036	0.13
	(0.093)	(0.074)		(0.096)	(0.078)	
Controls	YES	YES		YES	YES	
County-ethnicity-track FE	YES	YES		YES	YES	
County-cohort-track FE	YES	YES		YES	YES	
County-ethnicity-track FE × linear time trend	YES	YES		YES	YES	
Obs.	3,630,279	5,427,153		4,209,399	4,849,942	

Notes: This table reports split-sample estimates of the effects of AA doses on average annual consumption. Columns (1) and (2) split the sample by gender, and columns (3) and (4) split by household registration status (urban vs. rural hukou). *P-value for (1)=(2)* and *p-value for (3)=(4)* report p-values from F-tests of the null hypothesis that the corresponding coefficients are equal across the two subgroups within each pair. Both tests are conducted using the stacking approach with group-specific fixed effects. The reference group in each subsample consists of students with zero AA dose, and the five quintile groups are defined based on the distribution of AA doses among students with positive bonus points. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 8: Impact of AA Doses on Financial Investment

	(1) Financial investment	(2) Insurance	(3) Bonds & stocks
Panel A: Linear effect			
AA doses (0.1 unit)	-0.038***	-0.011	-0.036***
	(0.012)	(0.007)	(0.011)
Panel B: Non-linear effect			
1^{st} quintile	0.038	0.040**	0.009
	(0.031)	(0.017)	(0.027)
2^{nd} quintile	-0.051*	-0.041***	-0.036
	(0.030)	(0.016)	(0.027)
3^{rd} quintile	-0.041	-0.019	-0.038
	(0.032)	(0.018)	(0.027)
4^{th} quintile	-0.090***	-0.036**	-0.078***
	(0.031)	(0.018)	(0.027)
5^{th} quintile	-0.121***	-0.012	-0.127***
	(0.040)	(0.021)	(0.038)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509

Notes: This table reports estimates of the effect of AA doses on later-life expenditure on financial investment. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. The dependent variables in columns (1)–(3) are average annual expenditure on all financial investments, 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 (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 9: Effects of AA Doses on Predicted Income

	(1) Predicted income
Panel A: Linear effect	
AA doses (0.1 unit)	-0.013
	(0.013)
Panel B: Non-linear effect	
1^{st} quintile	0.145***
	(0.030)
2^{nd} quintile	0.037
	(0.029)
3^{rd} quintile	0.024
	(0.034)
4^{th} quintile	-0.038
	(0.031)
5^{th} quintile	-0.138***
	(0.043)
Controls	YES
County-ethnicity-track FE	YES
County-cohort-track FE	YES
County-ethnicity-track FE $\times$ linear time trend	YES
Obs.	9,063,509

Notes: This table reports estimates of the effect of AA doses on later-life predicted income. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. Since income data are available only for a subsample of individuals whose salaries are processed directly through UnionPay payroll systems, we impute income for the full sample using a LASSO prediction model. Specifically, we first estimate a LASSO regression on the subsample with observed income, using consumption, individual characteristics (gender, ethnicity, rural hukou status, birth city, track, CEE ranking, and high school quality) as predictors. The fitted values from this model are then used to construct predicted income for all individuals in the full sample. In the non-linear specification, the reference group consists of students with zero AA dose. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. Standard errors are clustered at the county-ethnicity-track level and reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 10: Impact of AA Doses on Academic Performance and Subjective Well-being in College (CCSS)

	(1) Below median rank	(2) Fail in courses	(3) Sat. with: GPA	(4) Sat. with: Social	(5) Sat. with: Relations	(6) Overall Sat.
Panel A: Linear effect						
AA doses (0.1 unit)	0.034***	0.025*	-0.018	-0.001	-0.010	-0.015
	(0.013)	(0.014)	(0.013)	(0.011)	(0.009)	(0.010)
Panel B: Non-linear effect						
1^{st} tercile	0.044	0.015	-0.000	0.027	0.009	0.006
	(0.030)	(0.033)	(0.032)	(0.027)	(0.022)	(0.024)
2^{nd} tercile	0.025	-0.032	0.007	0.012	0.019	0.009
	(0.031)	(0.037)	(0.032)	(0.029)	(0.023)	(0.025)
3^{rd} tercile	0.065*	0.073**	-0.047	-0.023	-0.044*	-0.047*
	(0.036)	(0.037)	(0.036)	(0.031)	(0.026)	(0.027)
Mean of dependent var.	0.24	0.44	0.76	0.82	0.89	0.87
Cell FE	YES	YES	YES	YES	YES	YES
Obs.	4,912	4,863	4,912	4,912	4,912	4,912

Notes: This table reports estimates of the effects of AA doses on academic performance and subjective well-being in college using the China College Student Survey data. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. The variable of interest is the AA doses at the ethnicity-birth-city-cohort level. The dependent variables in columns (1)–(2) measure academic outcomes: *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. Columns (3)–(6) present dummy variables for satisfaction with GPA, social activities, interpersonal relationships, and overall campus life, respectively, constructed from the original 5-point scale (1 = "highly dissatisfied"; 5 = "highly satisfied"). Each dummy variable equals 1 if the original score is at least 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, and hukou status. All specifications control for individual CEE scores and cell fixed effects. * p<0.1, ** p<0.05, *** p<0.01.

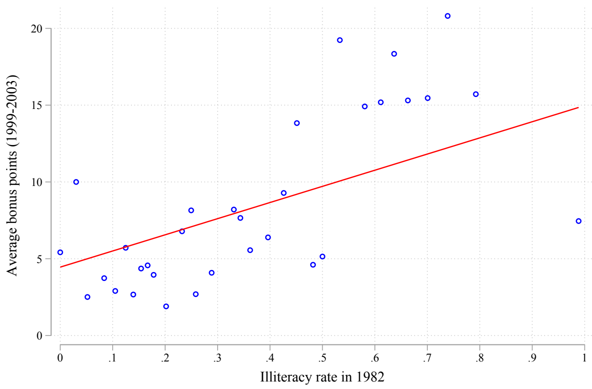
Online Appendix

College Affirmative Action and Students' Outcomes: A Matter of the Dose

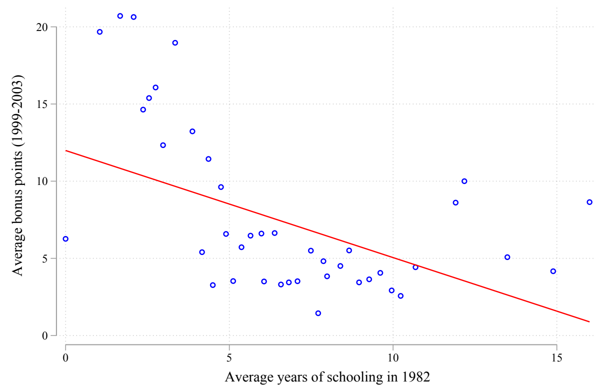
Yi Chen, Chao Fu, Hongbin Li, Teng Li, Siyan Tang

May 2026

Appendix A: Figures and Tables

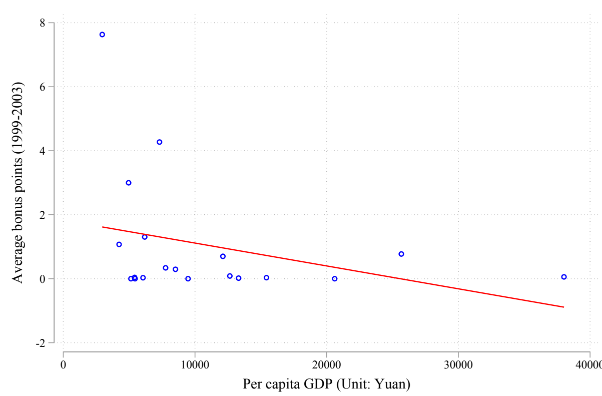


(a) Illiteracy rate in 1982



(b) Average years of schooling in 1982

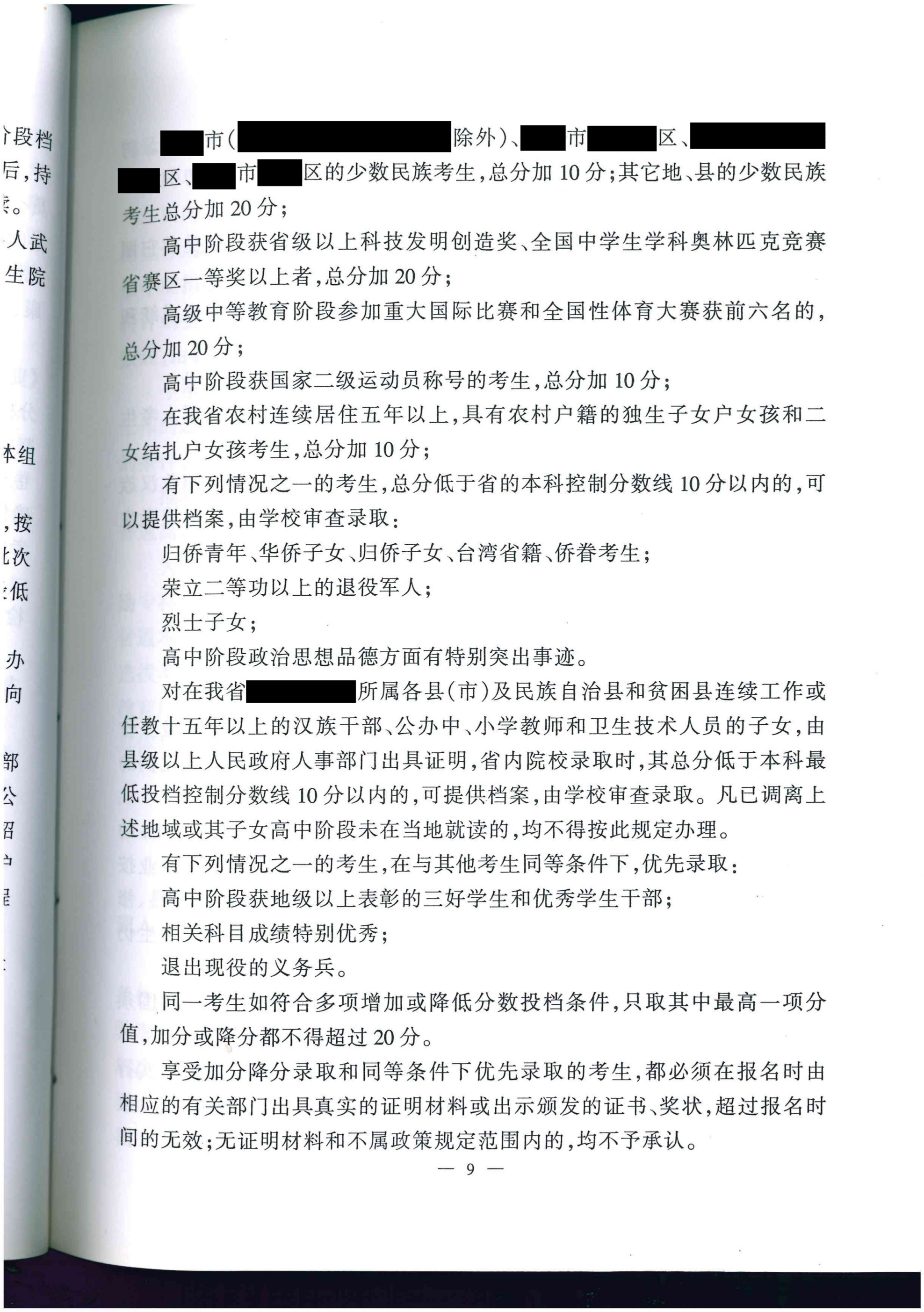
(c) Proportion of minorities in 1982



(d) GDP per capita

Figure A.1
Correlations Between Bonus Points and County Characteristics

Notes: This figure presents binned scatter plots showing the correlations between average bonus points for the 1999–2003 exam cohorts and county's socioeconomic characteristics. Panels (a) and (b) show the illiteracy rate and average years of schooling, respectively, constructed from the 1982 National Population Census, restricting to individuals aged 16 and above, and matched to bonus points at the province-ethnicity level. Panels (c) and (d) are matched at the province level: Panel (c) shows the proportion of ethnic minorities from the 1982 Census, and Panel (d) shows per capita GDP averaged over 1999–2003.



[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.

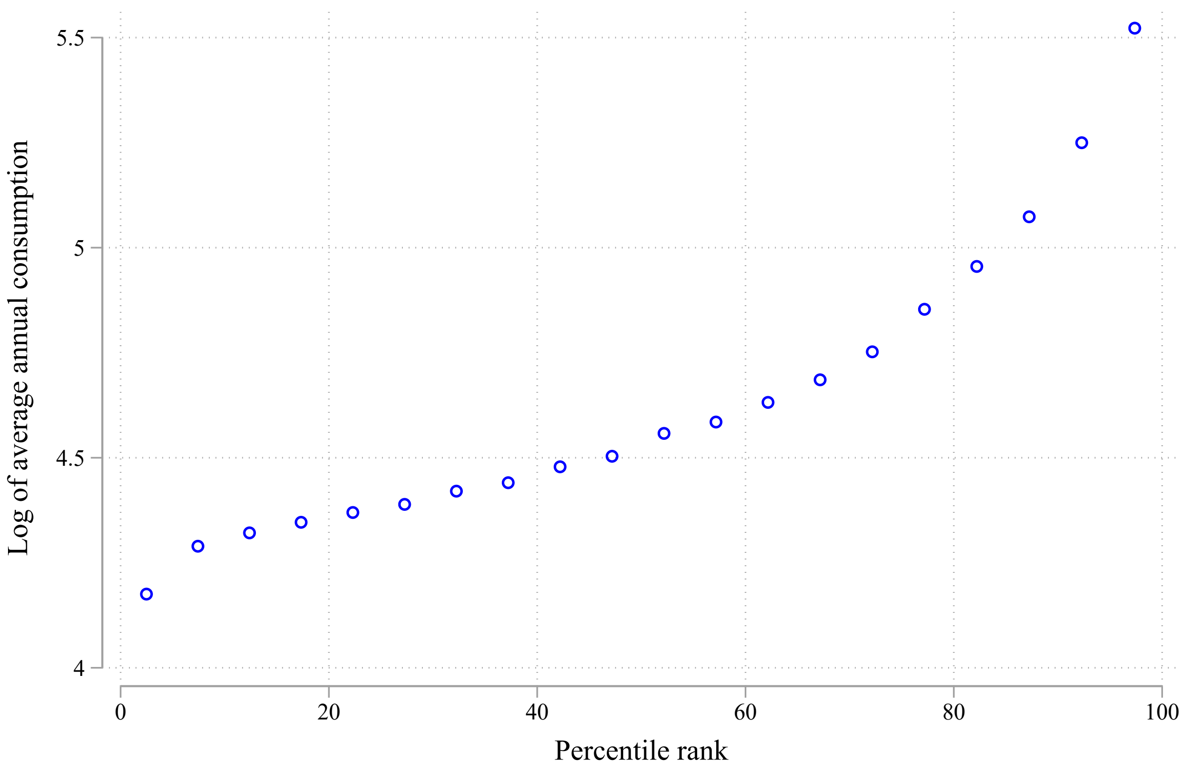


Figure A.3
Correlation Between CEE Rank and Consumption

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

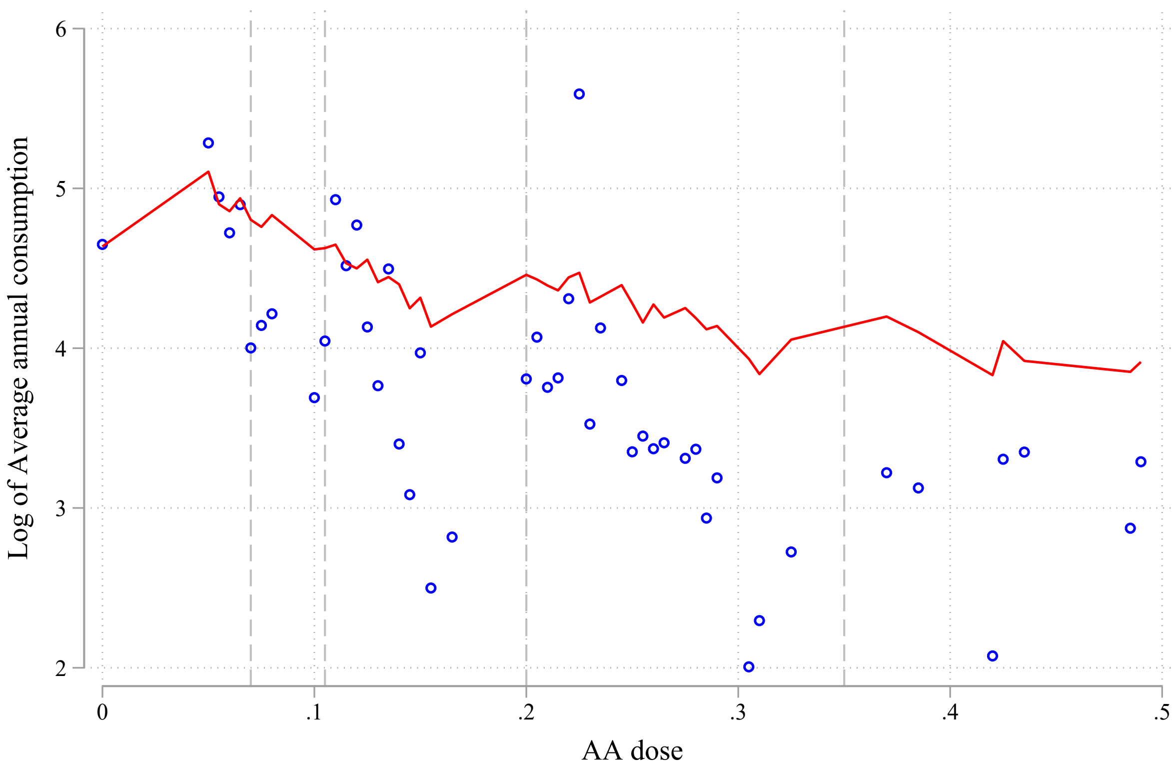


Figure A.4
Non-linear Relationship Between AA Doses and Consumption: Spline Estimates

Notes: This figure shows the relationship between AA doses and later-life average annual consumption (in log). Scatter points plot the 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.

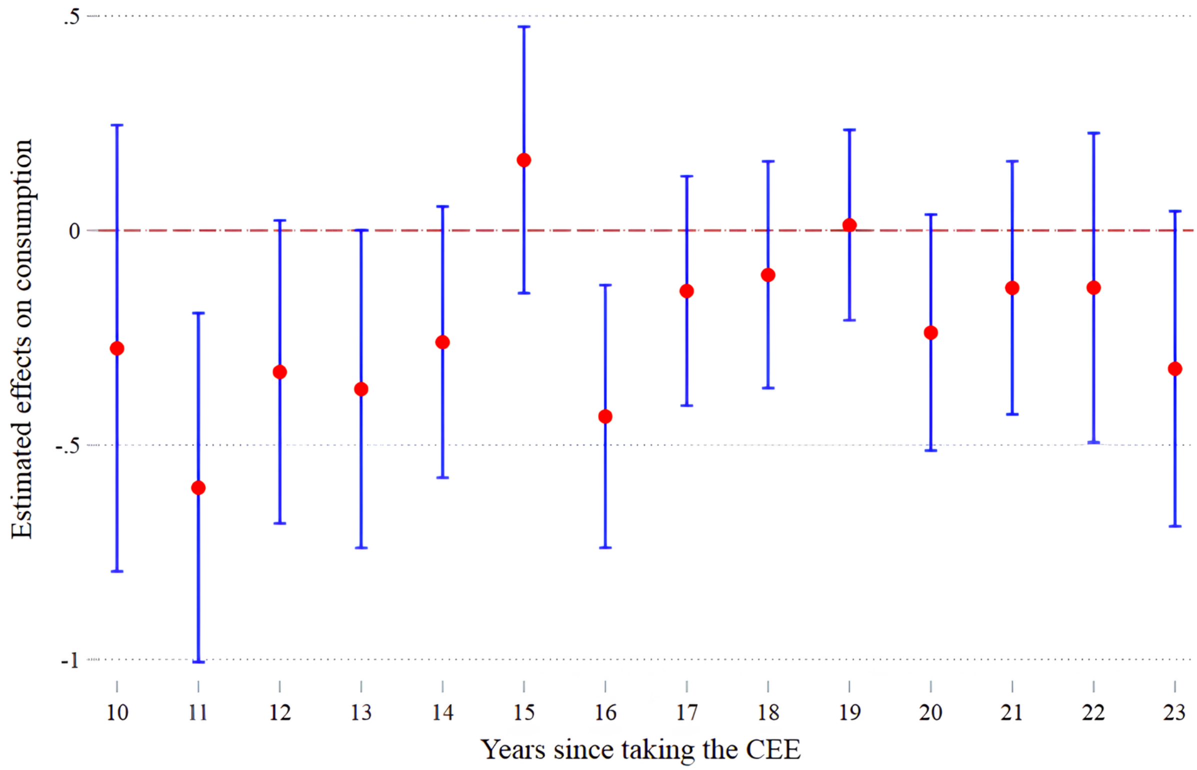


Figure A.5
Dynamic Effects

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 taking the CEE. All specifications include a full set of individual-level controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend.

Table A.1: Comparison of Matched Sample and Full Sample

	Matched sample		Full sample		
	N	Mean	N	Mean	Difference
Panel A: Demographic characteristics					
Female (=1)	9,063,509	0.40	11,241,830	0.40	0.00***
Age when taking CEE	9,063,509	19.00	11,241,830	19.01	-0.02***
Rural (=1)	9,063,509	0.54	11,241,830	0.54	-0.00***
Minority (=1)	9,063,509	0.04	11,241,830	0.05	-0.01***
Science track	9,063,509	0.55	11,241,830	0.57	-0.03***
Humanity track	9,063,509	0.27	11,241,830	0.28	-0.01***
Comprehensive track	9,063,509	0.19	11,241,830	0.15	0.04***
High school quality	9,063,509	49.12	11,241,830	49.20	-0.08***
Panel B: CEE performance					
CEE score	9,063,509	426.13	11,241,830	426.16	-0.03
Percentile rank	9,063,509	49.77	11,241,830	49.77	-0.00
Bonus points	9,063,509	0.47	11,241,830	0.64	-0.17***
Bonus points (Conditional on Bonus>0)	332,586	13.11	499,558	14.29	-0.02***
AA doses	9,063,509	0.01	11,241,830	0.01	-0.00***
AA doses (Conditional on Bonus>0)	332,586	0.16	499,558	0.18	-1.18***
Panel C: Admission outcomes					
Admitted	9,063,509	0.61	11,241,830	0.60	0.01***
Admitted by elite colleges	9,063,509	0.12	11,241,830	0.12	-0.00***
Admitted by top choice	9,063,509	0.41	11,241,830	0.40	0.01***
College quality	5,588,095	61.96	6,772,283	62.72	-0.76***
Relative ranking	5,590,361	-0.14	6,774,551	-0.14	-0.00
Relative score	4,144,038	1.85	5,240,573	1.31	0.54***
Top-three majors	5,590,361	0.64	6,774,551	0.64	0.00***
Bottom-three majors	5,590,361	0.05	6,774,551	0.05	0.00

Notes: This table compares the characteristics of the matched sample used in the main analysis and the full sample (matched and unmatched CEE takers combined). Unmatched individuals are those with missing national ID numbers that prevent linkage to the consumption data. "Difference" reports the difference in means between the matched and full samples (matched minus full). * p<0.1, ** p<0.05, *** p<0.01.

Table A.2: Sample Comparison: Main Analysis Sample vs. Income Subsample

	Main sample		Income subsample		
	N	Mean	N	Mean	Difference
Percentile rank	9,145,351	49.757	147,766	50.545	-0.788***
Female (=1)	9,145,430	0.402	147,769	0.394	0.008***
Age when taking CEE	9,145,430	18.993	147,769	18.898	0.095***
Rural (=1)	9,145,430	0.532	147,769	0.420	0.112***
High school quality	9,079,113	49.121	145,688	50.385	-1.264***

Notes: This table compares the demographic characteristics of the main analysis sample and the income subsample. The income subsample consists of individuals whose salaries are processed directly through UnionPay payroll systems, for whom income data are directly observed. "Difference" reports the difference in means between the main sample and income subsample. * p<0.1, ** p<0.05, *** p<0.01.

Table A.3: Robustness: Alternative Clustering Units

	(1)	(2)	(3)
	Dependent variable: Average consumption		
	Cluster 1	Cluster 2	Cluster 3
Panel A: Linear effect			
AA doses (0.1 unit)	-0.040**	-0.040*	-0.040
	(0.017)	(0.023)	(0.028)
Panel B: Non-linear effect			
1^{st} quintile	0.185***	0.185***	0.185***
	(0.036)	(0.048)	(0.055)
2^{nd} quintile	0.034	0.034	0.034
	(0.041)	(0.039)	(0.044)
3^{rd} quintile	-0.002	-0.002	-0.002
	(0.041)	(0.059)	(0.061)
4^{th} quintile	-0.106**	-0.106*	-0.106
	(0.043)	(0.056)	(0.065)
5^{th} quintile	-0.245***	-0.245***	-0.245***
	(0.056)	(0.070)	(0.071)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509

Notes: This table reports the impact of AA doses on annual average total consumption using alternative clustering levels. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In column (1), standard errors are clustered at the birth county-year-track level. Column (2) clusters at the province-year-track level, and column (3) clusters at the province-year level. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. * p<0.1, ** p<0.05, *** p<0.01.

Table A.4: Assessing the Randomness of AA Doses

	(1) Percentile rank	(2) Female	(3) Age when taking CEE	(4) Rural	(5) High school quality
AA doses (0.1 unit)	0.32	0.00	-0.01	0.03***	-0.38
	(0.56)	(0.01)	(0.02)	(0.01)	(0.30)
Mean of dependent var.	49.77	0.40	19.00	0.54	49.12
County-ethnicity-track FE	YES	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES	YES
Obs.	52,253	52,253	52,253	52,253	51,381

Notes: This table reports balance tests examining whether AA doses predict pre-determined student characteristics. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. All variables are collapsed to the county-ethnicity-track-cohort cell level, and each column regresses the cell-level average student characteristics on AA doses and the full set of fixed effects and a county-ethnicity-track-specific linear time trend. 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: Full Sample: Impact of AA Doses on Admission Outcomes

	(1) Admission	(2) Admitted by elite colleges	(3) Admitted by top choice	(4) College quality
Panel A: Linear effect				
AA doses (0.1 unit)	0.035***	0.012***	0.031***	2.201***
	(0.001)	(0.001)	(0.001)	(0.046)
Panel B: Non-linear effect				
1^{st} quintile	0.041***	0.010***	0.032***	1.999***
	(0.004)	(0.003)	(0.003)	(0.174)
2^{nd} quintile	0.031***	0.011***	0.045***	1.820***
	(0.004)	(0.003)	(0.004)	(0.242)
3^{rd} quintile	0.054***	0.021***	0.047***	3.762***
	(0.003)	(0.002)	(0.003)	(0.157)
4^{th} quintile	0.092***	0.031***	0.087***	4.988***
	(0.004)	(0.003)	(0.005)	(0.184)
5^{th} quintile	0.100***	0.032***	0.087***	6.043***
	(0.003)	(0.002)	(0.003)	(0.136)
Mean of dependent var.	0.60	0.12	0.39	62.72
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES
Obs.	11,241,830	11,241,830	11,241,830	6,769,257

Notes: This table replicates the analysis in Table 2 using the full sample, including both matched and unmatched CEE takers. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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: Full Sample: Impact of AA Doses on Relative Ranking to Peers

	(1) Relative ranking	(2) Relative score
Panel A: Linear effect		
AA doses (0.1 unit)	-1.995***	-3.711***
	(0.036)	(0.143)
Panel B: Non-linear effect		
1^{st} quintile	-1.663***	-3.823***
	(0.125)	(0.502)
2^{nd} quintile	-1.682***	-3.255***
	(0.134)	(0.520)
3^{rd} quintile	-3.027***	-7.229***
	(0.115)	(0.445)
4^{th} quintile	-4.439***	-8.822***
	(0.139)	(0.560)
5^{th} quintile	-5.760***	-9.730***
	(0.113)	(0.449)
Mean of dependent var. (sd)	-0.13 (14.87)	1.32 (44.41)
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES
Obs.	6,771,530	5,237,385

Notes: This table replicates the analysis in Table 3 using the full sample, including both matched and unmatched CEE takers. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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: Full Sample: Impact of AA Doses on Major Choices

	(1) Top-three majors	(2) Bottom-three majors
Panel A: Linear effect		
AA doses (0.1 unit)	-0.025***	0.003***
	(0.002)	(0.001)
Panel B: Non-linear effect		
1^{st} quintile	-0.016***	0.000
	(0.004)	(0.002)
2^{nd} quintile	-0.013***	0.004**
	(0.005)	(0.002)
3^{rd} quintile	-0.042***	0.004*
	(0.005)	(0.002)
4^{th} quintile	-0.061***	0.004
	(0.006)	(0.003)
5^{th} quintile	-0.067***	0.011***
	(0.006)	(0.003)
Mean of dependent var.	0.64	0.05
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES
Obs.	6,771,530	6,771,530

Notes: This table replicates the analysis in Table 4 using the full sample, including both matched and unmatched CEE takers. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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: Impact of Bonus Intensity on Consumption Variety and Diversity

	(1) Number of Subcategories	(2) Diversity Index
Panel A: Linear effect		
AA doses (0.1 unit)	-0.055*	-0.009***
	(0.031)	(0.003)
Panel B: Non-linear effect		
1^{st} quintile	0.153**	0.023***
	(0.067)	(0.006)
2^{nd} quintile	0.040	-0.005
	(0.084)	(0.007)
3^{rd} quintile	0.121*	0.002
	(0.072)	(0.007)
4^{th} quintile	-0.146*	-0.021***
	(0.080)	(0.007)
5^{th} quintile	-0.341***	-0.045***
	(0.093)	(0.009)
Mean of dependent var.	5.55	0.55
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES
Obs.	9,063,509	9,063,509

Notes: This table examines the impact of bonus intensity on the structure of individual consumption. The dependent variables are constructed based on the merchant category codes (304 in total) in the UnionPay transaction data (2013-2022). In Column (1), the dependent variable is the number of unique merchant category codes, measuring the variety of an individual's expenditure. In Column (2), the dependent variable is the Shannon Diversity Index, calculated as $H = -\sum_{i=1}^{N} p_i \ln(p_i)$, where p_i denotes the expenditure share of category i. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. All specifications include a full set of individual-level controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.9: Impact of AA Doses on Upper-Tail Consumption Mobility

	(1) Top-quintile consumption	(2) Above-median consumption
Panel A: Linear effect		
AA doses (0.1 unit)	0.001	-0.005***
	(0.002)	(0.002)
Panel B: Non-linear effect		
1^{st} quintile	0.002	0.024***
	(0.003)	(0.005)
2^{nd} quintile	0.003	0.001
	(0.004)	(0.004)
3^{rd} quintile	0.005	0.001
	(0.004)	(0.005)
4^{th} quintile	0.005	-0.015***
	(0.004)	(0.005)
5^{th} quintile	-0.002	-0.033***
	(0.005)	(0.007)
Mean of dependent var.	0.20	0.50
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES
Obs.	9,063,509	9,063,509

Notes: This table reports the effects of AA doses on the probability of reaching the upper tail of the consumption distribution. *Top-quintile consumption* is an indicator equal to one if the individual's average annual consumption falls in the top quintile of the distribution. *Above-median consumption* is an indicator equal to one if the individual's average annual consumption exceeds the median of the distribution. With the typical bonus being 10 points and the typical CEE score standard deviation being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. All specifications include a full set of individual-level controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.10: 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 (0.1 unit)	0.067	0.012	-0.008
	(0.067)	(0.025)	(0.025)
Panel B: Non-linear effect			
1^{st} quintile	-0.032***	-0.017***	0.009*
	(0.012)	(0.006)	(0.006)
2^{nd} quintile	0.021	0.003	-0.003
	(0.015)	(0.005)	(0.006)
3^{rd} quintile	0.028**	0.008*	-0.007
	(0.014)	(0.005)	(0.005)
4^{th} quintile	-0.020	-0.009	0.011*
	(0.020)	(0.007)	(0.007)
5^{th} quintile	0.019	0.010	-0.007
	(0.026)	(0.009)	(0.009)
Controls	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES
County-cohort-track FE	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES
Obs.	6,182,786	6,199,234	6,199,234

Notes: This table reports estimates of the effects of AA doses on individuals' residential location choices. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. In the non-linear specification, the reference group consists of students with zero AA dose. An individual's residential city is defined as the location with the highest frequency of UnionPay transactions during 2013–2022. The dependent variables are defined as follows. Column (1) uses the log of the average GDP of the individual's city of residence over 2013–2022. Column (2) is an indicator equal to one if the individual resides in a Tier-1 or Tier-2 city. Column (3) is an indicator equal to one if the individual resides in their birth city. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.11: Impact of AA Doses on Income

	(1) Income
Panel A: Linear effect	
AA doses	0.745
	(2.013)
Panel B: Non-linear effect	
1^{st} tercile	0.075
	(0.220)
2^{nd} tercile	0.326
	(0.351)
3^{rd} tercile	-0.149
	(0.647)
Controls	YES
Province-ethnicity-track FE	YES
Province-cohort-track FE	YES
County-ethnicity-track FE × linear time trend	YES
Obs.	143,311

Notes: This table reports estimates of the 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. Given the sample discrepancies documented in Table A.2, we reweight the subsample to match the full CEE population by adjusting for group-level differences in rank, high school quality, age, gender, and rural status. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.12: Summary Statistics (CCSS)

Variable	Observations	Mean	Std. Dev.
Panel A: Demographic characteristics			
Female (=1)	4,912	0.49	0.50
Rural (=1)	4,912	0.29	0.45
CEE scores	4,912	519.54	70.90
AA doses	4,912	0.02	0.05
Panel B: Academic Outcomes			
Below median rank	4,912	0.24	0.43
Fail in courses	4,865	0.44	0.50
Panel C: Subjective Well-being and Campus Life			
Sat. with GPA	4,912	0.76	0.42
Sat. with social activities	4,912	0.82	0.38
Sat. with interpersonal relationships	4,912	0.89	0.32
Overall satisfied	4,912	0.87	0.33

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, and hukou status (rural versus urban). *Rural* indicates rural hukou status prior to college enrollment. *AA doses* is constructed by merging each student's birth city and ethnicity to the average AA dose granted to the corresponding birth-city-ethnicity cell over the 1999–2003 CEE cohorts. *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 satisfaction variables are dummy variables constructed from the original 5-point scale (1 = "highly dissatisfied"; 5 = "highly satisfied"), each equal to 1 if the original score is at least 3 and 0 otherwise, measuring satisfaction with GPA, social activities, interpersonal relationships, and overall campus life, respectively.

Table A.13: Robustness: Alternative Calibration Values for Log Transformation

	(1) $K = 0$	(2) $K = 0.3$	(3) $K = 1$	(4) $K = 3$
Panel A: Linear effect				
AA doses (0.1 unit)	-0.040**	-0.042**	-0.047**	-0.062***
	(0.017)	(0.018)	(0.020)	(0.024)
Panel B: Non-linear effect				
1st quintile	0.183***	0.190***	0.206***	0.251***
	(0.040)	(0.041)	(0.044)	(0.052)
2nd quintile	0.033	0.035	0.038	0.047
	(0.039)	(0.040)	(0.043)	(0.052)
3rd quintile	-0.001	-0.003	-0.008	-0.022
	(0.046)	(0.048)	(0.051)	(0.062)
4th quintile	-0.104**	-0.110***	-0.124***	-0.162***
	(0.041)	(0.043)	(0.046)	(0.055)
5th quintile	-0.242***	-0.252***	-0.276***	-0.343***
	(0.058)	(0.060)	(0.065)	(0.079)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES	YES	YES
Obs.	9,063,509	9,063,509	9,063,509	9,063,509

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. With the typical bonus being 10 points and the typical CEE score sd being 100, a typical AA dose is 0.1. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.14: Robustness: Sample Restrictions by Banking Infrastructure Coverage

	(1) Excl. bottom quartile by bank-branch penetration	(2) Excl. bottom quartile by ATM penetration
Non-linear effect		
1^{st} quintile	0.109***	0.111***
	(0.041)	(0.040)
2^{nd} quintile	-0.021	-0.029
	(0.040)	(0.040)
3^{rd} quintile	0.033	0.029
	(0.045)	(0.045)
4^{th} quintile	-0.029	-0.013
	(0.073)	(0.073)
5^{th} quintile	-0.150*	-0.133*
	(0.081)	(0.080)
Controls	YES	YES
County-ethnicity-track FE	YES	YES
County-cohort-track FE	YES	YES
County-ethnicity-track FE $\times$ linear time trend	YES	YES
Obs.	5,916,242	5,939,262

Notes: This table reports robustness checks addressing potential concerns about selective UnionPay coverage across cities. Column (1) excludes individuals whose residential cities fall in the bottom quartile of the sample distribution in terms of bank-branch penetration, and column (2) applies the same restriction using ATM penetration. Both columns re-estimate the main nonlinear specification. The reference group consists of students with zero AA dose. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.15: Robustness: Impact of AA Doses on Long-term Consumption (2013–2018 Average)

	(1) Consumption	(2) Durables	(3) Non-durables	(4) Leisure
Panel A: Linear effect				
AA doses (0.1 unit)	-0.045**	-0.015	-0.033**	-0.001
	(0.019)	(0.014)	(0.015)	(0.007)
Panel B: Non-linear effect				
1^{st} quintile	0.172***	0.015	0.127***	0.015
	(0.042)	(0.029)	(0.030)	(0.015)
2^{nd} quintile	0.029	-0.012	0.026	0.013
	(0.042)	(0.036)	(0.035)	(0.017)
3^{rd} quintile	-0.002	0.010	0.042	0.039**
	(0.049)	(0.031)	(0.035)	(0.016)
4^{th} quintile	-0.111**	-0.023	-0.080**	0.016
	(0.045)	(0.036)	(0.037)	(0.019)
5^{th} quintile	-0.273***	-0.090**	-0.230***	-0.061***
	(0.061)	(0.040)	(0.048)	(0.022)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES
Mean of Y	12,337.50	3,176.91	823.46	37.17
Obs.	9,063,509	9,063,509	9,063,509	9,063,509

Notes: This table replicates the baseline analysis in Table 5 using the average annual consumption over 2013–2018 as the dependent variable, to address concerns that the post-2018 expansion of mobile payment platforms may affect the measurement of consumption. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.16: Pre-exam vs. Post-exam Application Regime

	(1)	(2)	(3)
	Dependent variable: Average consumption		
Sample:	Pre-exam	Post-exam	p-value for (1)=(2)
Panel A: Linear effect			
AA dose	-1.031***	-0.398*	0.11
	(0.345)	(0.206)	
Panel B: Non-linear effect			
1^{st} quintile	-0.017	0.211***	0.40
	(0.270)	(0.041)	
2^{nd} quintile	-0.062	0.039	0.58
	(0.175)	(0.042)	
3^{rd} quintile	-0.008	-0.021	0.93
	(0.144)	(0.049)	
4^{th} quintile	-0.200	-0.061	0.34
	(0.138)	(0.051)	
5^{th} quintile	-0.415***	-0.323***	0.55
	(0.129)	(0.080)	
Controls	YES	YES	
County-ethnicity-track FE	YES	YES	
County-cohort-track FE	YES	YES	
County-ethnicity-track FE × linear time trend	YES	YES	
Obs.	872,526	8,039,528	

Notes: This table examines whether the effect of AA doses on consumption differs across application regimes. During our sample period, students submitted rank-ordered lists under three timing regimes: before taking the CEE, after taking the CEE but before official scores were released, and after observing official scores. We group the latter two regimes as "post-exam." Because information on the application scheme is unavailable for Gansu province, this table contains fewer observations than the main results. *P-value for (1)=(2)* reports p-values from F-tests of the null hypothesis that the corresponding coefficients are equal across the two subgroups. The reference group consists of students with zero AA dose. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.17: Robustness: Including Students with Other Bonus Categories

	(1) Consumption	(2) Durables	(3) Non-durables	(4) Leisure
Panel A: Linear effect				
AA doses (0.1 unit)	-0.042**	-0.010	-0.029**	-0.004
	(0.018)	(0.014)	(0.014)	(0.007)
Panel B: Non-linear effect				
1^{st} quintile	0.163***	0.046	0.096***	0.020
	(0.038)	(0.031)	(0.027)	(0.015)
2^{nd} quintile	0.039	0.012	0.022	0.007
	(0.038)	(0.037)	(0.032)	(0.016)
3^{rd} quintile	-0.008	0.011	0.049	0.033**
	(0.047)	(0.034)	(0.034)	(0.015)
4^{th} quintile	-0.090**	-0.009	-0.050	0.012
	(0.041)	(0.036)	(0.034)	(0.018)
5^{th} quintile	-0.239***	-0.074*	-0.190***	-0.061***
	(0.057)	(0.042)	(0.044)	(0.021)
Controls	YES	YES	YES	YES
County-ethnicity-track FE	YES	YES	YES	YES
County-cohort-track FE	YES	YES	YES	YES
County-ethnicity-track FE × linear time trend	YES	YES	YES	YES
Mean of Y	11,066.13	4,396.98	574.29	27.82
Obs.	9,228,909	9,228,909	9,228,909	9,228,909

Notes: This table replicates the baseline analysis in Table 5 using an expanded sample. The baseline sample excludes students who received bonus points for reasons other than ethnic-minority status. This table adds these observations back and replaces the baseline percentile rank control with each student's province-year-track percentile rank computed from their raw CEE score plus bonus points for reasons other than ethnic-minority status. All specifications include a set of controls (CEE ranking after including other bonus points, female, age when taking CEE, rural hukou, and high school quality), along with county-ethnicity-track and county-cohort-track fixed effects and a county-ethnicity-track-specific linear time trend. 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.18: Regression Discontinuity: Effects of College Tier Cutoffs

	(1) Elite cutoff	(2) Second-tier cutoff	(3) Vocational cutoff
Panel A: Average consumption			
Above cutoff	0.025	0.035	0.032
	(0.035)	(0.036)	(0.035)
$rv \times \mathbf{1}(rv \geq 0)$	0.001	0.005	0.007
	(0.005)	(0.005)	(0.005)
$rv \times \mathbf{1}(rv < 0)$	-0.003	0.000	-0.001
	(0.005)	(0.005)	(0.005)
Panel B: College admission			
Above cutoff	0.425***	0.245***	0.080***
	(0.017)	(0.018)	(0.010)
$rv \times \mathbf{1}(rv \geq 0)$	0.006***	-0.004**	-0.001
	(0.001)	(0.002)	(0.001)
$rv \times \mathbf{1}(rv < 0)$	0.001	0.001	0.000
	(0.001)	(0.002)	(0.001)
Controls	YES	YES	YES
Province-cohort-track FE	YES	YES	YES
Obs.	215,726	215,860	203,628

Notes: This table reports regression discontinuity estimates of the effects of crossing college tier cutoffs on average consumption and college admission outcomes. Each column corresponds to a different cutoff: column (1) is the elite college cutoff, column (2) is the second-tier college cutoff, and column (3) is the vocational college cutoff. For each cutoff, the running variable is defined as the admission quota minus the student's final rank within the province-year-track cell, so that $rv \geq 0$ indicates the student's final rank falls within the cutoff. The treatment indicator equals one if $rv \geq 0$. Slope coefficients are allowed to differ on each side of the cutoff via $rv \times \mathbf{1}(rv \geq 0)$ and $rv \times \mathbf{1}(rv < 0)$. As a one-rank difference is quantitatively negligible, we scale the running variable by 100. Accordingly, the reported coefficients on $rv \times \mathbf{1}(rv \geq 0)$ and $rv \times \mathbf{1}(rv < 0)$ should be interpreted as the effects of a 100-rank change in rv. The sample is restricted to students who receive zero bonus points. All specifications include a set of controls (CEE ranking, female, age when taking CEE, rural hukou, and high school quality) 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.

Appendix B: Bonus Policies and Data Sources

While the original CEE dataset contains records of actual bonus points awarded to students and various "bonus tags," these tags were not coded using a standardized system. Coding schemes varied substantially across provinces and even changed within the same province over time. As a result, one cannot identify the specific rationale for each bonus based solely on the raw data. To isolate the effects of ethnicity-based bonuses, we conducted a comprehensive search to collect original policy documents from 1999 to 2003 and cross-referenced them with the individual-level bonus data.

Data Collection

Given the limited internet infrastructure during the 1999–2003 period and the subsequent loss of early digital records, most policy information was not readily available. We therefore reconstructed the policy database using information from the following five channels:

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 below 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.[30] This channel covered Beijing, Shanghai, Hebei, Henan, Heilongjiang, Jiangxi, and Zhejiang.

3. **Official Government Gazettes:** Policy documents for Guangxi and Shaanxi were obtained from 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 obtained documents for Anhui, Fujian, Guizhou, Hainan, Inner Mongolia, Sichuan, Chongqing, and Xinjiang.

[30] CNKI (China National Knowledge Infrastructure) is China's largest academic database, providing access to journals and digital versions of newspapers. Duxiu and Chaoxing are digital library platforms widely adopted by Chinese universities, offering extensive full-text e-book collections.

5. **Inference from Proximate Years:** For Gansu, where 1999–2003 documents remained unavailable, we compared the earliest available policy (2004) with the observed distribution of bonus points, ethnicity, and birth counties. This distribution was highly consistent between 1999 and 2004, indicating that ethnicity-based AA policy was likely constant. Therefore, we apply the 2004 policy rule to 1999-2003.

Despite extensive efforts, including formal requests to 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. Students from these provinces are excluded from our main sample.

Categorization of Bonus Policies

Based on the policy documents we collected, admission bonus policies can be grouped into several standard categories, listed below. Under the regulation of the Ministry of Education, candidates eligible for multiple categories may claim bonuses only from one category, the one with the highest point value.

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

2. **Honors and Leadership:** Bonuses for students who received prestigious honorary titles, such as "Merit Student" or "Excellent Student Cadre," at the provincial or municipal level.

3. **Academic and Scientific Achievement:** Points awarded to winners of scientific invention awards or high-ranking participants in academic Olympiad competitions.

4. **Athletic Excellence:** Bonuses for students who achieved rankings in elite sporting events or held 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.

Each province sets specific eligibility criteria and determines the bonus points, typically ranging from 5 to 30, to be added to candidates' total CEE scores. Candidates are required to submit formal supporting documents issued by relevant authorities at the time of college entrance examination registration. For ethnic minority-based bonus points, applicants are required to submit copies of their household registration booklet (*hukou*) and national identity card. Supporting documentation generally refer to a certificate issued by the county-level Ethnic Affairs Commission (or, in counties without such a commission, by the United Front Work Department and the applicant's parents' employer), attesting to the applicant's ethnic identity and regional information.[31] All materials are subject to review by the county (or district) admissions committee.

Typology of Minority Bonus Policies

Based on our archival research, we classify provincial ethnic minority bonus policies into five distinct types:

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

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

3. **Ethnicity-Based**: AA doses are ethnic group-specific (e.g., Xinjiang).

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

Sample Restrictions and Exclusions

Although we obtained policy documents for nearly all provinces, we excluded several provinces from the analysis due to data limitations and/or policy-induced complications that prevent a clean examination of the ethnic-minority AA policies:

- **Xinjiang:** Provincial policy ties eligibility for the maximum minority bonus to whether both parents belong to one of eleven designated ethnic minorities. Students with only

[31] The United Front Work Department (UFWD) is an organ of the Central Committee of the Chinese Communist Party, responsible for managing relations with groups and individuals outside the Party, including non-Party elites, religious communities, and overseas Chinese.

one parent from these groups receive a substantially lower bonus. Because our data lack information on parental ethnicity, we cannot accurately isolate these minority-specific bonuses from other potential rewards.

- **Chongqing and Sichuan:** In these provinces, bonus varied based on the tier of the university to which the student was admitted. For example, in 2003, Sichuan awarded a 25-point bonus to candidates from concentrated minority areas if admitted to first-tier colleges, but a 50-point bonus if admitted to other institutions. This structure mechanically links AA doses to student ability, generating substantial endogeneity.

- **Shandong:** Beyond the standard bonus point categories, Shandong implemented other idiosyncratic bonus policies, making it hard to isolate ethnic-minority-based AA policies.

- **Inner Mongolia:** Official policy for major minority groups (Mongolian, Daur, Oroqen, and Ewenki) used qualitative language, stating that students could be "admitted with a lower threshold when appropriate" rather than specifying a fixed point value. Consequently, recorded minority bonuses range from 1 to 141 points, reflecting a highly non-standardized implementation that is unsuitable for our dose-based measure.

- **Guangxi:** Guangxi's bonus policy involves a complex overlap of ethnic, geographic, and developmental criteria, making it distinct from a purely ethnicity-based affirmative action program. The province provides bonuses to students in 15 autonomous minority counties and 33 designated mountainous counties, and 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 within these jurisdictions, regardless of ethnicity (including Han students). Consequently, the policy combines ethnic, border-area, and poverty-alleviation incentives, preventing a clean identification of minority-specific treatment effects.