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Do Public Colleges in Developing Countries Provide Better Education than Private ones? Evidence from General Education Sector in India

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Executive Summary

Provision of quality tertiary education is an important determinant of economic growth and development (Barro 2000, Aghion et al. 2005).

One of the biggest policy challenges is to decide how to expand access to tertiary education- by direct provision or by contracting out to private providers and introducing need-and-merit based scholarships?

Governments in many developing countries directly provide tertiary education to make tertiary education accessible to greater number of students, and to have better control over the quality of provision. Private providers are often criticized for inferior quality of provision, as it is feared that they compromise the quality due to their market incentives to reduce costs. In many developing countries, public colleges are more prestigious. Public college graduates outperform graduates of private ones on the college exit exams and earn more than private college graduates. This has often been attributed to the cutting edge education provided in public colleges and perceived as an evidence for lower value-added by the private institutions, reflecting their incentives to maximize profits rather than improve quality. This makes a strong case for increasing public college infrastructure through direct provision.

However, public colleges are highly subsidized, suggesting that the private-public education outcome gap might reflect the pre-determined quality of the students who sort into public colleges rather than the causal impact of the public tertiary education on students' outcomes. While this is attributed to the value-added by the public colleges, little is known about whether or not the public colleges actually add value.

This paper evaluates the differential impact of public colleges on students' educational achievements in the context of India.

Admission to public colleges in India is based on the results of the Senior Secondary School examinations (the equivalent of high school exit exams). Also, the exit exams taken at the undergraduate level are identical (by field of education and University of affiliation) across private and public colleges. We take advantage of this to evaluate the value added of public colleges on students' educational outcomes using a Regression Discontinuity Design.

We assemble a unique data set that links admission data reflecting students' entry quality with their educational outcomes, measured by the performance on the common exit exams. Consistent with previous studies we find that the exit scores of the student's graduating from public colleges are significantly higher than those of their private counterparts. However, once we account for self-selection into public and private colleges, by comparing, in the neighborhood of the admission cutoff scores, those students just above the threshold with their peers just below the threshold we find that public colleges have no added value at this margin. Furthermore, controlling for entry scores, we find no differences between the exit outcomes of students graduating from public and private colleges.

Our findings stand in contrast to the stylized view that public colleges outcomes are better due to value added. The private-public observed quality gap reflects that better students sort into the less expensive prestigious colleges, rather than a causal impact of public colleges on tertiary educational outcomes.

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1 Introduction

Provision of quality tertiary education is an important determinant of economic growth and development (Barro 2000, Aghion et al. 2005). Economists have also identified positive externalities associated with tertiary education (Moretti 2004). As a result, there is a widespread concern over quality of tertiary education provision. Governments in many developing countries directly provide tertiary education to make tertiary education accessible to greater number of students, and to have better control over the quality of provision. Private providers are often criticized for inferior quality of provision, as it is feared that they compromise the quality due to their market incentives to reduce costs.[1] In many developing countries, public colleges are more prestigious, and their graduates have better outcomes. While this is attributed to the value-added by the public colleges, little is known about whether or not the public colleges actually add value.

Our paper aims to evaluate the differential impact of public colleges on students' educational achievements in the context of India. The remarkable economic transformation of India into a high-powered center of Information technology, which has been built on a large pool of high-quality highly educated workers, suggests that the expansion of high quality tertiary education is essential for the robust growth of India's economy. While the government wants to expand access, it also directly provides college education due to concerns over quality erosion by private providers.

Entry into tertiary education in India is highly regulated.The University Grant Commission Act prohibits any institution from awarding degrees unless it is established under an act of Parliament or is especially empowered to award degrees. A recent state reform that allowed private universities to operate and provide tertiary education was overturned by India's Supreme Court in a decision that led to the de-recognition of 112 private universities on quality grounds.[2] This resonates with the state skepticism about market oriented tertiary education sector to provide high quality tertiary education. One of the biggest policy challenges is to decide how to expand access to tertiary education- by direct provision or by contracting out to private providers and introducing need-and-merit based scholarships? Public colleges in India, as in many developing countries, are perceived as more prestigious and on the average, students graduating from public colleges in India have better educational

[1] Levy (2008,a and b) provide detailed discussion.

[2] The state of Chhattisgarh allowed the establishment of private universities under the Chhattisgarh Private Sector University (Establishment & Regulation) Act, 2002. But the Supreme Court declared as null and void the establishment of 112 private universities that emerged under this law. The decision is available at http://www.ugc.ac.in/inside/supremecourt.pdf

outcomes than their private counterparts.[3] This is validated in our sample as well (Figure I). In a pilot survey of college graduates, we find that public college graduates have higher average earnings than private college graduates. The distribution of earnings by college type is shown in Appendix Figure A.1. As a result, the public-private gap in educational outcomes is often perceived as evidence for lower value-added by the private institutions, reflecting their incentives to maximize profits rather than improve quality. This makes a strong case for increasing public college infrastructure through direct provision.

However, public colleges are highly subsidized for the sake of providing equitable access to higher education. Given that the average students from public colleges performs better in educational outcomes than the average students from a private colleges, and their wages seem to be higher on the average, students take this as a noisy signal about value-added of the public colleges. The prestigious public colleges are also much cheaper. Therefore, the private-public educational outcome gap might reflect the pre-determined quality of the students sorting into public colleges, rather than the effect of the public college attendance on students' outcomes. This paper aims to evaluate the value-added of public tertiary education in India.

Admission to public colleges in India is based on the results of the Senior Secondary School examinations (the equivalent of high school exit exams). [4] Also, the exit exams taken at the undergraduate level are identical (by field of education and University of affiliation) across private and public colleges. We take advantage of this to identify the value added of public colleges on students' educational outcomes using a Regression Discontinuity Design. We establish a unique data set that links admission data reflecting students' entry quality with their educational outcomes, measured by the performance on the common exit exams. While passing these exams is required for graduation, performance on these exit scores influences admission to graduate educational programs, access to scholarships, and qualifying for most jobs.[5] We find that the exit scores of the student's graduating from public colleges are significantly higher than those of their private counterparts. However, once we account for

[3]See (Powar and Bhalla, 2008) for example. This is true of other developing countries as well. Except for a few elite private institutions of higher education, public institutions share a higher prestige than private ones (Gupta, 2005).

[4]Professional colleges and a few elite private colleges usually conduct an entrance exam to select students. However, country wide admissions into colleges for general education are governed by marks obtained in class XII Senior Secondary School exams.

[5]Some examples can be found at the following URLS:
http://www.winentrance.com/Indian_Institute_of_technology/Delhi/IIT_Delhi_Admissions_PH_D_Programmes.html,http://www.amity.edu/scholarships/, http://www.licindia.com/pages/aao_generalist_ca_actuarial.pdf

self-selection into these colleges, using a Regression Discontinuity Design framework, we find that public colleges have no added value at the margin. Controlling for entry scores, we find no differences between the exit outcomes of students graduating from public and private colleges. Our findings stand in contrast to the stylized view that public colleges outcomes are better due to value added. The private-public observed quality gap reflects that better students sort into the less expensive prestigious colleges, rather than a causal impact of public colleges on tertiary educational outcomes.

Our study complements the literature examining the costs and benefits of public versus private provision of public services. We make two contributions to the existing literature. [6] First, we examine whether public tertiary educational institutions produce better trained college graduates in the context of a developing country. This question is of significant policy relevance from public finance point of view. Second, our unique data set in which we match college admission data to college exit scores, allows us to employ a regression discontinuity design to evaluate the value-added effect of public versus private providers of a public service. Our paper is the first study to shed light on the value-added of public versus private tertiary education institutions in a developing country setting.

The rest of the paper is organized as follows. We provide the institutional background in section 2, and the theoretical framework in section 3. The data we use in our analysis is discussed in section 4. Section 5 describes our empirical strategy. Section 6 provides the main results, while section 7 compares the cost of education at public and private colleges. We describe the results of our robustness checks in section 8. We conclude by discussing policy recommendations in section 9.

2 Institutional background

India's Economy and Growth of Higher Education

India has experienced tremendous growth in recent years, which has been attributed to its vast pool of highly educated workers. In 2003, the service sector contributed approximately 47 percent of the GDP, followed by the industrial sector's contribution of 24 percent. This is in stark contrast to only a half century earlier, as Indian economy was largely agricultural

[6] Various studies have tried to address the private versus public school efficacy using vouchers (see Angrist et al (2002) for detailed references). Some recent studies have addressed the quality difference between private and public elementary schools in South Asia (Kingdon, 1996; Das, Pandey and Zajonc, 2006) and concluded that the private schools outperform public schools. But surprisingly, not much research has focused on tertiary education even though tertiary education has improved growth prospects in places like India and Ireland.

as recently as 1950. Tertiary education especially technology-oriented training, feeds the current boom of business process out-sourcing to India. The high rate of growth in the service sector has had a feedback effect on demand for tertiary education. While the number of colleges has steadily increased since India's independence in 1947, it was only in the 1990s that the number of colleges saw a dramatic rise.[7] The enrollment figures also show a similar trend. General education college enrollment spurted in the post-reform decades. Although the demand for higher education is on the rise, only 7-9 percent of the college-age population enrolls in tertiary education institutions.

Overview of Public and Private Institutions of Tertiary Education in India

While there are no formal private universities in India in the general education sector as of 2005, there are a large number of private colleges offering general and technical education.[8] Each college has its own campus and infrastructure. Private colleges are managed privately, though they may receive public funds ("private aided college") or may be totally self financed ("private unaided college"). The private aided colleges can raise funds by charging higher fees and accepting donations from philanthropic or business groups. On the other hand, public colleges are managed and financed by the government. Public colleges cannot accept any private donations, and the state funds their maintenance and development expenses.[9] Although, the teachers have to take the same University Grants Commission Exam to qualify for teaching positions in private colleges, they do not enjoy the same degree of job security as the government teachers. Their contracts differ from college to college and are negotiated with the private management. Private colleges also hire more adjunct teachers on short term contracts than public colleges. In contrast, public colleges are managed and run by state employees. Teacher contracts are negotiated with the government and offer tenure security. Facilities and equipment are funded by the state in public colleges, but private colleges (both aided and un-aided) have to self finance these kinds of expenditures. Any government aid can only be applied to teachers salaries by the private aided colleges.

[7]The higher education system in India grew rapidly after Independence. By 1980, there were 132 universities and 4738 colleges in the country enrolling around five per cent of the eligible age group in higher education. The pace of growth in number of institutions accelerated after the economic reforms that commenced in 1991. Today, India is the third largest higher education system in the world in terms of enrollment (after China and the USA), and it is the largest higher education system in the world in terms of number of institutions. The number of institutions of higher education in India is more than four times the combined number of institutions both in the United States and all of Europe (Agarwal, 2006).

[8]Although these colleges are a private initiative, they are not recognized as "for- profit businesses".

[9]In our sample, the private aided colleges receive public funds to meet their recurring expenditures (mostly teacher salaries) and charge much higher tuition than the government colleges.

Since Independence, the government of India has put considerable emphasis on equitable access to higher education as an important policy goal and has subsidized higher education accordingly. To implement this subsidy, government colleges charge only a nominal fee for attending such institutions. Among the colleges in our sample (in 2005), private institutions charged about 5-6 times more than the public colleges in tuition. [10] The admission to public colleges is strictly based on merit. However, beneficiaries of affirmative action also attend public colleges under a system of reservation of seats for marginalized groups i.e., scheduled castes. The merit criterion used for these groups tends to differ than the one used for general category non-reserved seats.

Regulations in India's Tertiary Education and Admission into Public Colleges

Tertiary education sector in India is highly regulated. In this section, we highlight features of the educational system in India that will be used in our identification strategy.

Identical Exit Tests for Private and Public Colleges

An important feature of the education system is that the power to grant degrees is vested with the universities.[11] Independent colleges are not allowed to confer a degree on their own accord.[12] These colleges have to affiliate with a university in order to operate. As a result, all students in colleges (private or public) affiliated with the same university, take the same exit exams. These exams vary by field of study, but conditional on the field, private and public college students are exposed to the same curriculum and take the same exam. These exams test for language competencies(English and regional language) and field specific competencies, for example commerce students take tests in accounting, taxation etc. The examinations for the affiliated colleges are conducted by the respective universities, which also set the course curriculum. The affiliated colleges only offer prescribed courses of study. Thus, conditional on university and field affiliation, we can compare the educational outcomes of students in public and private colleges as they take the same exit tests.

Admission to Public Colleges

Admission to all public colleges in the general education sector, namely all fields of education except professional colleges such as those dedicated to medicine, is solely determined on the

[10]The fee structure is available from the college brochures.

[11]The University Grant Commission Act (UGC), which is the government body that regulates tertiary education, has a provision that prohibits any institution from awarding degrees unless it is established under an act of Parliament or is specially empowered to award degrees.

[12]The colleges account for about nine-tenths of undergraduate enrollments (Agarwal, 2006)

basis of the results of the Senior Secondary School examinations taken in class XII.[13] All high schools in India must be affiliated either with one of the two national boards (Central Board of Secondary Education or Indian Certificate of Secondary Education) or with their state's regional board. The exit exams are conducted by school boards across India and are recognized nationally. Students cannot be admitted to college without at least passing this exam, but in order to be admitted to public colleges, their score needs to exceed a specified cutoff. This admission cutoff for public colleges is determined every year and varies by gender and area of study. It also varies by caste as part of the affirmative action policy. Students who score above the cutoff are eligible for admission to public colleges. While a list of students who are invited to take admission in public colleges is announced (posted by colleges), the admission cutoffs are unknown to the public. To account for differences in Senior Secondary School exams (high school exit exams) across affiliating boards, the college admission committees implicitly standardize exam scores of applicants from other boards than the regional ones.[14] The formulae for standardizing and determining the admission cutoff are not public knowledge. These rules are confidential information even ex-post. Students apply to various colleges simultaneously as the admissions open in Spring. The admission decisions are made public in early Fall shortly before the start of the academic year.

3 Theoretical Framework

There is considerable debate about when government should provide services and institutions such as prisons, hospitals, fire departments, and educational institutions and when should these be contracted out to private providers. Economists have addressed this issue both theoretically and empirically. Advocates of private provision point out that the private providers deliver public goods at a lower cost than the government. Also, there are agency problems and incentive design issues. The public employees have little at stake in the service provision, and hence do not exert any effort to deliver quality service. Additionally, a lack of accountability results from unconditional job security, and non-merit criterion like seniority for promotion of public employees. In contrast, critics stress that private providers would cut quality to achieve lower costs, and hence the quality of public services provided by private suppliers would be inferior to those provided by public employees.

Theoretically, the choice of contracting services out versus providing them in-house has been investigated in the framework of incomplete contracts. Hart et al (1997) developed

[13] Class XII is equivalent to a high school grade 12, the last year of high school.

[14] Both public colleges reported standardizing the scores using a formula.

a framework to demonstrate that private providers under certain circumstances can deliver higher quality services than the public employees.In the same vein, Besley and Ghatak (2001) show that if contracts are incomplete, then contracting out to non-profits can be preferred especially for social goods that non-profits value. In case of tertiary education, this choice is not clear ex ante. Since students choose which institution to attend, private colleges have a strong incentive to provide higher quality education in order to compete. At the same time, unless the education is paid for by the government, as is the case in voucher arrangements in schools, the private colleges would also have an incentive to reduce costs. As a result, if incentives to reduce costs outweigh quality improvement, then the quality of provision can be undermined. Thus, the public employees whose incentives are more aligned with the government might provide better service. To our knowledge, no empirical study addresses this question in the context of tertiary education. Moreover, this issue is even more pertinent in a developing country setting where a robust tertiary education sector can accelerate economic growth (Aghion et al, 2005), which can lead to trickle-down benefits that improve standards of living.[15]

In India, there is intense debate about whether government should provide tertiary education.[16] While the expansion of high quality tertiary education is essential for the continued robust growth of the Indian economy, the existing infrastructure is not able to meet the demand for college graduates. From a policy perspective, whether the government should expand the public college system or contract higher education out to private providers, remains an open question. In this paper, we attempt to address whether public colleges operated by public employees provide better quality of services than private providers in the context of the general college education in India.

Our findings also complement a set of studies that examine the payoff of attending a more selective college(Dale and Krueger, 2001; Behrman et al, 1996). Since the unobserved characteristics of students might influence both college admissions and later outcomes such as performance in college or post- college earnings, it is difficult to disentangle the effect of going to a more selective college from student's pre-college characteristics. A number of approaches including siblings fixed effects, and matching methods, and more recently regres-

[15]The issue of private versus public provision of other services in developing countries, such as drinking water and health, has been addressed in some recent papers. Galiani et al (2005) studied the effect of privatization of water services in Argentina and found that child mortality fell by 8 % in areas that privatized. Bloom et al (2006) studied the effects of contracting out management of government health services to NGOs in Cambodia. While targeted outcomes (like receipt of vitamins by children) improved significantly, there is limited evidence that the program improved self-reported health of the residents of districts where services were managed privately.

[16]See Gupta (2005) for a good background on the subject.

sion discontinuity design (Hoekstra, 2010 ; Saavendra , 2009) have been used to address this issue.[17] The public colleges in India however are distinct. These are considered more prestigious, but they also reserve 25 percent of the seats for marginalized groups who enter college based on a much lower admission cutoff. Hence, these colleges are not highly selective in the strict sense. But it is worthwhile to highlight other features of our study that distinguish it from these other papers. Unlike Hoekstra (2010), with our data, we are able to examine the college educational outcomes of the students. This helps us to assess the value added by the college. Moreover, we are comparing the outcomes of students graduating from *public and private* institutions, whereas Hoekstra(2010) compares the labor market outcomes of students who attend a flagship American university to those who are denied admission. These students may or may not have attended another college. In our setting, students have to take the college exit exams to graduate, unlike Saavendra (2009) where the exit test is optional. Therefore, in our study there is no selection into taking the exit tests. The most important difference is that our paper sheds light on the value-added by public institutions relative to private ones. In developing countries, where resources are scarce, a very important public finance agenda is to understand the efficacy of subsidized public goods provision by government agencies. None of these other papers shed light on the relative value-added of *public* colleges relative to *private* ones.

Attending prestigious colleges can influence later life outcomes of the students like labor market participation, and wages. This can be on account of (i) better human capital production in colleges, (ii) networking or (iii) screening by employers(Epple and Romano, 1998; Macleod and Uriquola, 2010). In this paper, we demonstrate that atleast the first channel does not seem to be operating, and there does not seem to be significant value added by the public colleges. It is worth noting that attending public colleges can have positive effect on post-college earnings in spite of no value-added due to these other mechanisms.[18] We aim to explore this by complementing our data with survey evidence in future work.

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[17]Regression Discontinuity Design has been used for evaluating returns to attending selective k-12 schools and understanding the effects of tracking (Damon, 2010; Pop-Eleches and Urquiola(2009); Dupas et al, 2010). See Dupas et al(2010) for references and discussion.

[18]In the Indian context, the public colleges are prestigious but also reserve significant proportion of seats for lower caste students who enter colleges with lower scores on the average. Hence, information channel where employers screen on college type may not operate as expected.

4 Data

Data sources

Our estimates are based on a unique data set that we assembled from admissions records and university exam results of four general education colleges in a district in India. The admission records from two private and two public colleges for the academic years 1998-99 to 2002-03 were obtained and were matched to the university examination results from the 'Result Gazettes' for the respective years.

Selection of Colleges

Typically, all the colleges in a particular district are affiliated with the same university.[19] As a result, all the students in the district take the same exams in order to graduate from college. We restricted our choice of sample colleges to the district headquarter. This is an urban area with a population of over one million, according to the 2001 Census of India. There are two public colleges and 10 private colleges in the district headquarters all affiliated with the same university.[20] The colleges are either exclusively for men or for women. Among the two public colleges, one is for women and the other is for men. There are 7 private colleges for women and 3 for men in the district headquarters. While all the women's colleges receive some degree of financial support from the state government which varies across colleges, 1 of the 3 men's colleges is an unaided private college, i.e. it receives no support from the state government. We obtained the admission records for both the public colleges and selected one women's and one men's private aided college within 5 kilometers of the public colleges.[21] This was done to ensure that transportation costs did not significantly affect the choice between these colleges. The variables reported in the admission records include date of birth, gender, medium of instruction in senior secondary school, board of Secondary School examination [22] , marks obtained in the senior secondary board exams, place of residence (rural or urban) , father's occupation, and income.[23]

[19]District is the administrative unit below the state. There are three universities that offer general education in the state and the colleges affiliate with a university largely based on geographical proximity to the university.

[20]There are other institutions also called colleges, which confer a diploma and are typically not recognized by the university. A diploma is not considered equivalent to a degree for purposes of admission to higher education institutions or for applying for jobs.

[21]Within the 5 KM radius, there are 2 men's private colleges and 3 women's private colleges.

[22]The Secondary School exams are administered by examination boards which can be national or regional.

[23]The major boards in the data include the regional School Education Board and Central Board of Secondary Education. Almost 80 % of the sample is from the regional board.Women's public college does not

The marks obtained in the college exit exams are reported in the university wide 'Result Gazette'. Each student who takes the university exam is assigned a unique roll number. These gazettes, with results for each student listed under a roll number, are available from the university. We obtained these for the 5 years in our sample. These were then matched to individual student admission records in the colleges. For the purposes of our analysis, we look at the overall composite score obtained in the college degree program, which is the accumulated total of the scores on each of three annual exams administered to students during their undergraduate program.

In order to verify that the private colleges in our sample are similar to other private colleges, we compare the educational outcomes of private colleges in our sample to others in the same district headquarters. The left panel in Appendix Figure A.2 shows that the densities of college exit tests (for academic year 2009-2010) for in-sample private colleges are similar to those for other private colleges in the same district headquarters. Our sample is from a single district. We therefore compare the educational outcomes of the private colleges in our sample to those from a neighboring district headquarters (Right Panel, Figure A.2), and in-sample public colleges to those in a neighboring district (Figure A.3). The densities are very similar. These comparisons provide assurance that we are not comparing best private colleges to worst public colleges, and that our results are likely to hold in other settings as well.

Main Micro Sample

Our main micro sample is taken from admission records of private and public colleges for admissions years 1998 to 2002. The cutoffs vary by year, gender, and field of education. We normalized individuals' entry scores by taking deviations from each groups' admissions cutoffs. Exit exams also vary by field of education. Therefore, our main sample focuses on individuals admitted and graduated in Liberal Arts, the most popular field of study in India. [24] We exclude observations with missing entry or exit exam scores. We have 3,394 observations in the final sample of college graduates. This sample also excludes students admitted on affirmative action reservation. Data appendix provides more details on the sample generation. Appendix table A.3 provides overall summary statistics.

record father's income .

[24]According to UGC statistics cited in Gupta (2005) about 45 percent of all enrolled students in higher education in 2002-2003 were in Liberal Arts.This is also reflected in our data where about 63 percent of our main sample graduated from Liberal Arts.

Public-Private Educational Outcomes Gap

The "effect" of public colleges on educational outcomes

The graduates of the public colleges on average do far better than their private counterparts on their college exit examinations, suggesting that public colleges do outperform private colleges. This holds for both genders as well as for all fields of study by year. For the sake of brevity, we demonstrate these differences using our main sample focusing on Liberal Arts students. This sample includes students from 5 cohorts, from both genders, one field of study, and admitted on the non-reserved category seats. Figure I sketches the college exit exams scores for men and women separately for the main field of study in our sample. As Figure I demonstrates, the average scores in the college exit exams for students at public colleges are consistently higher for 9 out of 10 gender-year cells. Between 1998 and 2002, the average exit scores of men and women graduating from a public colleges, were 0.5 standard deviations higher than the average exit scores of their private college counterparts. However, the exit score gap might reflect pre-determined differences in the academic quality of these students rather than the reduced form impact of public college on students' educational achievement.

Differences in Pre-Characteristics among Public and Private College Students

Table I reports summary statistics of the pre-determined characteristics of the students by type of college for all years, all fields of study , and both genders pooled together. We find that public college students have better family and social backgrounds than their private college counterparts, and they perform better on common high school cognitive achievement exams. Hence, public-private comparisons do not provide a valid treatment-comparison setting for evaluating the impact of public college added value on educational achievements, and that the observed gap in exit exam scores might reflect other pre-determined factors rather than the value-added by public colleges.

5 Estimation of the Causal Effect of Public Colleges on Students' Scholarly Achievements

Let Y_i denote a student i's college exist score. Let P_i be a binary variable that is equal to 1 if the i is student is enrolled in a public college and zero otherwise. For the sake of simplicity, let us assume that outcomes can be approximated by the following linear form:

$$Y_i = X_i^{'}\beta + \gamma P_i + U_i, \tag{1}$$

where X is a set of other observed variables assumed to affect exist scores, and γ is the average impact of public colleges on the students' exit scores. The disturbance term U_i represents unobservable factors influencing outcomes. We want to estimate the effect of attending public colleges on the college educational outcome. We want to isolate γ, which is the treatment effect of attending public colleges in our specification.

The OLS estimates of γ would be biased due to omitted student's characteristics like innate ability that may influence both admission into public colleges, and the educational outcomes in exit exams. To avoid the pitfalls associated with omitted student characteristics, we make use of the fact that the admission into public colleges is a deterministic function of the class XII Senior Secondary School examinations (high school equivalent) test scores (S), and estimate γ in a Regression Discontinuity Design framework.

The identification approach we take in this paper exploits the fact that the treatment indicator of interest attending a public college - is determined by a known discontinuous function of an observed covariate - Senior Secondary School exit test scores. The conditional expectation of college test scores given college type is interpreted as reflecting the causal effect of switching from private to public college that is induced by changes in Senior Secondary School exit test scores at the margin of admission. This interpretation is plausible because the admission function is known to share this pattern, while it seems likely that any other mechanism linking enrollment and test scores will be much smoother. By estimating Equation (1) among students very close to threshold - where there is a discrete change in college type - we can avoid the pitfalls associated with omitted student characteristics.

The students whose Senior Secondary School marks are below a distinct threshold $\left(\bar{S}\right)$ are not eligible for admission into the public colleges. Let T_i be a binary variable with $T_i = 1$ indicating that the student i was admitted to a public college and 0 otherwise. Students are admitted to public college if $S > \bar{S}$. Therefore, T_i is expressed as:

$$T_i = 1\left(S_i > \bar{S}\right), \tag{2}$$

where $1\left(\cdot\right)$ is an indicator function equal to one if the enclosed statement is true, and $\left(\bar{S}\right)$ is the threshold for admission into the public college. In this set-up we are considering that students are not randomly assigned to private and public schools, which means that is not independent of the treatment state. Further, the disturbance term U is a combination of the unobserved factors associated with individual's pre-determined abilities (captured by the class XII Senior Secondary School exam scores S_i), and mean zero person-specific $i.i.d$

shocks (ε_i):

$$U_i = \theta(S_i) + \varepsilon_i \tag{3}$$

where $\theta(S_i)$ is an unknown (to the econometrician) function of S. Hence, while we do observe S, $\theta(S_i)$ is unobserved by the econometrician. Although OLS estimates of (1) do not have a causal interpretation, a quasi-experimental Regression-Discontinuity Design estimates still might.

The key identification assumption that underlies the Regression Discontinuity strategy is that $\theta(S_i)$ is a smooth (continuous) function which, at least at the margin of $\theta(S_i)$, where T switches from 0 to 1, can be approximated by a flexible function of S. The causal interpretation of RDD estimates depends on whether it is reasonable to assume that, after accounting for the direct impact of S using a smooth function $g(S)$, the differential benefits from public college are the only source of discontinuity in outcomes around the cutoff.

If all the students admitted to a public college attend public college rather than a private one, then $T_i = P_i$, and a sharp RDD would arise. In that case, the mean impact in a neighborhood of $S = \underline{S}$ (the local average treatment effect), would be identifiable using OLS at this margin.

$$Y_i = X_i^{'}\beta + \gamma T_i + g(S_i) + \varepsilon_i \tag{4}$$

However, if a few students who are admitted to public colleges choose to attend private colleges instead, then we will not have perfect assignment. The usual approach for dealing with miss-assignment involves a simple form of instrumental variables analysis where the index T_i becomes an instrumental variable for attending public college rather than a switching treatment indicator. The RD provides a consistent estimator for the *Local Average Treatment Effect*. In our analysis, we also use TSLS method estimating γ based on the regression function (1) , with the indicator $T_i = 1(S_i \geq \underline{S})$ as the excluded instrument, and X_i and $g(S_i)$ as a set of exogenous variables. We include fixed effects for the admission year (which captures the fixed effect for admission cutoff) in every specification.

Using Senior Secondary School Exit Test Scores and the Admission Rules in a Regression Discontinuity Design

The admission process provides a "natural discontinuity" in the sorting of students into public and private colleges by high school exit exams that can be used to evaluate the causal impact of public college education on schooling outcomes at the margin of entry. Using the data that we assembled, we aim to evaluate the causal impact of public colleges on

educational achievements, as measured by college exit exam, using a Regression Discontinuity Design (hereafter RDD). Public colleges might not follow the formal rules. Admission to public colleges might reflect networks and family connections rather than educational achievements as measured by high school exit exams. Eligible students might choose not to attend public colleges. For these reasons, we perform a number of robustness checks to examine the validity of the RDD in this particular context.

Using the Regression Discontinuity Design to Account for Selection into Public Colleges

First, we validate the use of a regression discontinuity design in this framework. We examine whether the propensity to attend public colleges jumps from 0 to 1 at the admission cutoff. We normalize the class XII Senior Secondary School examination results as deviations from admission cutoffs, which change from year to year. We look at the percentage of students in public colleges as a function of normalized class XII (Senior Secondary School) results. Figure II shows the regression fit from linear regressions of the fraction of students in public colleges on 4 percentage point bins of the normalized class XII scores on either side of the cutoff.[25] Clearly the percentage of students attending public colleges to the left of the cutoff is almost 0. Furthermore, there is a steep jump in the percentage of students attending public colleges at the admission cutoffs.[26] For instance, less than 2 percents of all college students whose high school exit score is just one bin below the cutoff attend public colleges whereas more than 95 percents of all college students whose high school exit score is just one bin above attend public colleges. Although some who are eligible choose not to attend public colleges and very few who did not meet the cutoff attend public colleges, Figure II clearly illustrates that admission cutoff corresponds to a sharp discontinuity design.

6 Results

Before we turn to the regression analysis, we provide prima facie evidence of our main findings. In Figure III, we graph the regression functions from local polynomial regressions of the college outcome scores on normalized Class XII Senior Secondary Scores for public and private colleges (a polynomial regression of degree 2 using epanechnikov kernel for smoothing

[25]Results are robust to this choice. We check for sensitivity to bin size and use of higher order local polynomial regressions, and do not find any difference. The results are Shown in Appendix Figure A.4 .

[26]This cutoff is applicable only to students who apply for general admission, and is not applicable to those who apply under affirmative action policies. This exploratory analysis is shown for only one of the three fields of study pooling the data for both genders and 5 years. The other fields show the same pattern.

on either side of the admission cutoff).[27] We observe that this graph is very smooth and shows no discontinuity around the cutoff. Two main facts emerge: (i) public college students perform better on exit exams than their private college counterparts and (ii) there is no difference between the mean and dispersion of exit scores at the cutoff margin.

The summary statistics (Table I) indicate that students attending public colleges come from more affluent family backgrounds than their private college counterparts and perform better on Senior Secondary School and college exit exams. Table II reports the public-private exit score gaps, controlling for socio-demographic indicators such as age, fathers' occupations, place of residence and board of education. The first entry in Column (i) reports the average crude public-private exit score gap. Public college students score on average about 80 points more than their private college counterparts, which is about 0.5 of a standard deviation. Females perform better on entry/exit exams than male students, and the fraction of females among those who graduate from private colleges is higher. To account for the gender gap in test scores, we next control for gender and other socio-demographic characteristics in Column (ii). Columns (iii-a) and (iii-b) report the regression coefficients on public college indicator variable for the entire sample controlling for a rich set of demographic characteristics and socio-economic variables. Columns (iii-a) and (iii-b) report the results separately by gender. As columns (ii) through (iii) indicate the public-private crude score gap cannot be explained by students' socio-economic and demographic characteristics. We find the adjusted gaps to be persistently higher and statistically significant at the 1 percent level.

Tables III through Table VI report our main findings. We find that (i) public college students have higher exit test scores than their private college counterparts, but it solely reflects the difference in entry test scores; (ii) attending public college does not have any positive impact on educational achievement, as measured by the exit test scores. The results from the estimation of (1) are reported in Table III. In our benchmark regressions reported in Column (i) of Panel A, attending public college seems to improve the college exit exam outcomes by around 124.1 points, which is about 0.75 of a standard deviation. These estimates are significant at a 1 percent level, and suggest that public college students perform better on average than the private college students. Our next step is to control for selection into treatment by including class XII Senior Secondary School examination outcomes in the regressions. The admissions cut-off, as noted, is based on these outcomes. Panel B of Table III shows the results when the class XII (Senior Secondary School examination) outcomes

[27]This figure is not sensitive to the degree or bandwidth used. The average values of the standardized college exit test scores in 2 percentage bins of class XII normalized Senior secondary school exam scores are shown in Appendix Figure A.5.

are added to the regressions.[28] Accounting for entry scores, we find the mean outcomes of public and private schools to be statistically indistinguishable (Columns (i)-(iii)). So far we have limited our sample to the main field of education chosen by more than one half of our sample. The college exit exam outcomes vary by field. As a robustness check, we re-estimate all our specifications from Table III pooling all the fields accounting for field fixed effects. We find that the public-private gaps are robust to the field of education.[29]

One natural concern is that students who are further from the admission cutoffs in either direction are not similar in their abilities. To address this, we carry out the analysis in a regression discontinuity framework. We narrow the window around the admission cutoffs and re-estimate the effect of public colleges on college exit exam outcomes. Estimates are reported in Tables IV and V. Panel (i) of Table IV restricts the interval to 12 percentage points of normalized Secondary School Exam scores (class XII) around the cutoff. Panel (ii) restricts the interval to 8 points around the cutoff, Panel (iii) to 4 points, and finally Panel (iv) to a 1 point window. As we shrink the interval, the exit scores of students graduating from public and private schools turn out to be statistically indistinguishable. We also determine the optimal bandwidth proposed by Imbens and Kalyanaraman(2009) and carry out the estimation in that bandwidth. The result is shown in Panel (v). The coefficient is statistically insignificant. This is suggestive that perhaps the public-private exit score gap is explained by pre-determined differences in students' characteristics rather than the causal impact of public colleges. In Table V, the corresponding panels with intervals of 12, 8, 4 and 1 points around the cutoff, confirm that there is no public college effect when we compare the students close to the admission cutoff after correcting for selection by controlling for class XII Senior Secondary Exam outcomes. In Panel (v), we report the regression discontinuity design estimate using the optimal bandwidth proposed by Imbens and Kalayanaram (2009), and find no effect. These results indicate that the private-public observed quality gap reflects the sorting of better students into less expensive but more selective colleges, rather than the causal impact of public college value added on educational outcomes.

As noted earlier, compliance with the assignment rules is not perfect. To allay concerns about non-compliance, we use a 2SLS strategy where we instrument attendance by the indicator for whether or not the entry score is above the admission threshold. The results are reported in Table VI. The instrument does a very good job of predicting the assignment

[28]We have used a linear specification for the control function i.e. we have included class XII Senior Secondary School exam outcomes in the regressions. Including higher-order polynomials yields similar qualitative results. We also test whether dropping all control variables yield similar estimates to the estimates reported in Table III. Results are shown in Appendix Table A.4.I and A.4.II

[29]Results are shown in Appendix Table A.5.

as reported in the top Panel A.I of table VI. The second stage estimates show an even larger public-private score gap when we do not control for pre-determined factors (Panel A.2, Columns (i)-(iii)). Next, we repeat this exercise controlling for the class XII Senior Secondary School exam outcomes to account for selection. The results are reported in Panel B.I and B.2. The second stage estimates reinforce our previous findings that the public-private college differential is on account of selection, and not value added by public colleges.

Thus far, we have looked at the effect of public college attendance on educational outcomes pooling cutoffs across different admission cohorts,and gender. Next, we examine the possibility of benefits of public colleges being heterogenous across the distribution of students. It may be possible that smarter students gain more from being in public colleges. For instance this can be on account of teachers paying closer attention to these students. We exploit the fact that the admission varies by year of admission, gender and stream of admission. Focussing on the main stream in the sample, we carry out the analysis restricted to various levels of cutoffs. The cutoffs in the 5 years have significant amount of variation and span 30 percentage points. The results are reported in Table VII. Panel A reports the OLS estimates of public college effect across different levels of cutoffs. As the cutoff changes from highest to lowest in columns (i)- (iv) of Panel A, the public college effect seems to decline in magnitude but is still strong and positive. Thus, the students with higher entry scores seem to gain the most from public colleges. However, in Panel B, we control for the Class XII Senior Secondary scores that determine assignment to public colleges. The public college effect becomes statistically indistinguishable from 0 across all the levels of cutoff admission. These findings suggest that the public colleges do not benefit students with different abilities in a heterogenous way.

7 Are the Public Colleges More Cost Effective?

We find that the public-private quality difference is not on account of value-added by the public colleges. However, public colleges could be more efficient in terms of cost- effective provision. If this were the case, then public colleges would have an advantage over private colleges. In order to address this, we collected cost data from the institutions in our sample to compare the average cost-per-pupil in public versus private colleges. Since we do not have a measure of the marginal cost of educating a student in a private or public college, and we compare only average costs, this comparison is suggestive at best. The average cost-per-pupil per annum in the private colleges in the year 2006-2007 was 13,022 Indian Rupees whereas the average cost-per-pupil in the public colleges was 13,743 Indian Rupees. Although the difference is not huge, private colleges have a lower cost-per-pupil than the public ones.

Hence, it does not seem to be the case that the public colleges are more cost-effective either.

8 Robustness Checks

Do observable characteristics vary at the cutoff margin?

Figures IV plots the regression function from the local polynomial regression of the student's age on four point bins of the normalized class XII Senior Secondary School examination scores. We also check regression functions from similar regressions of residential location, board of class XII examinations, and father's occupation on the 4 point bins of the normalized scores and find no jump in these characteristics. These are shown in Appendix tables A.6 through A.8.[30] While public college students are on average (i) younger, (ii) their fathers are less likely to be working in the agricultural sector and they (iii) are more likely to take the final senior Secondary school exams in the National Board of Education, we find no differences in all these measures at the margin of the cutoff scores. Thus, none of these variables exhibits a "discontinuity" at the admission cutoff level, indicating that a RDD is an appropriate setting for evaluating the causal impact of public college on educational achievements in this context.[31]

Do Students Manipulate Behavior ?

The estimation strategy relies on the assumption that students in a narrow interval around the admission cutoff are indistinguishable in their unobserved (to the econometrician) characteristics. If the students knew the rule that determined the cutoff, they could manipulate their behavior (for example, by trying to achieve higher scores in the Senior Secondary exams), and that would compromise the validity of the RD approach used here.[32] In this case, the sample of students' right around the cutoff may not be of comparable abilities.[33] However, the admission cutoff changed from year to year. Moreover, the rule that determined the cutoff was only known to the colleges internally. The students cannot control their entry

[30] Un-smoothed figures are consistent with these and are available on request.

[31] As detailed in Lee(2008), the continuity of the conditional expectation of the baseline characteristics delivers the identification of the parameter of interest.

[32] It is also possible that students around the cutoff, who could not get admission in public colleges, exert more effort in private colleges by way of using the rejection as a motivation. Given that a two sided test for equality of scores strongly rejects that the mean scores for public and private colleges are different around the cutoff (difference -0.62,significance .953 in a -4 to +4 deviation window around the cutoff), it seems less plausible that this effect would be large enough to counter the positive value added effect of public colleges.

[33] Van der Klaauw (2002) describes the threat to the validity of the RDD if the rules that determine the cutoff are known to students in the context of financial aid decisions by colleges in USA.

test scores perfectly as the Senior Secondary tests are evaluated in a double blind manner. Additionally, even if they could manipulate their scores, they cannot perfectly control the cutoff. This corresponds to a case where the 'forcing variable' is not fully in the control of students. Hence, we think this kind of manipulation is not a threat to the identification. Figure V suggests that there is no break in the density of the the Normalized Senior Secondary exam (Class XII) scores which is smooth around the cutoff. [34]

Attrition: Can Characteristics of the Students Dropping-Out Explain the Results?

While admission seems to be almost perfectly projected by entry rules, this does not prevent selective dropout. Naturally we expect dropout rates to be higher among those who were not admitted to public colleges because tuition is higher at the private colleges. If the less able students are more likely to drop-out than the public-private exit score gap might understate the causal impact of public college education on students' performance. Figure VI (Panel A and Panel B using different bandwidths) shows that those who performed better in class XII Senior Secondary exams, are more likely to finish college education. However, there is no stark discontinuity in this drop-out rate around the admission cutoff. We also test if the students who drop out near the cut-off in public and private colleges are different in their Senior Secondary exam scores, which is a proxy for their ability coming in. We estimate the probability of drop-out separately for public and private colleges for each gender, and compare if the Senior Secondary exam scores differentially affect dropping out probabilities across public and private colleges. In a sample including all students, we do observe that Senior Secondary scores have a different impact on dropping out from public relative to private colleges for both genders (Appendix Table A.6). Father's occupation (government service and business) also have a differential impact on probability to drop out. However, when we restrict the sample to students in a -4 to +4 percentage point deviations window from the cutoff, neither the Senior Secondary scores, nor the father's occupation differentially effect the probability of dropping out in public versus private colleges (Appendix Table A.7). The students who drop-out from private colleges are very similar in ability and family background to students who drop out from public colleges in the proximity of the admissions cut-off.

[34] See McCrary 2008 for details on varieties of manipulation that can cause identification problems. In this case, sorting into different colleges using the Senior Secondary Scores is not in perfect control of the students, hence in this setting, the public college impact can be identified under the regularity conditions proposed by Lee (2008).

Attrition:Could the characteristics of the Rejected Applicants Explain the Results?

Another related concern could be selective enrollment decisions. If student's from relatively poor backgrounds decide not to attend college unless they are admitted to public colleges, then this can attenuate the impact of attending public colleges. While we do not observe students who did not enroll, evidence suggests that this should not be of major concern, at least at the margin of admission. The private colleges offer a limited number of need- based scholarships to those students whose performance in the class XII Senior Secondary School exams is outstanding. Personal correspondence with senior management personnel in the private colleges revealed that if a student at the margin is willing to pursue college education but cannot afford it, he or she is usually able to avail a need based scholarship offered by the private colleges. According to the details provided by 1 private college in our sample for year 2006-2007, 21 students were offered a 100 percent fee waiver,10 students were offered a 75 percent fee concession, and 2 students received a 50 percent fee concession.[35] This might be one of the reasons that explain why the dropout rate is smooth and continuous around the admission cutoff. Moreover, we see that right around the admission cutoff, the characteristics of those who drop out from public colleges are similar to those who drop out from private colleges. Hence, it seems less likely that we will be missing students with different characteristics. If students with parents in low paying occupations did not enroll for example, then we should expect the parents to of students in private colleges right around the cutoff to be in high paying occupations. We have ruled out this possibility by showing that a number of students background characteristics are very smooth around the cutoff.

In addition, very few individuals migrate to pursue higher education in the general sector. We examine the reported reasons of migration by migrants in the 2001 Population Census of India. Only 3 percent report migrating for pursuing education and this includes those who migrate to pursue technical and professional education as well (Appendix Table A.8). [36] Hence, we think that at least at the margin of admission, selective attrition is not biasing down our estimates.

Could Differential Peer Effects explain the Differences ?

The class composition in public colleges is a mix of general category students, and students from marginalized groups who enter public colleges because of the state reservation policy and

[35]There are limited number of scholarships available. As a result the students incentive to get into subsidized public colleges is not dampened.

[36]Most of the migration in the age category 18-25 is reported by women on account of marriage.

their entry scores are much lower than the entry scores of students entering public colleges in open seats. One concern might be that the scores of the students on the margin of selection in public colleges are negatively influenced by this 'peer effect' [37], which could attenuate the positive value added by public colleges. However, the students in private colleges who are close to the margin of admission experience plausibly similar peer effects. We plot the density for Class XII scores of (i) the students graduating from public colleges who enter on a caste based reservation seat, (ii) and the students from private colleges. We observe that the distribution of human capital (as approximated by the Class XII Senior Secondary Exam scores) among low scoring peers of students close to the admission cut-off in public colleges is no different than those in private colleges.[38] Hence, it does not seem less likely that the negative 'peer effects' are offsetting the positive public college value added effect. Similarly, a negative invidious comparison effect[39] that lowers the scores of students near the cutoff in public colleges is less likely due to the heterogenous composition of classes with students admitted on reserved seats and open category seats taking the same classes. The open category students near the cutoff are in the middle of the incoming scores distribution. Although, the college drop out rate is very high, the number of repeaters is negligible (close to .01 percent in the sample including both open and reserved category students). Hence, peer effects from those who repeat classes (as posited by Lavy et al 2008) would not be of a discernible significant magnitude.

Overall, our results are supportive of a model in which teacher effort is higher in the private institutions, but this is compensated for the marginal student admitted in the public institutions by positive peer effects. In the absence of such peer effects, it could be the case that the marginal student's outcomes in public colleges would be lower than their private counterparts, as seen in K-12 education in India.

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[37] We are considering the reduced form effect of attending a public college. This could either be on account of high value added or peer effects. The colleges offer a prescribed curriculum and there is no evidence of academic tracking in the Indian education system. Given the mixed composition, peer effects would not necessarily have a significant positive effect on the student outcomes. However, in our analysis we will only address the overall effect of students attending public colleges. A detailed analysis of 'peer effects' on various margins will be offered in a forthcoming study.

[38] The densities are shown in Appendix Figure A.9.

[39] This effect would imply that higher achieving peers depress the outcomes of lower ability students due to lowering of morale (Hoxby and Weingarth, 2005).

9 Conclusion

Our findings indicate that selective sorting into public colleges accounts for the public-private college exit exam score gap. Controlling for entry scores, we find the exit scores of the students graduating from private and public colleges to be statistically indistinguishable. These findings indicate that the apparent value added by public colleges reflects selection of the best students into the less expensive schools rather than the causal impact of public education on students' performance. Our findings suggest that at the margin private colleges are a perfect substitute to public colleges in terms of training the students. We also show that students in the different parts of the ability distribution do not differentially benefit from attending public college. From policy perspective, the relevant margin of analysis is the admission cutoff. It is the students at this margin who are affected by public finance decisions to expand college infrastructure.

Given that excess demand for higher education is not being met by the current infrastructure, policy makers need to determine whether to expand government college infrastructure or to adopt other policies such as more merit-cum-need based scholarships to students in private colleges.[40] Increasing public spending on expansion of government colleges warrants a cost-benefit analysis around the cut-off of admissions. An expansion of government institutions would lower the cut-off for admission, providing free education to those who are otherwise willing to pay for college admission. In return, if the quality of education that these students received was higher, then a stronger case could be made to expand public tertiary education and incur the loss of revenue. However, our results indicate that expanding public education will not yield better trained graduates. Unless the public colleges serve other objectives, serious consideration should be given to allowing the private sector to expand. [41]

An alternative policy could be to devise scholarship programs for private colleges that expand financial aid to the students who cannot afford a college education. The average cost-per-pupil provides suggestive evidence that the private colleges are cheaper (to confirm that at the margin of selection, we would require information on marginal costs which we do not have). If the share of wealthy students who would attend private colleges in absence of the

[40] A recent article in New Yorker reports that the salaries for skilled workers might rise by about 14 percent indicating an excess demand for skilled workers. Another article in The Economist points out that the central government is planning to open 30 new centrally run institutions to meet the excess demand for higher education.

[41] An important thing to note is that when students make college choices, they look at the outcomes of the *average students* from the institutions rather than the outcome of the *marginal* student admitted. Hence, they choose public colleges over private colleges due to the perception that public colleges are better. There is an information asymmetry that influences the college decisions.

public subsidy, among the students who actually receive scholarships is not too large, then a modest difference in costs can make this policy more appealing.[42] When these alternate policies are feasible, the state can extend its role in monitoring the standards of education offered by the colleges, and encouraging the development of a market based tertiary education sector.

Our paper examines how public colleges affect quality of human capital acquired in colleges. As indicated by a large body of literature, there can be significant returns in the labor markets from attending selective and prestigious institutions. As mentioned before, this can be on account of value added by the colleges, networking, or on account of screening by the employers when there is information asymmetry about ability of the employees (Epple and Romano (1998); Macleod and Urquiola (2009)). Analyzing whether there are significant positive returns to attending public colleges in labor market and if so, what explains them is an important avenue of future research.

[42]Let C_1 be the MC of educating a student in a public college and C_0 be the MC of educating the student in the private college at the cutoff for admission. Suppose P is the fraction of additional students who receive the scholarship instead of attending public colleges.Then the benefit of the scholarship program would be $(C_1 - C_0)P$ and the cost of this program will be $(1 - P)C_1$. The cost results from the use of this subsidy by some students who afford private college fee and would have paid it in absence of the subsidy. Therefore, if $1 - \frac{C_0}{C_1} > \frac{1}{P} - 1$, then this policy would be cost effective.

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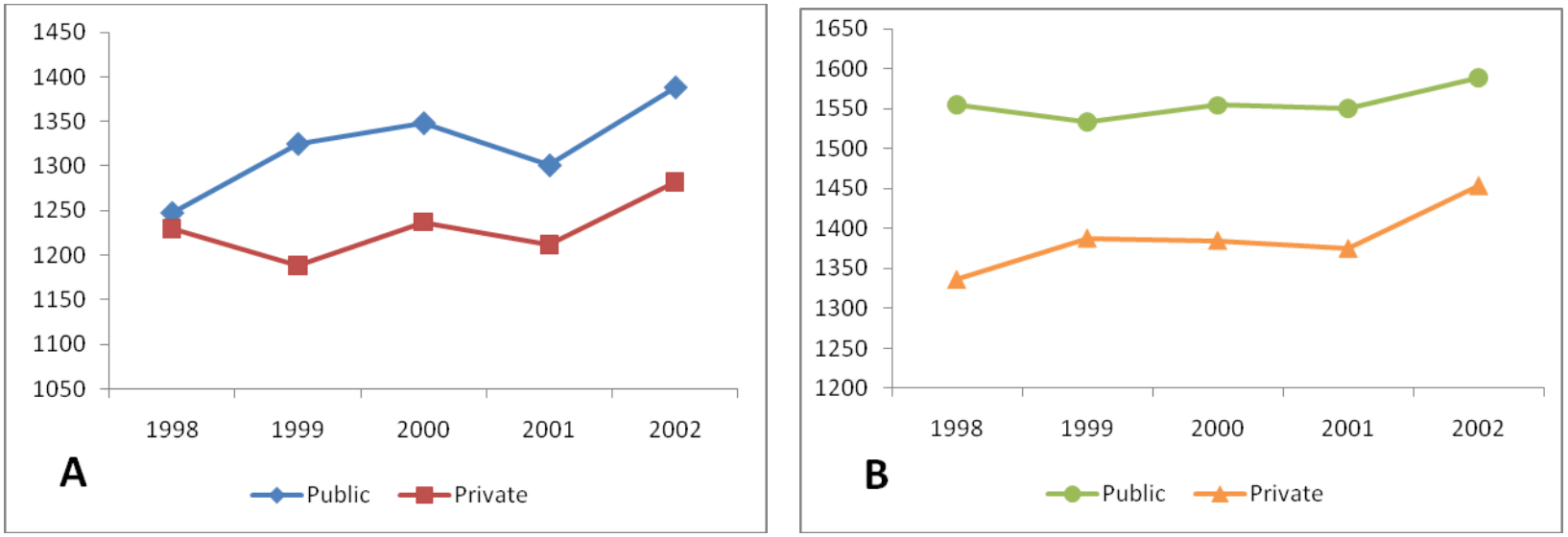


Figure I : Panel A and B show the college exit exam scores for liberal arts stream for men and women respectively. Difference between public and private college outcomes is statistically significant at 1 percent for all years for men and women (except for men in 1998).

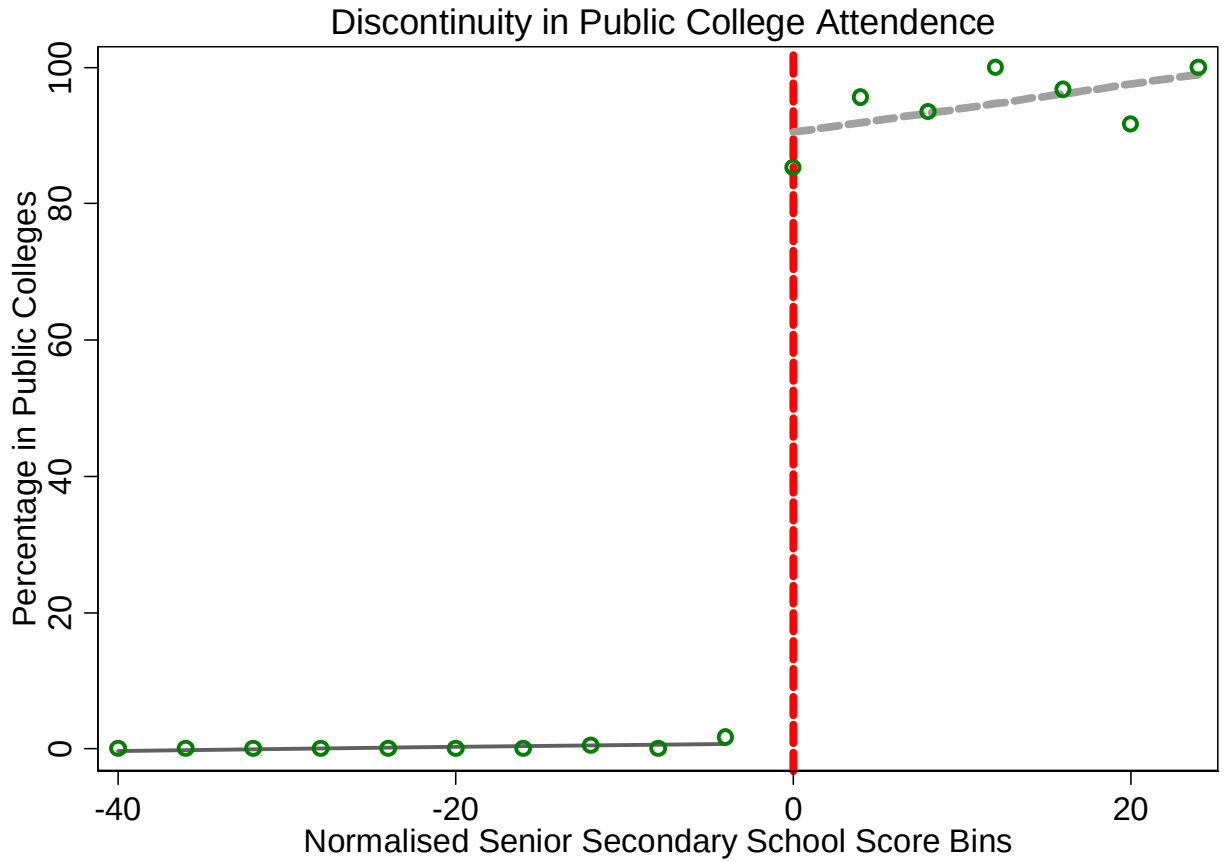


Figure II: This Figure graphs the regression functions from a linear regression of percentage of students in public colleges on the 4 point intervals of Normalized Class XII Senior Secondary Scores on either side of the admission cutoff. Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score.

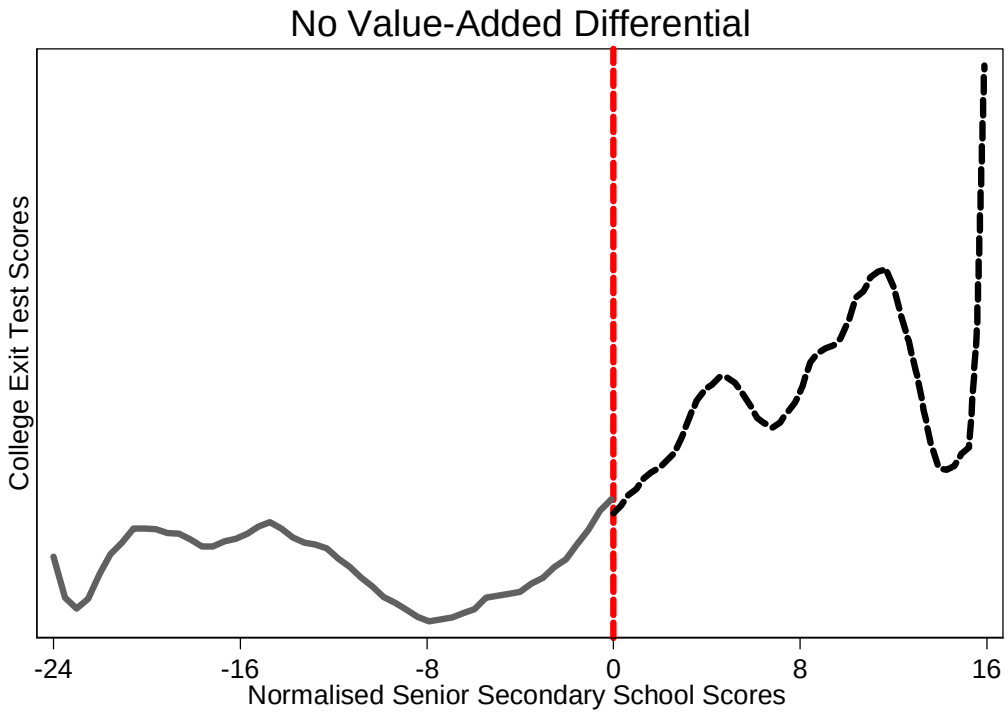


Figure III: This figure graphs the regression functions from a local polynomial regression of marks obtained in the exit exams of the undergraduate degree in liberal arts for students in private(to the left of 0) and public (to the right of 0) colleges on their normalized class XII Senior Secondary School Exam Percentage. Class XII percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score. The regressions use epanechnikov kernel with a bandwidth of 2, and a polynomial of degree 2.

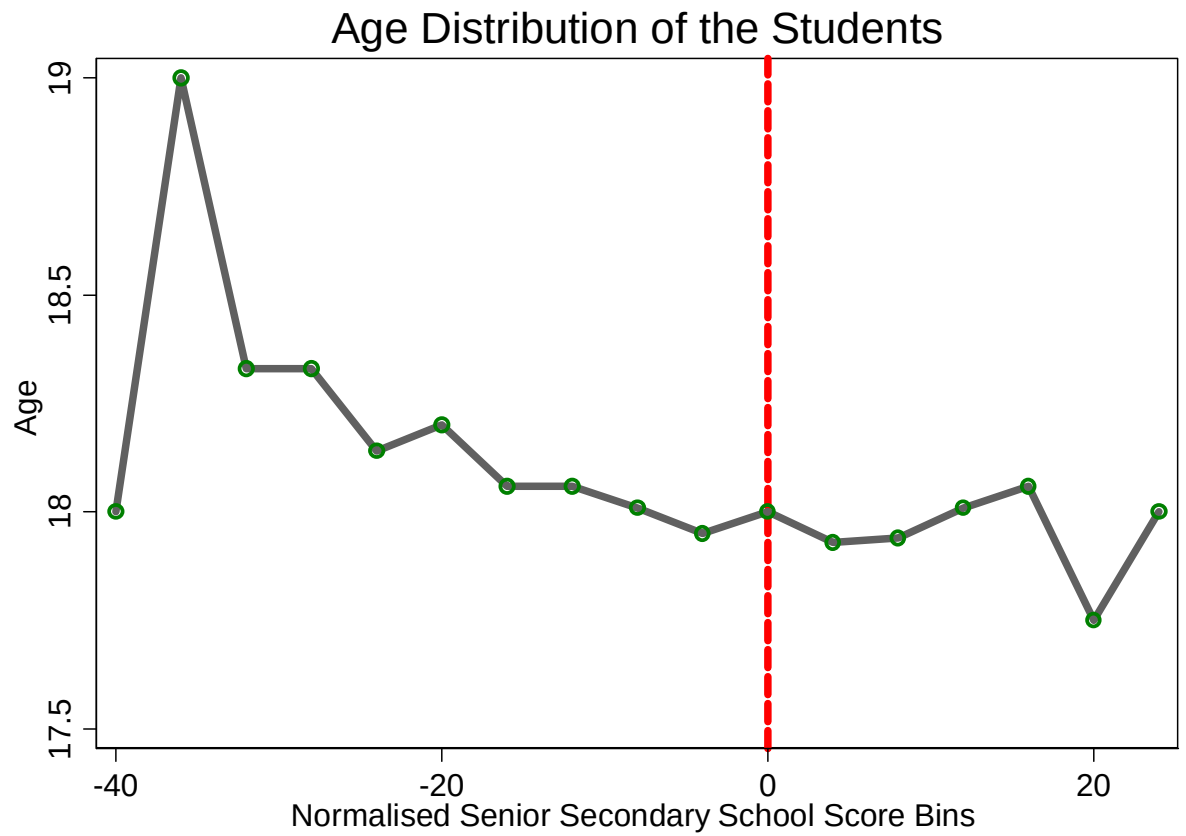
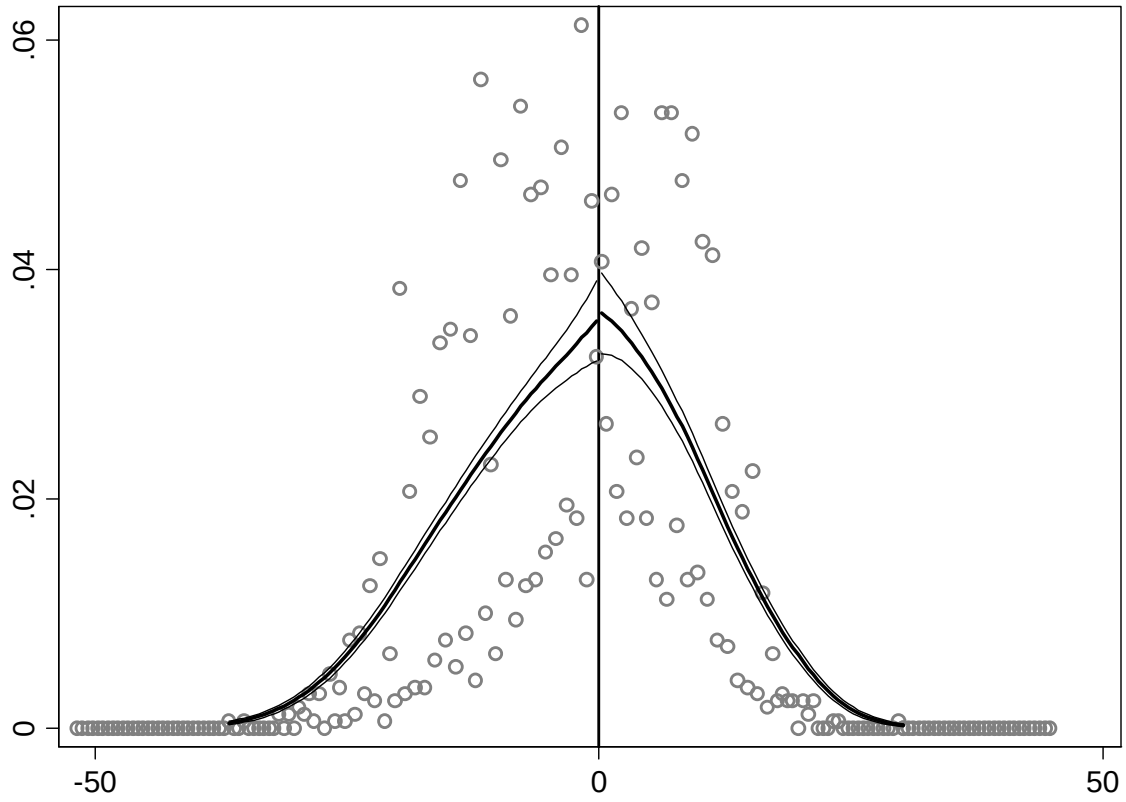


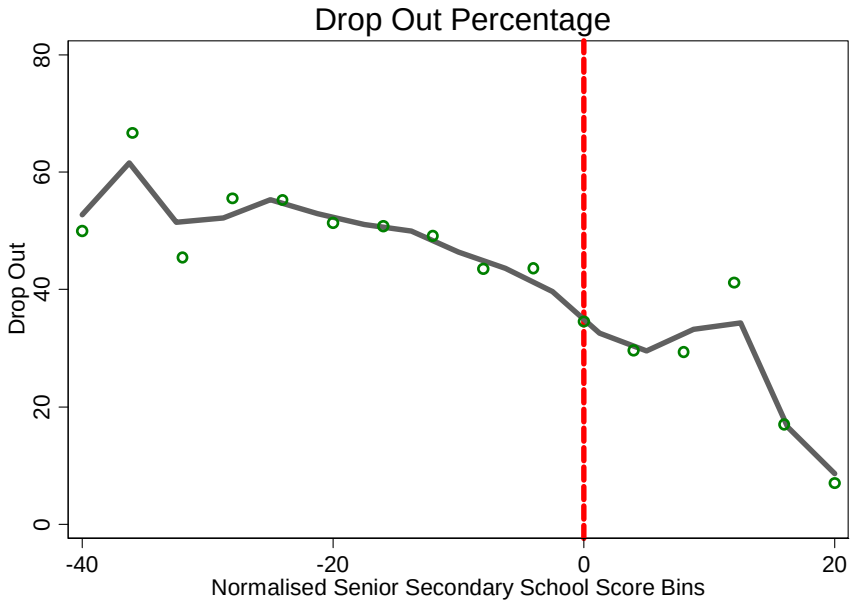
Figure IV: This figure graphs the regression function from a polynomial regression of the average age of students on 4 point intervals of normalized class XII Senior Secondary Exam percentage score. Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score. The regressions use epanechnikov kernel with a bandwidth of 2, and a polynomial of degree 2.



Density of the class XII Senior Secondary School exam normalized scores
(Histogram bin size 0.5, smoothed kernel density using epanechnikov kernel)

Figure V: This figure shows that the density of the selection variable is smooth around the cutoff

Panel A: Bandwidth 2



Panel B: Bandwidth 4

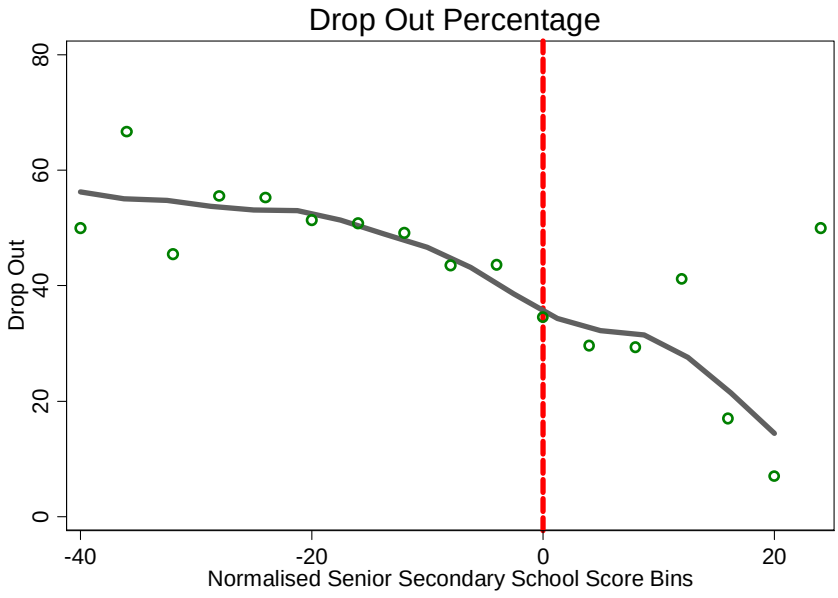


Figure VI: This figure graphs the regression function from a polynomial regression of the percentage of students dropping-out of college on 4 point intervals of normalized class XII Senior Secondary Exam percentage score. The regressions use epanechnikov kernel with a bandwidth of 2. Dropping-out rate is very smooth around the admission cutoff. In Panel A, a bandwidth of 2 is used, while a bandwidth of 4 is used in Panel B. The shape of the function is robust to the bandwidth choice.

Table I: Summary Statistics by College Type

	Private	Public	Difference
Fraction Males	0.198	0.477	
Variables			
Age	17.99	17.95	0.04
	(.014)	(.015)	(.02)
School Board in Class XII			
Regional	0.78	0.63	0.15
	(.007)	(.01)	(.01)
Central	0.2	0.36	-0.155
	(.007)	(.01)	(.011)
Rural Residence	0.124	0.086	0.038
	(.006)	(.006)	(.0094)
Father's Occupation			
Agriculture	0.092	0.065	0.026
	(.005)	(.005)	(.007)
Business	0.42	0.37	0.05
	(.0087)	(.01)	(.013)
Government Employee	0.07	0.08	-0.008
	(.004)	(.005)	(.007)
Labor	0.032	0.039	-0.007
	(.003)	(.004)	(.005)
Professional	0.054	0.041	0.012
	(.004)	(.004)	(.006)
Service	0.24	0.31	-0.065
	(.007)	(.009)	(.012)
Senior Secondary Percentage Score			
Liberal Arts	58.55	70.07	-11.5
	(.172)	(.187)	(.258)
College Exit Exams Scores			
Liberal Arts	1378.73	1461.08	-82.35
	(3.43)	(4.58)	(5.6)

Table II: OLS Estimates of the Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree

	(i)	(ii)	(iii)	(iii-a)	(iii-b)
			All	Males	Females
Public College	82.34	131.3	124.14	97.96	133.14
	(5.6)	(5.7)	(6.2)	(11.7)	(7.3)
Controls					
Age		-4.76	-26.56	-8.1	207.19
		(3.07)	(42.8)	(54)	(106.97)
Age squared			0.51	0.23	-6.07
			(1.14)	(1.28)	(3)
Male		-189.54	-181.14		
		(6.5)	(7.03)		
Rural		-29.17	-29.68	-26.7	-32.27
		(7.8)	(9.3)	(15)	(11.8)
Father's Occupation					
Agriculture			7.8	-16.27	41.7
			(15.3)	(22.1)	(21.28)
Business			10.4	-17.9	41.98
			(13.1)	(19)	(18.4)
Professional			27	-34	58.53
			(17.6)	(49.2)	(22)
Private Service			-4.1	-27.7	27.18
			(13.3)	(18.4)	(18.9)
Government Service			-19.4	-19	6.52
			(15.8)	(24.5)	(21.32)
Regional Class XII Board			-30.12	-29.7	-26.48
			(8.5)	(17.2)	(9.86)
Obervations	3394	2742	2612	662	1950
F	215.56	290.57	83.72	9.71	43.51
R-Squared	0.06	0.3	0.3	0.16	0.22

Notes: Columns (i) - (iii) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Final marks in undergraduate degree are the composite overall the composite overall scores of the students in liberal arts streams. Public college is an indicator variable equal to 1 if the student attends public college. Column (ii) and (iii) control for the observable student characteristics including age, gender, and rural residence status. Column (iii) also controls for square of age, father's occupation type, the board of education in class XII (Senior Secondary Board), and year of admission (not reported). Excluded category for father's occupation is `labor'. Professional includes doctors,lawyers, accountants, jounalists, and professors. Columns (iii-a) and (iii-b) report the regression estimates by gender. Robust standard errors are reported in parentheses.

Accounting for Selection : Controlling for the Class XII (Senior Secondary) Exit Exams Scores

Table III: OLS Estimates of the Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree

	Panel (A)			Panel (B)		
	(i) ALL	(ii) Males	(iii) Females	(i) ALL	(ii) Males	(iii) Females
Public College	124.1	97.96	133.14	1.28	-1.57	1.72
	(6.2)	(11.7)	(7.3)	(8.06)	(16.63)	(9.44)
Class XII Percentage (Senior Secondary)				8.8	7.87	9.03
				(.409)	(.97)	(.45)
Obervations	2612	662	1950	2612	662	1950
F	83.72	9.71	43.51	122.93	14.56	76.53
R-Squared	0.31	0.16	0.22	0.41	0.22	0.35

Notes: Panels (A) - (B) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Final marks in undergraduate degree are the composite overall scores of the students in liberal arts streams. Public college is an indicator variable equal to 1 if the student attends public college and 0 otherwise. Panel (A) shows the results from the benchmark regressions (also reported in Table I: Column (iii)). Panel (B) reports the results from the linear regressions that control for the percentage of marks scored in Class XII senior secondary exams which form the basis of selection into Public Colleges. Each regression also controls for observable student characteristics including age, age squared, gender,rural residence status,father's occupation,board of education in Class XII (Senior Secondary board), and year of admission(not reported). Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. The results are reported separately for Males and Females in columns (ii) and (iii) of each panel. Robust standard errors are reported in parentheses.

Regression Discontinuity Design Framework

Table IV:The Effect of Attending Public Colleges on Educational Outcomes

	Dependent Variable : Final Marks in Undergraduate Degree												
	(i)			**(ii)**			**(iii)**			**(iv)**			**Optimal Bandwidth (v)**
	1	2	3	**1**	2	3	**1**	2	3	**1**	2	3	**width**
	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	0.921
Public College	90.66	79.4	93	66.9	65.11	67.2	35.5	41.1	32.2	14.47	42.33	-0.34	16.76
	(6.51)	(12.66)	(7.76)	(7.38)	(14.84)	(8.68)	(9.8)	(19.69)	(11.87)	(19.88)	(36)	(26.19)	(24.21)
Obervations	1978	577	1401	1499	465	1034	847	279	568	308	135	173	235
F	73.19	6.83	19.66	62.9	5.6	10.08	43.83	2.73	4.61	16.31	0.83	1.73	11.51
R-Squared	0.34	0.13	0.15	0.3	0.14	0.1	0.4	0.11	0.09	0.41	0.08	0.12	0.42
	12 points window			8 points window			4 points window			1 point window			

Notes: Panels (i)-(iv) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Final marks in undergraduate degree are the composite overall scores of the students in liberal arts streams. Public College is a binary variable that equals 1 if the student attended public collge and 0 otherwise. Panel (i) reports the results for a sample restricted to 12 points window above and below the cutoff. The sample is restricted to a smaller window of 8 points around the cutoff in Panel (ii). In Panel (iii), the window is shrunk to 4 points above and below the cutoff and in Panel (iv),we report the results from a sample restricted to 1 point window around the cutoff. Each regression also controls for observable student characteristics including age, age squared, gender, rural residence status, father's occupation,board of education in Class XII (Senior Secondary board), year of admission, and the concentration stream (not reported). Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. Results are reported separately for Males and Females in Columns 2 and 3 of each Panel. Robust standard errors are reported in parentheses. Panel V reports the results using optimal bandwidth.

Accounting for Selection in the Regression Discontinuity Design Framework

Controlling for the Class XII (Senior Secondary) Exit Exams Scores

Table V: The Effect of Attending Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree

	(i)			(ii)			(iii)			(iv)			Optimal Bandwidth (v)
	1	**2**	3	1	**2**	3	1	**2**	3	1	**2**	3	**Width**
	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	0.921
Public College	-7.14	-6.87	-10.51	-8.3	-10.7	-11.75	8.23	27.3	-5.48	7.76	38.03	-10.27	5.74
	(9.93)	(17.96)	(11.84)	(10.78)	(19.84)	(13.46)	(13.46)	(24.6)	(17.9)	(20.91)	(39.94)	(30.6)	(24.71)
Class XII % (Senior Secondary)	10.3	9.14	10.34	10.7	11.4	10.92	7.5	4.53	10.23	7.86	6.84	13.83	19
	(.84)	(1.39)	(.92)	(1.14)	(2.06)	(1.44)	(2.5)	(4.87)	(3.64)	(7.64)	(27.41)	(22.01)	(9.7)
Obervations	1978	577	1401	1499	465	1034	847	279	568	308	135	173	235
F	85.21	9.89	28.4	67.9	7.74	13.93	41.86	2.59	4.89	16.31	0.83	1.73	11.13
R-Squared	0.4	0.2	0.22	0.4	0.12	0.16	0.43	0.12	0.11	0.41	0.08	0.12	0.43
	12 points window			8 points window			4 points window			1 points window			

Notes: Panels (i)-(iv) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Final marks in undergraduate degree are the composite overall scores of the students in liberal arts streams. Public College is a binary variable that equals 1 if the student attended public collge and 0 otherwise. Panel (i) reports the results for a sample restricted to 12 points window above and below the cutoff. The sample is restricted to a smaller window of 8 points around the cutoff in Panel (ii). In Panel (iii), the window is shrunk to 4 points above and below the cutoff and in Panel (iv),we report the results from a sample restricted to 1 point window around the cutoff. Each set of regressions control for the percentage of marks scored in Class XII Senior Secondary exams which form the basis of selection into Public Colleges. Each regression also controls for observable student characteristics including age, age squared, gender, rural residence status, father's occupation,board of education in Class XII (Senior Secondary board), year of admission, and the concentration stream (not reported). Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. Results are reported separately for Males and Females in Columns 2 and 3 of each Panel . Robust standard errors are reported in parentheses. Panel V reports results using optimal bandwidth.

Table VI :Two Stage Least Square Estimates of the Effect of Public Colleges on Educational Outcomes

First Stage Instrumental Variable Estimates

Dependent Variable : Indicator for Public College Attendence

	Panel A.1			Panel B.1		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	ALL	Males	Females	ALL	Males	Females
Indicator for Eligibility	0.89	0.93	0.856	0.827	0.85	0.805
	(.008)	(.018)	(.001)	(.013)	(.03)	(.015)
Class XII Percentage	No	No	No	Yes	Yes	Yes
Obervations	2612	662	1950	2612	662	1950
F	986.58	215.34	682.24	930.9	203.8	641.12
R-Squared	0.84	0.812	0.82	0.84	0.81	0.82

Second-Stage Instrumental Variable Estimates of Public College Attendence on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree

	Panel A.2			Panel B.2		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	ALL	Males	Females	ALL	Males	Females
Predicted Public College	153.56	117.59	164.92	11.76	-0.15	13.21
Attendence	(6.81)	(12.9)	(8.11)	(10.45)	(22.23)	(12.23)
Class XII Percentage	No	No	No	Yes	Yes	Yes
Obervations	2612	662	1950	2612	662	1950
F	93.15	10.7	50.84	123.08	14.56	76.6
R-Squared	0.33	0.176	0.2545	0.415	0.24	0.35

Notes: Panels (A) - (B) report the two stage least square estimates of the effect of attending public college on educational outcomes. The top panel reports the first stage results from a linear regression where the indicator for eligibility is a dummy variable equal to 1 if the Class XII percentage score of the student exceeds the Public College admission cutoff . The bottom panel reports the results from the second stage. Final marks in undergraduate degree are the composite overall scores of the student in the liberal arts streams. Panel (B) controls for the the precentage marks scored in Class XII (Senior Secondary exams) which form the basis of selection into Public Colleges while Panel (A) doe not. Public College is an indicator variable equal to 1 if the student attends public college . Each set of regressions also controls for observable student characteristics including age, age squared, gender, rural residence status,father's occupation,board of education in Class XII, and year of admission (not reported). Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. The results are reported separately for Males and Females in columns (ii) and (iii) of each panel. Robust standard errors are reported in parentheses.

Robustness Check: Testing for Heterogeous Effect by Distribution of Admission Cut-off Scores

TableVII: OLS Estimates of the Effect of Public Colleges on Educational Outcomes by Distribution of Admission Cutoff Scores

Dependent Variable : Final Marks in Undergraduate Degree

	Panel A				**Panel (B)**			
	(i)	**(ii)**	**(iii)**	**(iv)**	**(i)**	**(ii)**	**(iii)**	**(iv)**
Cutoff Admission	**Highest**			**Lowest**	**Highest**			**Lowest**
Public College	146.65	129.78	101.87	90	17.16	-3.8	3.08	-8.2
	(15.2)	(8.4)	(14.8)	(18.64)	(19.07)	(10.9)	(21.11)	(26.6)
Class XII Percentage (Senior Secondary)	No	No	No	No	Yes	Yes	Yes	Yes
Obervations	479	1471	458	204	479	1471	458	204
F	13.33	36.74	6.93	5.43	23.47	64.05	10.02	7.71
R-Squared	0.22	0.23	0.15	0.21	0.35	0.37	0.23	0.3

Notes: Panels (A) - (B) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Columns (i) to (iv) restrict the sample to specific cutoffs that vary by year and gender. Final marks in undergraduate degree are the composite overall scores of the students in liberal arts stream. Public college is an indicator variable equal to 1 if the student attends public college and 0 otherwise. Panel (A) shows th results from the regressions restricting the admission cutoffs to different values ranging from low to high. Panel (B) reports the results from the linear regressions that control for the percentage of marks scored in Class XII senior secondary exams which form the basis of selection into Public Colleges. Each regression also controls for observable student characteristics including age, age squared, rural residence stau, father's occupation, board of education in Class XII (Senior Secondary board). Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. Robust Standard Errors are reported in paranthesis.

Appendices

Data Appendix: Data Collection and Formation of Samples

We obtained the admission records for students who applied to study liberal arts, commerce or science streams. We obtained the admission data for 15783 students. Out of these,7467 students were admitted in public colleges and 8316 were admitted in private colleges. These included 7983 women and 7796 men. 65 percent of the students took admission in humanities and social sciences, 20 percent in science and 15 percent in commerce. While these colleges have significant autonomy in determining the incoming class size for social sciences and humanities stream, the number of seats in commerce and science are capped by the university that these colleges are affiliated to. Usually the available seats are in multiples of 70 and the decision is based on the college infrastructure and demand for the stream.

The dropout rate is around 45% and the sample appearing for final year exams includes 8775 students. The dropout rate is similar across private and public colleges. The retention rate of public colleges is 58% and that of private colleges is 53%. Across the streams, retention rate is highest for commerce (66 percent), followed by social sciences and humanities (56 percent) and sciences have the lowest retention rate (44 percent). The graduating students in the non reserved category comprise our main sample used in the analysis(henceforth non reserved graduating sample).

Specific percentage of seats in the public colleges are reserved for scheduled classes under affirmative action policy of the state. Additional reservations are made for backward classes, children of deceased armed force personnel who die in active duty or freedom fighters, riot victims, immigrants from Kashmir which is a disturbed area in the northern part of Indian subcontinent, teachers wards and athletes. We exclude the admissions based on reserved seats from our sample. We observe the result status of everyone in the graduating class. However, the final composite score is not reported for some students whose result is late on account of administrative reasons. The scores of these students are notified by the university later through college notifications. We exclude these from our sample. In addition, we exclude cases where either the senior secondary marks or final composite marks are missing. We also exclude reappearing students and students who remained absent from the final year exams. Finally, we trim the cases where the students failed in the final exams as the percentage of these cases is small and is not systematically different across private and public colleges. Table A.1.a summarizes these exclusions. In Table A.1.b, we show that the number of excluded observations are not systematically different across private or public colleges for any category of excluded observations. Table A.3 shows number of observations by variables.

Supplemental Material Appendix : Additional Tests and Robustness Checks

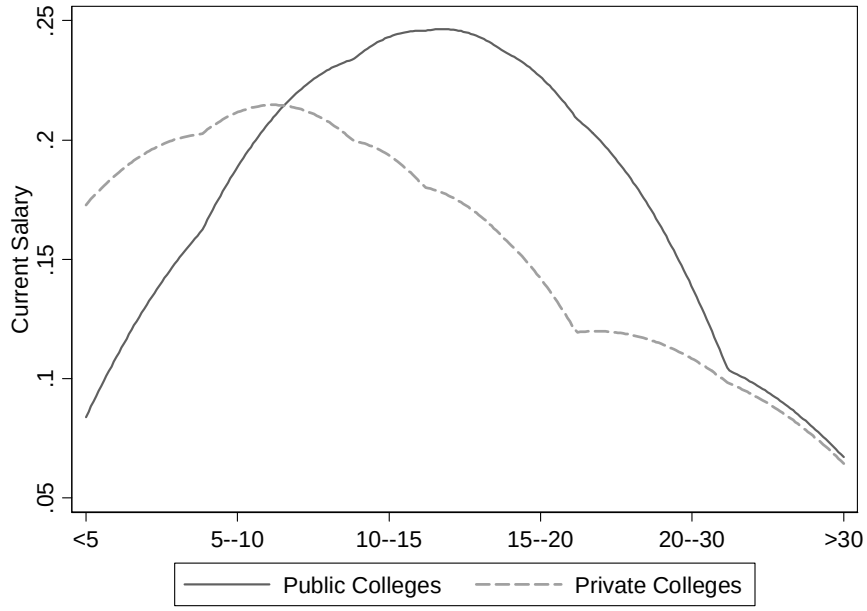


Figure A.1: This figure shows the density of salaries (in '000 of Indian Rupees) by public and private status in a small pilot survey of college graduates in the same area conducted in 2009.

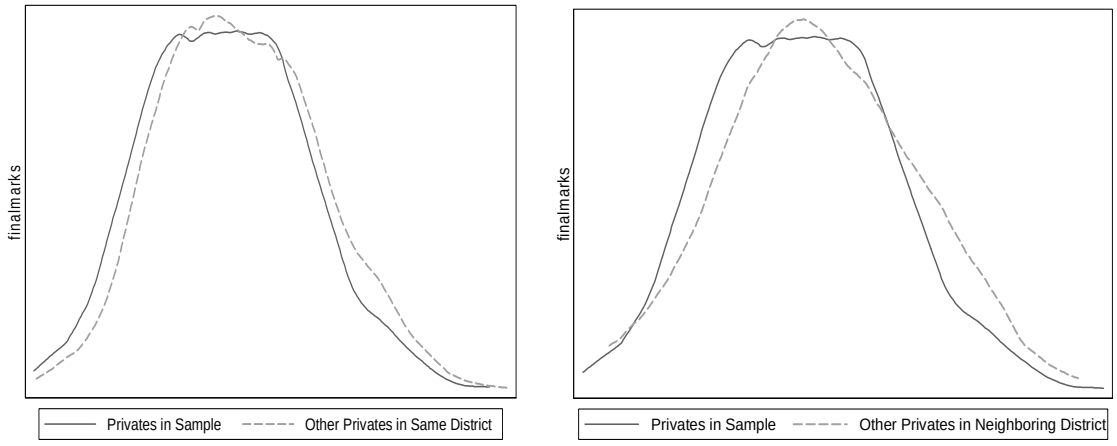


Figure A.2 This figure shows the density of college exit scores for the in-sample private colleges compared to other private colleges in the same district (left panel) and private colleges in the neighboring district (right panel) for the academic year 2009-2010.

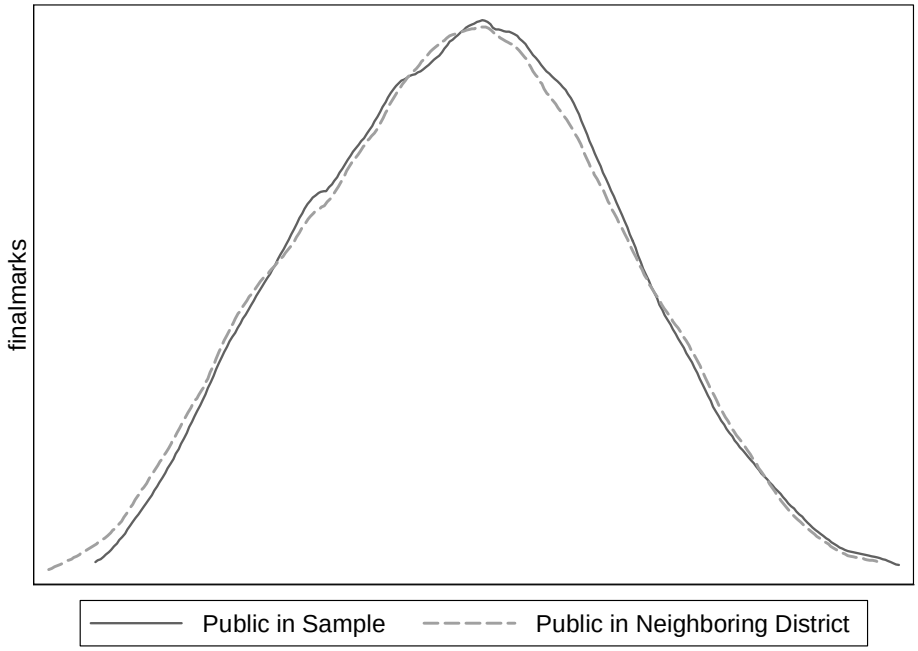
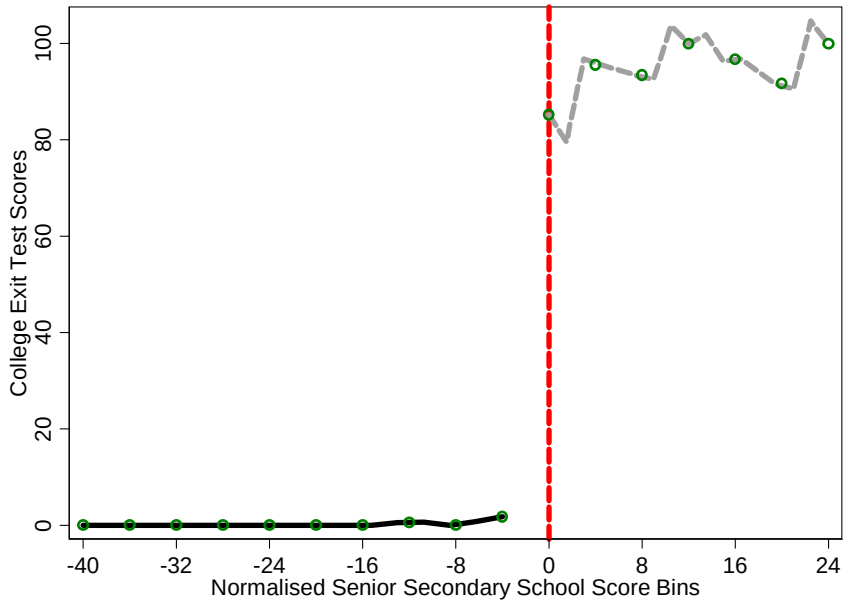


Figure A.3 This figure shows the density of college exit scores for the in-sample public colleges compared to other private colleges in the neighboring district for the academic year 2009-2010.

Panel A: Polynomial fit of degree 2 and bandwidth 2 using epanechnikov kernel



Panel B: Linear fit using a bin size of 2 percentage points instead of 4 percentage points

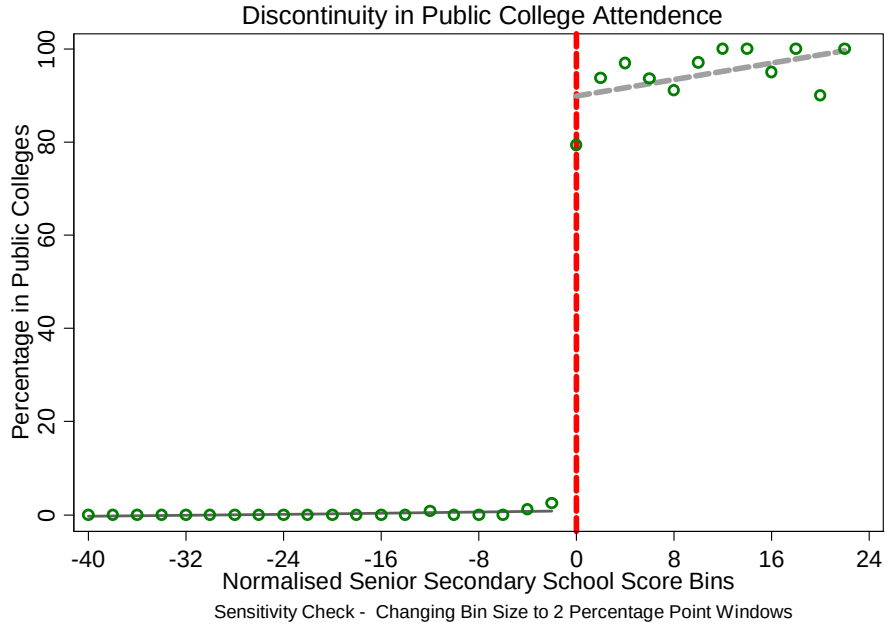


Figure A.4: This figure plots the regression functions from a polynomial regression in Panel A and a linear regression in Panel B of the percentage of students attending public colleges on the bins of normalized class XII Senior secondary school percentage score. The bin size in Panel A is 4 percentage points but the functions are based on a degree 2 polynomial local regression on either side of the admission cutoff. Panel B depicts a linear fit but the bin size is 2 percentage points.

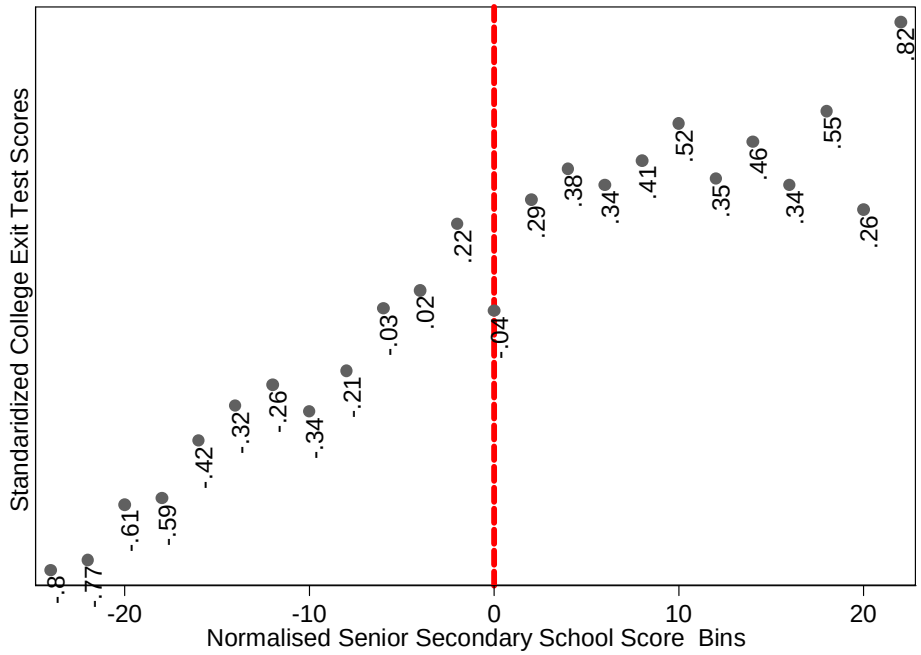


Figure A.5: This figure shows the average values of standardized college exit test scores in 2 percentage point bins of normalized class XII Senior secondary school percentage scores.

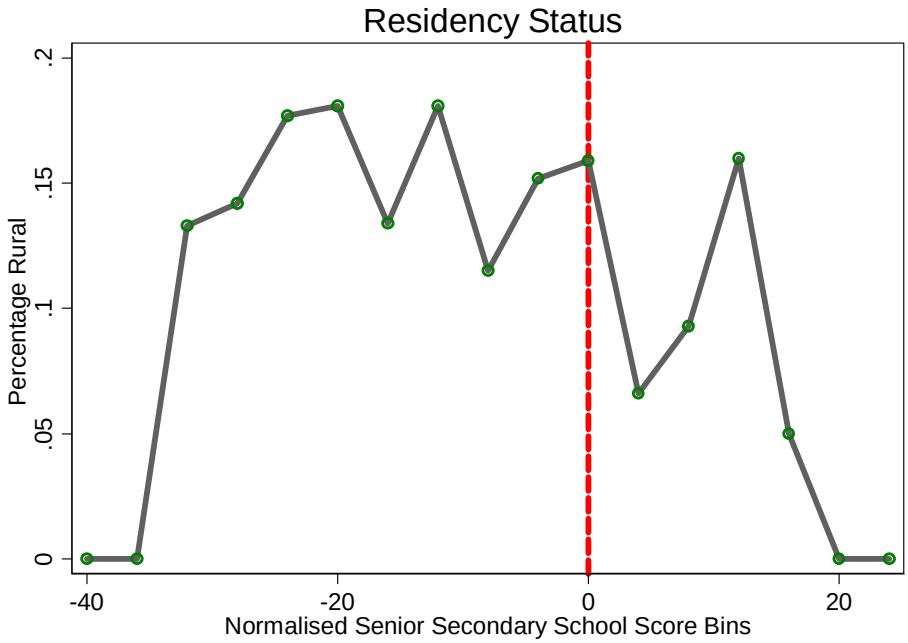


Figure A.6: This figure graphs the regression function from a polynomial regression of the percentage of students from rural areas on 4 point intervals of normalized class XII Senior Secondary Exam percentage score. The regressions use epanechnikov kernel with a bandwidth of 2, and a polynomial of degree 2.

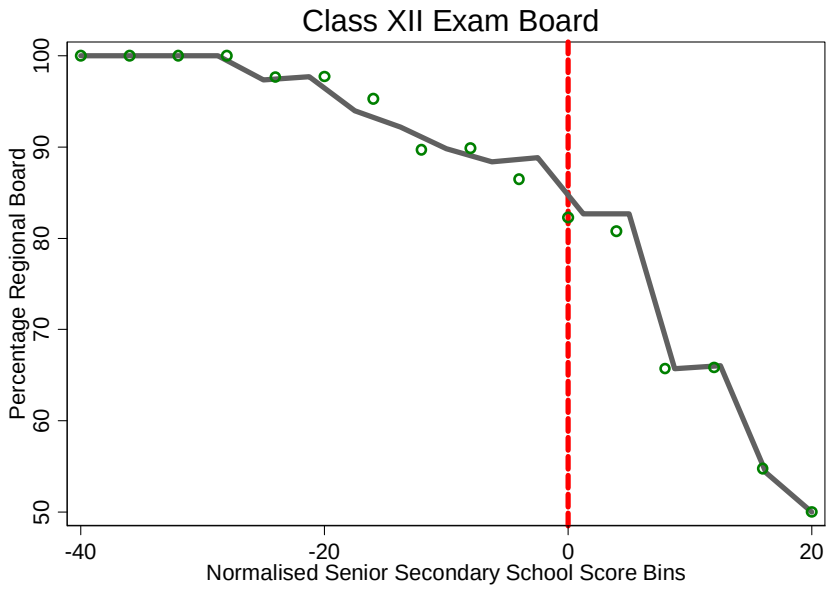
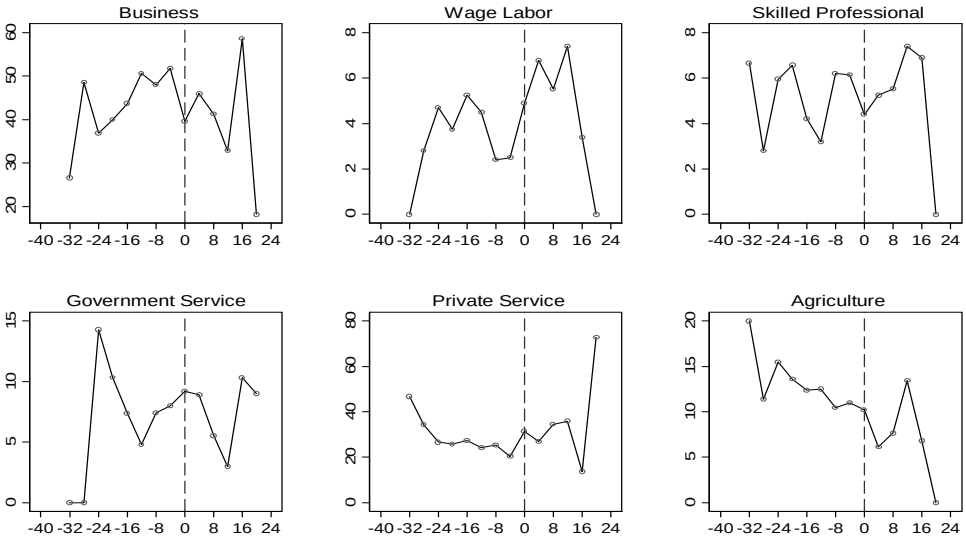


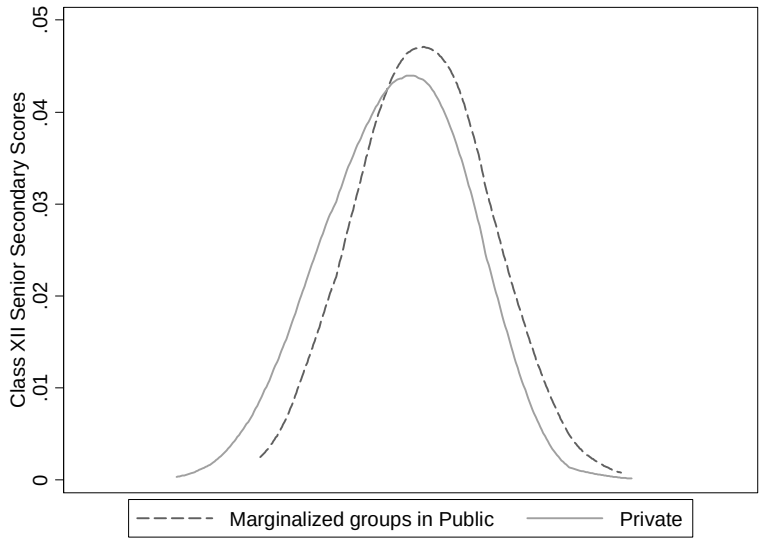
Figure A.7: This figure graphs the regression function from a polynomial regression of the percentage of students from regional school board on 4 point intervals of normalized class XII Senior Secondary Exam percentage score. The regressions use epanechnikov kernel with a bandwidth of 2, and a polynomial of degree 2.



Percentage of Students by Father's Occupation

Figure A.8: This Figure graphs the percentage of students in 4 point intervals of Normalized Class XII Percentage by Father's occupation. Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score. In each Panel, Y Axis represents Percentage of Students with particular Father's occupation. Normalized Class XII scores are along X axis.

Panel A: Kernel Density of Class XII Senior Secondary Exam Scores for students in Public colleges who enter through reservation for Marginalized Groups and the students in private colleges.



Panel B: Kernel Density of Class XII Senior Secondary Exam Scores for students in Public colleges who enter through any reservation policy and the students in private colleges.

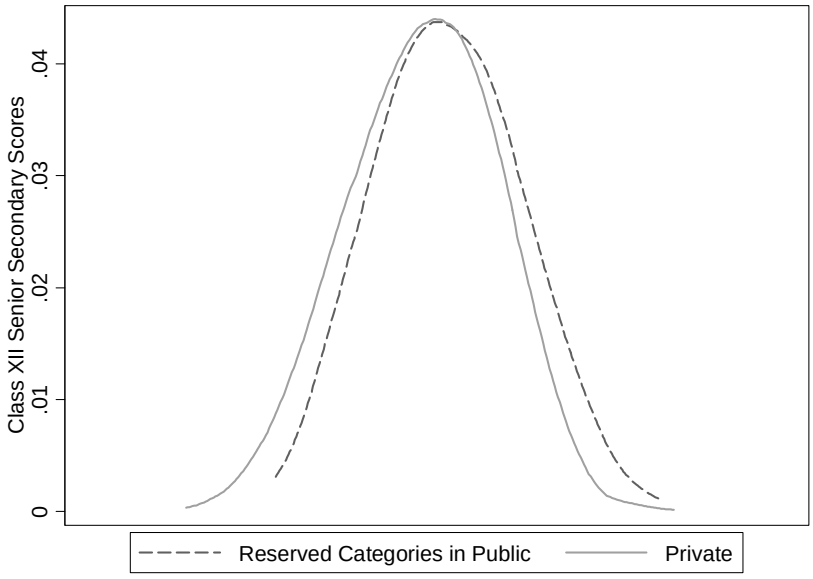


Figure A.9: Densities of Class XII Senior Secondary Exam Scores for students in public colleges entering through reservation policy compared to the students in private colleges.

Table A.1.a : The Admissions and Results Data for Academic years 1998-99 to 2002-03
Main Sample

	Excluding		Total included
	Number	% of Total	
All Observations	---	---	15783
1) Drop Outs	7008	44.4	8775
Excluding:			
2) Pass but missing Senior Secondary marks	152	1.7	8623
3) Pass but missing Final composite score	25	0.28	8598
4) Late Score Notification	301	3.4	8297
5) Absent or reappear	1110	12.6	7187
6) Fail	202	2.3	6985
7) Admitted on Reserved category seat	1339	15.2	5646
7) Total main sample			**6985**
8) Total non reserved category main sample			**5646**

Table A.1.b
Excluded Observations by Type of College

	Pivate		Public	
Total	4418		4357	
	Excluded	% of total	Excluded	% of total
Pass but missing Senior Secondary marks	120	2.7	32	0.7
Pass but missing Final composite score	16	0.3	9	0.2
Late Score Notification	123	2.7	178	4
Absent or reappear	563	12.7	547	12.5
Fail	94	2.12	108	2.4

Table A.2: Observations by Variables in the Non Reserved Graduating Sample

	Total	% of total
	5646	---
Variables		
Gender	5646	100.00
Age	5646	100.00
Board in Senior Secondary	5603	99.20
Stream of Study in Senior Secondary	5646	100.00
Medium of Instruction in Senior Secondary	2761	48.90
Marks obtained in Senior Secondary exams	5646	100.00
Rural/Urban Residence Indicator ++	4586	81.20
Father's Occupation	5009	88.70
Father's Income @	3496	62.00
Admission Year	5646	100.00
Final composite Marks in University Exams	5646	100.00
Result Status	5646	100.00
Stream of study in College	5646	100.00

++ *Rural/Urban indicator was not reported for 1998-99*

@ *Women Public College does not record father's income*

Table A.3: Summary Statistics

	Proportion	Mean	Std. Dev.
Gender			
Male	0.313	---	---
Residence Indicator			
Rural	0.11	---	---
Father's Occupation			
Agriculture	0.089	---	---
Business	0.437	---	---
Govt. Employee	0.083	---	---
Labor	0.038	---	---
Professional	0.053		
Service	0.297	---	---
Senior Secondary Board			
PSEB	0.72	---	---
Percentage Marks			
Arts	---	63.42	9.4
Commerce	---	74.34	7.95
Science	---	64.4	8.41
Age	---	17.97	0.809
Final Composite Marks			
Liberal Arts	---	1413	166.46
Commerce	---	899.62	99.7
Science	---	1289.6	168.6

Robustness Check: Including different functional forms of the control function

Table A.4.I: Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts				
	(i)	**(ii)**	**(iii)**	**(iv)**
Public College	1.28	-5.1	-6.25	-36.97
	(8.06)	(8.36)	(8.38)	(55.45)
Class XII Percentage	Yes	Yes	Yes	Yes
Sqaured Class XII Percentage		Yes	Yes	
Class XII Percentage Cube			Yes	
Public* Class XII Percentage				Yes
Obervations	2612	2616	2616	2616
F	122.93	116.07	109.58	115.26
R-Squared	0.41	0.41	0.41	0.41

Notes: Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix.
Public College is a binary variable that equals 1 if the student attended public collge.
In addition to the variables shown, each regression controls for age, age squared, father's occupation board in Class XII , rural /urban residence status, and year of admission.

Robustness Check: Dropping Controls

Table A.4.II : Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts

	12 point window		8 point window		4 point window		1 point window	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
	Men	Women	Men	Women	Men	Women	Men	Women
Public Attendence	79.87	97.03	66	67.76	38.5	35	39.6	-3.73
	(12.4)	(7.36)	(14.54)	(8.38)	(18.9)	(11.3)	(32)	(24.29)
Obervations	577	1402	465	1035	279	569	135	174
F	20.15	54.4	16.09	23.66	6.97	8.12	1.96	2.1
R-Squared	0.12	0.13	0.11	0.08	0.09	0.05	0.06	0.04

Notes: Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix
Public College is a binary variable that equals 1 if the student attended public collge.
Each Regression Controls for the year of admission.

Robustness Check : Estimates from a sample pooling all streams of education with stream fixed effects

Table A.5 : OLS Estimates of the Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree

	Panel (A)			Panel (B)		
	ALL	**Males**	**Females**	**ALL**	**Males**	**Females**
Public College	113.71	91.67	125.58	-0.32	-6.49	6.8
	(4.88)	(9.53)	(5.72)	(6.04)	(12.3)	(7.02)
Class XII Percentage (Senior Secondary)				9.22	8.6	9.24
				(.33)	(.74)	(.367)
Obervations	4087	997	3090	4087	997	3090
F	665.79	142.91	549.53	793.6	160.75	660.81
R-Squared	0.72	0.68	0.72	0.76	0.72	0.775

Notes: Panels (A) - (B) report the results from linear regressions estimating the effect of attending public college on educational outcomes. Final marks in undergraduate degree are the composite overall scores of the students in a pooled sample of all streams Public college is an indicator variable equal to 1 if the student attends public college and 0 otherwise. Panel (A) shows the results from the benchmark regressions (Table I: Column (iii) reports these for 1 stream). Panel (B) reports the results from the regressions that control for the percentage of marks scored in Class XII senior secondary exams which form the basis of selection into Public Colleges. Each regression also controls for observable student characteristics including age, age squared, gender, rural residence status,father's occupation,board of education in Class XII (Senior Secondary board), year of admission, and the concentration stream (not reported). Excluded category for father's occupation is 'Labor'. Professional Includes doctors, lawyers,accountants, journalists, and professors. Sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. Robust standard errors are reported in parentheses. The results are reported separately for Males and Females in columns (ii) and (iii) of each panel.

Table A.6: Probit Estimates of Probability of Dropping out -Entire Sample

	Men		Chow Test		Women		Chow Test	
	Public	**Private**	**Stat**	**Significance**	**Public**	**Private**	**Stat**	**Significance**
Senior Secondary Score	-0.019	-0.035	3.28	0.07	0.009	-0.02	8.97	0.002
	(.007)	(.005)			(.01)	(.003)		
Father's Occupation								
Government Service	0.2	0.187	0	0.94	0.2	-0.23	2.93	0.08
	(.15)	(.182)			(2)	(.13)		
Professional	0.12	-0.03	0.16	0.68	0.1	-0.17	1.17	0.28
	(.24)	(.28)			(.2)	(.14)		
Service	0.047	-0.006	0.12	0.72	0.3	-0.26	2	0.15
	(.12)	(.09)			(.17)	(.11)		
Agriculture	0.21	0.23	0.02	0.88	0.23	0.009	0.75	0.38
	(.13)	(.10)			(.2)	(.12)		
Business	0.1	0.02	0.19	0.66	0.1	-0.35	5.53	0.01
	(.125)	(.1)			(.16)	(.112)		
Regional Borad	-0.0031964	-0.006	0	0.98	-0.03	-0.25	2.54	0.11
	(.12)	(.14)			(.09)	(.09)		
Rural	0.0001629	-0.000057	2.17	0.14	0.0005	0.0002	8.13	0.004
	(0.00009)	(.0001)			(.0001)	(.00005)		
Age	0.132	0.09	0.83	0.36	0.09	0.14	0.54	0.46
	(.03)	(.03)			(.06)	(.02)		
Observations	1757	3142			1102	3141		

Notes: The first 2 columns in each panel report results from a separate probit regression of drop-out probablity restricted to public and private colleges respectively. Panel (i) reports the results for Men and (ii) for Women colleges. The results from the test of equivalence of coefficients (Chow test) are reported in next 2 columns with test statistic in the third column and significance level in the fourth coulmn. Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the 'Data Appendix'.

Table A.7: Probit Estimates of Probability of Dropping out - Sample Restricted to -4 to + 4 Point Window Around Admission Cutoff

	Men		Chow Test		Women		Chow Test	
	Public	Private	Stat	Significance	Public	Private	Stat	Significance
Senior Secondary Scores	-0.044 (.03)	-0.043 (.03)	0	0.97	-0.005 (.04)	0.003 0.04	0.02	0.88
Father's Occupation								
Government Service	-0.05 (.2)	-0.04 (.46)	0	0.99	-0.23 (.33)	-0.2 (.47)	0	0.96
Professional	0.56 (.44)	0.64 (.68)	0.01	0.91	-0.21 (.36)	-0.31 (.48)	0.03	0.86
Service	-0.28 (.17)	0.18 (.22)	2.72	0.1	-0.1 (.25)	-0.1 (.45)	0	0.97
Agriculture	-0.04 0.188	0.3 (.25)	1.2	0.27	0.05 (0.32)	-0.57 (.47)	1.18	0.27
Business	-0.12 (.17)	0.03 (.24)	0.25	0.61	0.12 (.24)	-0.61 (.43)	2.15	0.14
Regional Board	0.22 (.25)	-0.0003 (.3)	0.32	0.57	0.14 (.15)	-0.4 (.17)	5.13	0.02
Rural	0.0002 (.0001)	-0.0002 (.0002)	2.06	0.15	0.0004 0.0001	0.003 (.0001)	0.34	0.56
Age	0.12 (.05)	0.1 (.07)	0.03	0.86	0.02 (.08)	0.24 (.07)	3.53	0.06
Observations	633	289			476	491		

Notes: The first 2 columns in each panel report results from a separate probit regression of drop-out probablity restricted to public and private colleges respectively. Panel (i) reports the results for Men and (ii) for Women colleges. The results from the test of equivalence of coefficients (Chow test) are reported in next 2 columns with test statistic in the third column and significance level in the fourth coulmn. Excluded category for father's occupation is 'Labor'. Sample used is the 'Non Reserved Graduating Sample' as described in the 'Data Appendix'.

Table A.8: Reasons for Migration of Migrants by Last Residence -Duration (0-9 years)

Persons	Total	Males	Females
Total migrants	98,301,342	32,896,986	65,404,356
Reason for migration:			
Work/Employment	**14.7**	37.6	3.2
Business	**1.2**	2.9	0.3
Education	**3.0**	6.2	1.3
Marriage	**43.8**	2.1	64.9
Moved after birth	**6.7**	10.4	4.8
Moved with households	**21.0**	25.1	18.9
Other	**9.7**	15.7	6.7