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

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Abstract

Public colleges in many developing countries outperform private colleges. Graduates of public colleges do far better than their private counterparts as manifested in their college exit examination outcomes. This has often been attributed to the cutting edge education provided in public colleges. 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 student's outcomes. We evaluate the impact of public colleges using a newly assembled unique data set that links admission data with the educational outcomes on a set of common exit exams in India. Admission to general education public colleges is strictly based on the results of the senior secondary school examinations. We exploit this feature in a regression discontinuity design, and find that the public colleges have no added value at the margin of selection. Controlling for entry scores, we find no differences between the exit exam outcomes of students graduating from public and private colleges.

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1 Introduction

Provision of quality tertiary education is an important determinant of economic growth and development of an economy (Barro 1999, Aghion et al. 2005). Economists have also identified positive externalities associated with tertiary education (Moretti 2004, Ciccone and Perry 2006). As a result, there is a widespread concern over quality of tertiary education provision. Governments in many developing countries directly provide tertiary education as it is feared that private providers may compromise the quality of provision on account of their market incentives to reduce costs. Public colleges in many of these countries are more prestigious and their outcomes are better. This is attributed to the value-added by the public colleges. But little is known about whether or not the public colleges actually add value. Our paper aims to examine this question in the context of India which is a very pertinent setting for evaluating this issue.

The remarkable economic transformation of India into a high-powered center of Information Technology, which builds on supply of high quality educated workers, suggests that the expansion of high quality tertiary education and applied research 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. One of the biggest policy challenges is to decide how to expand access- by direct provision or by contracting out to private providers and introducing need and merit based scholarships? Public colleges in India, like in many developing countries, are perceived as more prestigious and their outcomes are better. It is common knowledge outside academic journals that on the average students graduating from public colleges in India have better educational outcomes than their private counterparts[1]. 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.

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[2] that allowed private universities to operate and provide tertiary education

[1] This is true of other developing countries as well. Except a few elite private institutions of higher education, public institutions share a higher prestige than private ones (Gupta, 2005).

[2] The state of Chhattisgarh allowed private universities to set up in the state under the *Chhattisgarh*

was overturned by the Supreme Court de-recognizing 112 private universities that had emerged. This resonates with the state skepticism about market oriented tertiary education sector to provide high quality tertiary education.

However, public colleges are highly subsidized for the sake of providing equitable access to higher education. 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 student's outcomes.

This paper aims at evaluating the value-added of public tertiary education in India. Admission to public colleges is based on the results of the senior secondary school examinations that are essentially the high school exit exams in India. [3]Also, the university wide exit exams taken by students in private and public colleges conditional on their field of study are identical. We take advantage of that to identify the value added of public colleges on student's educational outcomes using a regression discontinuity design. We establish a unique data set that links admission data reflecting student's entry quality with their educational outcomes, measured by a set of common exit exams taken by students at the private and public colleges.

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 these colleges, using 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. Hence, the private-public observed quality gap reflects the sorting of the better students into the less expensive colleges rather than causal impact of public colleges on tertiary educational outcomes.

2 Institutional background

General

India has experienced a tremendous increase in growth in the recent years and it has been attributed to its vast pool of highly educated workers. In 2003, the service sector

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

[3] 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.

contributed around 47 percent of the GDP, followed by industry's contribution of 24 percent. This is in stark contrast to the scenario in 1950 when the Indian economy was largely agricultural. Tertiary education especially technology oriented training is feeding the current boom in business process out-sourcing to India.[4] The high rate of growth in the service sector has had a feedback effect on demand for tertiary education. The number of colleges has been increasing since independence showcasing Indian government's focus on promoting tertiary education but it is only in the 1990s that the number of colleges saw a dramatic rise. Figure Ia (based on data collected by the University Grants Commission, India) highlights the increase in number of colleges in India between 1950 and 2001 and depicts this pattern clearly.The enrollment figures also show a similar trend. General education college enrollment spurted in the post reforms decades (Figures Ib).

Public and Private Institutions of Tertiary Education -Basic Facts

While there are no formal private universities in India, there are a large number of private colleges [5] in general and technical education. Private colleges are managed privately and may receive public funds ("private aided college") or may be totally self financed ("private unaided college").The private aided colleges receive public funds to meet their recurring expenditure (mostly teacher salary) and charge much higher tuition than the government colleges that are managed and financed by the government. Public colleges cannot accept any private donations and the state exchequer funds their maintenance and development expenses. The aided private colleges can raise funds by charging higher fees and accepting donations from philanthropic or business groups. Public colleges are managed and run by state employees.

The non-aided private colleges have started emerging only in the post reforms era and there has been a remarkable increase in their number, especially in the professional education sphere.[6] Around three fourths of the total colleges in India are private

[4]The Indian experience of growth enhancing tertiary education supports recent research that explores relation between tertiary education and growth. In cross country regressions, Barro (1999)finds that education attainment at higher education level has positive and significant effect on subsequent rate of economic growth. Policy reports on productivity and growth difference between Europe and USA argue that under investment in higher education is responsible for slow growth in Europe (Sapir ,2003). Aghion et al. (2005) explore the causal impact of higher education on growth and find that tertiary education does effect growth but the magnitude of the effect depends on the distance of the country from the technology frontier.

[5]Although these colleges are a private initiative, these are not recognized as "for profit businesses"

[6]Nasscom (The National Association of Software companies) reports that out of 139 engineering colleges in 1970, 4 were private; whereas in 2006, 1400 out of the 1600 engineering colleges were

colleges (UNESCO,1998). Figure II.a shows the share of government and private sector in junior colleges and higher secondary schools in 2003-04. Around 64 percent of these institutions were privately managed, and 35 percent were run by the government.

The government of India has laid considerable emphasis on equitable access to higher education as an important policy goal since independence and has subsidized higher education significantly. The effective fee is negative in many institutions of higher education and around 70 percent of the expenditure on tertiary education is financed by the government(Tilak and Varghese, 1991). To implement this subsidy, Government colleges charge only a nominal fee for attending such institutions. The admission to such institutions is strictly based on merit. However, beneficiaries of affirmative action also attend public colleges under a system of reservation of seats for marginalized groups like scheduled castes. Among the colleges in our sample,in 2005 the private institutions charged a fee which was about 5-6 times more than the public colleges.

Regulations in India's Tertiary Education

Entry into tertiary education in India is highly regulated.The University Grant Commission Act (hereafter UGC), which is the apex 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. The UGC allocates the central grants to various universities based on their requirements and needs (Department of Secondary and Higher Education, Government of India).

An important feature of the education system is that the power to grant degrees is vested with the university. Independent colleges are not allowed to confer a degree of their own accord. So they 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 stream of study but conditional on the stream, private and public college students are exposed to the same curriculum and take the same exam. The universities have laid out detailed conditions that the management of a college have to satisfy in order to apply for affiliation. The UGC recommends guidelines for affiliation to the universities. The examinations for the affiliated colleges are conducted by the respective universities, which also set the course curriculum. The affiliate colleges only offer prescribed courses of study.[7]

private.

[7]The UGC has recently conducted an experiment of conferring autonomous status on selected

The universities across the country also coordinate on prescribing the curriculum, assessing performance, determining structure of fees to be charged and establishing norms for teacher qualifications in an attempt to homogenize tertiary education so that it is more equitable. There is a national level eligibility test for appointments as a teacher in the tertiary educational institutions.

3 Theoretical Motivation and Related Literature

There is a considerable debate about when should government provide services like prisons, hospitals, fire departments, and educational institutions in- house 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 public employees do. 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 good quality service. Unconditional job security and non merit criterion like seniority for promotion of public employees, results in lack of accountability. For example, in a recent survey of health care facilities in rural India, Bannerjee et al (2004) find significant absenteeism among the staff of the public health care facilities. These facilities were also found to be closed erratically.

In contrast, the critics stress that the private providers would cut quality to achieve lower costs and hence the quality of public services that private suppliers provide would be inferior to that provided by public employees. In private versus public health-care provision debate, critics worry that private health-care providers would find ways to cut costs by providing low quality services or rejecting very sick patients. In the case of prisons, the argument is that unqualified guards may be hired to save money, thereby threatening the security of prisons. Likewise there is a widespread concern that private schools would reject students who are expensive to educate even if paid for by the government. The critics also fear that private educational institutions would replace expensive teachers with cheaper ones thereby potentially eroding the quality of education provided.

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

colleges which enables these colleges to prescribe the courses, determine the content, and decide the learning methods. The colleges continue to remain affiliated to the universities who approve the courses,hold exams,and award degrees

a framework to demonstrate that private provision under certain circumstances can deliver higher quality services than the public employees. In their framework, both public employees and private providers invest resources in cost reduction and quality improvement. Cost reduction however, adversely affects the quality of provision. Since the government retains residual control rights, the employees receive only fraction of returns on either quality improvement or cost reduction. So they do not have strong incentives to either improve quality or reduce costs. On the other hand, a private contractor has control rights over the asset. So the private provider has an incentive to both reduce costs and improve quality. Recent evidence from a survey of schools in India for example shows less absenteeism in private schools relative to the government schools (Chaudhury, Hammer, Kremer, Muralidharan and Rogers, 2003). The private provider's incentive to reduce cost however maybe too strong, and that may jeopardize quality of provision. It is not clear which effect would dominate. In the same vein, Besley and Ghatak (2001) show that if contracts are incomplete, then the ownership of the public good should lie with a party that values the benefits generated by it relatively more. Therefore, for social service delivery like health-care and primary education which are valued by NGO's, contracting out might be preferred whereas for goods such as defense where quality of provision is very important, in-house service is better. 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 cost 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[8] addresses this question in the context of tertiary education. Moreover, this issue is even more pertinent in a developing country setting[9] where a robust tertiary education

[8]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 the tertiary education even though it is considered to be the engine of India's economic growth.

[9] Private versus Public provision of other services like drinking water provision and health care in developing countries have been addresses in some recent papers. Galiani et al (2005) study the effect of privatization of water services in Argentina and find that child mortality falls by 8 in areas that privatized. Kremer et al (2006) study the effects of contracting out management of government health services to NGOs in Cambodia. While the targeted outcomes like receipt of vitamins by children improved significantly, there is limited evidence that the program improved self -reported health of

sector can accelerate economic growth (Aghion et al, 2005) which can lead to trickle down benefits that improve standards of living. In India, there is an intense debate about whether government should provide tertiary education or contract it to private providers.[10] The remarkable growth experienced by India in the last two decades is attributed to its large pool of highly educated skilled workers. While the expansion of high quality tertiary education is essential for robust growth of the Indian economy, the existing infrastructure is not able to meet the demand for college graduates. From policy perspective, whether the government should expand the public college provision or contract it out remains an open question. In this paper, we attempt to address whether the public colleges that are operated by public employees provide better quality of services than private providers in the context of general college education in India.

Our findings also complement a set of studies that examine the payoff to attending a more selective college in USA. Since the unobserved characteristics of students might influence both the college admission decisions and the later outcomes like performance in college or earnings after college, it is difficult to de-tangle the effect of going to a more selective college from student's pre-college characteristics. In order to address this issue, Dale and Krueger (2001) match students who were admitted to and rejected from same set of institutions but some attend more selective colleges than others. They estimate a fixed effects model to control for unobserved characteristics that influence college admission and find that the students who attended more selective institutions do not earn more than those who attended less selective colleges. Financial returns to attending a higher quality college falls substantially once adjustments for selection on the part of the college are made. On the other hand, Behrman, Rozenzweig and Taubman (1996) make use of female twins to difference out the common unobserved characteristics and find that there is a high payoff to attending more selective colleges. Berhman et al (1996) use an instrumental variable approach for college choice using family variables as instruments and show that ignoring selection into colleges overstates the payoff of more selective colleges. Our findings are consistent with those of Behrman et al (1996) and also Dale and Krueger (2001). However, we use a novel RDD based approach to account for unobservable differences in college admissions in a developing country and find that the observed educational outcome gap between more prestigious public colleges and their private counterparts washes away when we control for selection

the residents of treated districts.

[10]Gupta 2005 provides a good background on the subject.

by colleges.

4 Data

Data sources

Our estimates are based on a unique data set that we assembled from the admission records and university exam results of four general education colleges in a district in a northwestern state in India. The admission records from two private[11] 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 to the same university.[12] As a result all the students in the district appear for the same exams in order to graduate from college. We restricted our choice of sample colleges to the district headquarter.This city is a an urban area with over a million people according to the 2001 Census of India. There are two public colleges and 10 private colleges in the district headquarter all affiliated with the same university. 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 headquarter. While all women colleges are in part aided by the state, 1 of the 3 men colleges is unaided. We obtained the admission records for both the public colleges and selected one women and one men private college within 5 kilometers of the public colleges.[13] This was done to ensure that transportation costs do 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 along with the board of examination and stream of study [14], percentage marks obtained in the senior secondary board

[11] As reported in the text, these colleges are run by private managements, but they do receive state aid in addition to private endowments as opposed to the public colleges that are managed and run by the government. The public colleges do not receive private donations. There chief source of finance is the state exchequer.

[12] 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.

[13] In the 5 KM distance, there are 2 men private colleges and 3 women private colleges.

[14] 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.

exams, rural or urban residence indicator, father's occupation and income.[15] The marks obtained in the college exit exams are reported in the university wide 'Result Gazette'. Each student who takes the university exams is assigned a unique roll number. These gazettes with roll number specific results 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 degree program which is the accumulated total of the scores in the annual exams for three years that the students spend to earn their degrees.

Main Micro Sample

Our main micro sample is taken from the pool of private and public colleges for admissions years 1998 to 2002. The cutoffs varies by year, gender and stream of education we normalized individuals' entry scores by taking deviations from each groups admissions cutoffs. Exit exams also varies by education stream. Therefore we our main sample focuses on individuals admitted and graduated in Liberal Arts, the most popular stream of choice in India. For instance, 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 is graduating in Liberal Arts (see Data Apendix). We exclude observations with entry or exist exam scores leaving sample size to include 3394 observations. Tables A1 through A3 summarize the data processing, report the variables we use and list the summary statistics respectively.

First glance

The extra "effect" of public colleges on educational outcomes

Public colleges do outperform private colleges. The graduates of the public colleges on average do far better than their private counterparts as manifested in their college exit examination outcomes. This holds for both genders as well as for all education streams by year (see Appendix Table A.4).

We next turn to our main sample. Figure III graphs the college exit exams scores for men and women separately for the main stream of study in our sample. As Figure III makes clear the average for students in public colleges is consistently higher for 9

[15] Women's public college does not record father's income (see appendix).

out of 10 gender-year cells. The average exist score of girls and boys graduating from a public college between 1998 and 2002 was 0.5 standard deviation higher than the average exist scores of their private college counterparts. 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.

The non-random sorting into public and private colleges

Table I reports summary statistics of the pre-determined students' characteristics by type of school for all years, all streams and both genders pooled together. As this table makes clear students admitted to public colleges (i) are more likely to attend high schools affiliated with the central board (ii) their fathers' are less likely to work in the agricultural sector, (iii) they are less likely to come from rural areas than their private college counterparts, and (iv) have better high school educational achievements, as measured by their high school exist scores.

Public school students have better family and social background than their private college counterparts. They also perform better on common high school cognitive achievement exams. Hence, these finds indicate that public-private comparisons do not provide a treatment-comparison setting for evaluating the impact of public college added value on educational achievements and that the observed exit gaps might reflect other pre-determined factors rather than public college add values.

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

Admission to Public Colleges

Admission to all public colleges in general education sector, namely all streams of education except professional colleges, is solely determined on the basis of exit exams results of the Senior Secondary School examinations taken in class XII. All high schools in India must be affiliated either with the national board (Central Board of Secondary Education) or with state 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. An admission cutoff for public colleges is determined every year. This varies by state and educational stream. It also varies by gender and caste as part of affirmative action policy. Students who score above the cut-

off 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 exit high schools exams across affiliating boards, the college admission committees implicitly standardize exam scores of applicants from other boards than the local. The formulae for standardizing and determining the admission cutoff are not public knowledge. Obviously these rules are confidential information even ex-post.

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 least at the margin of entry. To take advantage of this "natural discontinuity" we assembled a unique data set that combines micro level data including (i) Senior Secondary school exit scores, (ii) family and social background as well as (iii) college exit scores with the admission cutoffs by stream, gender, and year.

Employed with these data we aim at evaluating the causal impact of public colleges on educational achievements, as measured by college exit exam using Regression Discontinuity Design. 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 examine the validity of the RDD and the extent in which discontinuity is sharp or fuzzy in this particular context.

Do Public Colleges Follow the Cutoff Rules?

As a first step, 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 IV draws the fraction of students in public colleges by deviations from the admission cut-offs in 4 percents bins. 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.[16] For instance, less than 2 percents of all college students whose high school exit score is just one bin below the cuttoff

[16]This cutoff is applicable only to open seat students. This cutoff is not applicable for the reserved seat students from marginalized groups

attend public colleges whereas 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 IV clearly illustrates that admission cutoff corresponds to a sharp discontinuity design.[17]

Do observable characteristics vary at the cutoff margin?

Figures Va through Vd plot student's (a) age, (b) type of residential location, (c) father's occupation, and (d) board of education by deviations from the entry cut-off in four point intervals of the normalized class XII senior secondary examination results respectively. 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, as these figures make clear, 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.

In the next section we formalize our identifying approach and discuss briefly its practical implications.

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

Let Y_i denote student's i college exist score. Following the notation of the *potential* outcome approach to causal inference (see Rubin, 1974), Let Y_i^1 and Y_i^0 denote the *potential* outcomes that the i student would experience by enrolled to public or private college respectively. The causal impact of treatment on the i student is then defined as the difference between these two potential outcomes $\gamma_i \equiv Y_i^1 - Y_i^0$. For the sake of simplicity let us assume that outcomes can be approximated by the following linear form:

$$Y_i = \left\{ \begin{array}{llll} Y_i^1 = & X_i'\beta + & \gamma_i & +U_i \\ Y_i^0 = & X_i'\beta + & & +U_i \end{array} \right\}, \tag{1}$$

[17]This exploratory analysis is shown for only one of the three streams of study. The other streams show the same pattern.

where X is a vector of student observed characteristics and γ_i measures the effect of treatment on person's i outcomes, whereas $E(\gamma_i) = \gamma$ is the average treatment effect (ATE). The term U_i is an $i.i.d.$ mean zero random student component that combines unobserved abilities, pre-determined to treatment, and person-specific random outcomes shocks:

$$U_i = \theta_i + \varepsilon_i, \tag{2}$$

where θ_i is the vector of unobserved variables that influence outcomes and ε_i represents person-specific $i.i.d.$ shock.

In the absence of a controlled experiment we do not observe the same students in public and private schools. Let $Y_{0,i}$ and $Y_{1,i}$ denote the *actual* outcomes of the i student in the private and the public colleges respectively:

$$Y_i = \left\{ \begin{array}{llll} Y_{1i} = & X_i'\beta + & \gamma_i & + U_{1i} \\ Y_{0i} = & X_i'\beta + & & + U_{0i} \end{array} \right\}. \tag{3}$$

Carefully note that in the set-up we are considering that students are not randomly assign to private and public schools suggesting that error term is no longer independent from the treatment state. We allow non-stochastic abilities to vary between public and private college students:

$$U_i = \left\{ \begin{array}{lll} U_{1i} = & \theta_{1i} + & \varepsilon_i \\ U_{0i} = & \theta_{0i} + & \varepsilon_i \end{array} \right\}, \tag{4}$$

where $\theta_1 \neq \theta_0$ and ε_i is assumed to be $i.i.d.$ Let P_i be a binary variable that is equal to 1 is the i student is enrolled in a public college and zero otherwise. Educational outcomes of person i can be expressed as:

$$Y_i = P_i Y_{1i} + (1 - P_i) Y_{0i}. \tag{5}$$

Equation (5) is Quandt's (1972) switching outcomes model**,** as well as the Roy model (1951) of income distribution. By substituting Equations (3), and (4) into Equation (5) the outcome function can be re-written as:

$$Y_i = X_i'\beta + \gamma P_i + \upsilon_i, \tag{6}$$

where $\upsilon_i = P_i(\theta_{1i} - \theta_{0i}) + \varepsilon_i$. Since P is not randomly assigned, in practice it is likely to be correlated with potential outcomes. 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). These exams are conducted at national and regional levels and students have to pass these in order to study further. 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. If the unobservables $\theta\left(S\right)$ are 'smooth' at the threshold level $\left(S=\bar{S}\right)$, then comparing the outcomes of public college students with the outcomes of their private college counterparts with similar high school test scores controls for all omitted factors correlated with selection to public colleges. Let T be a binary variable with $T=1$ indicating that the i student was admit to a public college and 0 otherwise. Let S be the random variable according to which students are admitted into the public college ("treatment") and let us denote by $\bar{S}$ the threshold for admission. Students are admitted to public college if and only if $S>\bar{S}$ namely:

$$T_i = 1\left(S_i > \bar{S}\right), \tag{7}$$

where $1\left(\cdot\right)$ is an indicator function equal to one if the enclosed statement is true. Let us further assume that

$$\theta_i = \left\{ \begin{array}{lll} \theta_{1i} = & \theta\left(S_1\right) + & \nu_i \\ \theta_{0i} = & \theta\left(S_0\right) + & \nu_i \end{array} \right\}, \tag{8}$$

where ν_i is assumed to be a mean zero $i.i.d.$ Although OLS estimates of (6) do not have a causal interpretation a quasi-experimental Regression-Discontinuity Design (Cook and Campbell 1979) estimates still might. Note that conditioning on S allows to identify the average impact of public college on students with high school test score of $\bar{S}$, namely a Local Average Treatment Effect (hereafter LATE) at the margin of $S=\bar{S}$ as $\left(\theta\left(S_1\right),\theta\left(S_0\right)\right) \perp T \mid S=\bar{S}$. In fact, in a neighborhood of $\bar{S}$ this design presents the same features of a randomized experiment [18] since the admission to public college has the feature of a quasi-experimental design as the probability of receiving treatment changes discontinuously as a function of one (or more) underlying variables.

The RDD methodology was recently used (also) by Angrist and Lavy (1999) [19],

[18] See Rubin, 1977.

[19] Angrist and Lavy (1999) estimate the effect of class size on student test scores, taking advantage of a rule stipulating that another classroom be added when the average class size exceeds a threshold level.

Black (1999) [20],Van der Klaauw (2002)[21],and Chay and Greenstone (2005)[22]. The causal interpretation of RDD estimates depends on whether it is reasonable to assume that, after controlling for Xs, the only reason for any association between public/private college status and test scores is the association between being just above or just below the threshold and college type. The identification approach taken here exploits the fact that the regressor of interest - public college - is partly determined by a known discontinuous function of an observed covariate - senior secondary school exist 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 exist 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 (6) 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.

If all students admitted to public college attend public college (and vice versa), namely if $P = T$, the standard RDD would arise and the mean impact on units in a neighborhood of $\left(S = \bar{S}\right)$ would be identifiable using OLS at the $\left(S = \bar{S}\right)$ margin. In the absence of perfect assignment, let's assume that sorting into public college can be approximated by the following linear form:

$$P_i = X_i^{'}\pi_X + \pi_S T_i + \eta_i \tag{9}$$

where π_X and π_S are parameters and X is a vector of student-level covariates. The error term η_i is defined as the residual from the population of regression of P on X and the "instrument" X. This residual captures other factors that are correlated with college status that are probably also related to students' achievements which is the reason why OLS estimates of Y on P do not have a causal interpretation. However,

[20]Black (1999) uses an RDD to estimate parents' willingness to pay for higher quality schools by comparing housing prices near geographic school attendance boundaries. Regression discontinuity methods have potentially broad applicability in economic research, because geographic boundaries or rules governing programs often create discontinuities in the treatment assignment mechanism that can be exploited under the method.

[21]Klaauw (2002) estimates the effect of financial aid offers on student's decisions to attend a particular college, using administrative rules that set the aid amount partly on the basis of a discontinuous function of the students' grade point average and SAT score.

[22]Chay and Greenstone (2005) use county-level EPA regulations as instrumental variables for changes in total suspended particulates (TSPs) pollution to estimate the value of clean air using RDD.

since T_i is a deterministic function of (S), and (S) is almost certainly is related to students' college achievement for reasons other than the direct effect of public college, the key identifying assumption that underlies estimation using T as an instrument is that any other effects of (S) on test scores are adequately controlled by the terms in $X^{'}$s in Equation (6), and "partialled out" of the instrument by the term Xs in Equation (9). The second stage equation is given by:

$$Y_i = X_i^{'}\beta + \gamma_S \hat{P}_i + \epsilon_i, \tag{10}$$

where $\epsilon_i = \gamma\eta_i + \upsilon_i$. The 2SLS estimator of γ_S provides a consistent estimate for the extra impact of public college education on the scholarly achievement of students at the threshold margin.

7 Results

Accounting for Socio-Demographics (Selection on "Standard Observables")

We preview our rigorous analysis by taking a glance at the raw data. Figure VI a and VI b sketch students' final exit colleges exam results by the senior secondary school scores (VI a) and by their normalized entry scores in a 4 percentage points bin windows(VI b). Two main facts emerge: (i) public college students perform better on exit exams than their private colleges counterparts and (ii) almost no difference between the mean and dispersion of exit scores at the cutoff margin.

Our first glance at the data (Table I) indicates that students attending public colleges come from better family background 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' occupation, place of residence and board of education. The first entry in Column (i) reports the average crude public-private exist score gap for the entire sample. 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 their fraction among does who graduate from private colleges is higher. To account for the gender gap in test scores we next control for gender and other socio- demographics in Column (ii). Columns (iii) reports the regression coefficients on public college indicator 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) though (iii) indicate the public-private crude score gap cannot be explained by socio-economic and demographic characteristics of the students. We find the adjusted gaps to be persistently higher and statistically significant at the 1 percent level.

Accounting for Selection on Senior Secondary School Achievements - Selection on "Unobservables"

Table III through Table VI report our main findings. We find that (i) public college students have higher exist 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 exist test scores.

The results from the estimation of (6) are reported in Table III.a. In our benchmark regressions reported in Column (i) of Panel A, attending public college seems to improve the college exit exam outcomes by around 0.75 of a standard deviation. These estimates are significant at 1 percent level and convey that the public college students perform better on the average than the private college students. Our next step is to control for the selection into treatment by including class XII senior secondary examination outcomes in the regressions. The admission cutoff, as noted, is based on these outcomes. Panel B of Table III.a shows the results when class XII (senior secondary school examination)outcomes are added to the regressions.[23] The public college effect drops to almost 0 and is statistically insignificant (Columns (i)-(iii)). We have limited our sample to the main stream of education chosen by the almost 60 percent of the students. The college exit exam outcomes vary by field. As a robustness check, we re-estimate all our specifications from Table III.a pooling all the fields and adding controls for the fields. Results are reported in Table III.b. We find that the public-private gap is not sensitive to field of education. Panel A reports the results from the benchmark regressions for a sample that pools all fields. The coefficient on the indicator for public colleges reported in Columns(i) in panel A does not change much and is highly statistically significant. However, when we control for selection and include the class XII senior secondary examination outcomes, the coefficient drops to 0 as reported in Column (i) of Panel B. These results are reported separately by gender in columns (ii)

[23]We have used a linear specification for the control function i.e. we have included class XII exam outcomes in the regressions. Including higher order polynomials did not change the results.

and (iii) of each panel.

The results reported sofar are based on the full sample. One natural concern is that students that are further from the admission cutoffs in either direction are not similar in their abilities. To address this concern, we carry out the analyze in a regression discontinuity framework. The results from this framework are consistent locally around the cut-offs. In order to get to consistent LATE (Local Average Treatment Effect) estimates, we narrow the window around the admission cutoffs and re-estimate the effect of public colleges on college exit exam outcomes. The results of (6) in intervals around the admission cutoffs are reported in Tables IV and V. Panel (i) of Table IV restricts the interval to 12 points around the cutoff. Panel (ii) restricts the interval to 8 points around the cutoff , Panel (iii) to 4 points, and finally Panel (iv) to 1 point window. As we shrink the interval, the public college effect remains positive and statistically significant at the 1 percent level. In Panel (iv), the effect is statistically insignificant as the number of observations has reduced significantly. The public-private college gap narrows but persists.

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. These results indicate that the private-public observed quality gap reflects the sorting of the 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, the compliance to the assignment rules in not 100 percent. For example, there are students who choose not to attend public colleges even when they are eligible. In order to allay concerns about non-compliance, we use a two stage least square 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 assignment as reported in Top Panel A, Columns (i)-(iii). The second stage estimates show an even larger and statistically significant public-private gap (Bottom Panel A, Columns (i)-(iii)). Next, we repeat this exercise controlling for the class XII senior secondary exam outcomes to account for selection. The results are reported in Panel B. The second stage estimates reinforce our previous results that the public-private college differential is on account of selection and not value added by public colleges.

8 Are the Public Colleges More Cost Effective?

We find that the public-private quality difference is not on account of high value-added by the public colleges. However, public colleges can be more efficient in terms of more cost effective provision. If this is the case, then public colleges have an advantage over the private colleges. We collected cost data from the institutions in our sample to compare the cost-per-pupil in public versus private colleges. The average cost-per-pupil per annum in the private colleges in the year 2006-2007 was 13022 Indian Rupees whereas the average cost-per-pupil in the public college was 13743 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.

9 Caveats and Conclusion

The estimation relies on the assumption that students in a narrow interval around the admission cutoff are similar in their observed and unobserved characteristics. If the students knew the rule that determined the cutoff, they could manipulate their behavior, and that would compromise the validity of the RD approach used here. However, the admission cutoff changed from year to year. Moreover, the rule that determined the cutoff was only known to the colleges internally.

Another concern might be that the students who complete college education are not representative of those who appeared for the class XII senior secondary examinations. There are two potential reasons why this might be the case. First, drop-out on average, is lower in the public colleges. If it were the case that lower ability students were more likely to drop out, then this would result in higher average scores for private than public college students conditional on completion. Hence,our results would not be valid at the margin, if the drop out rate jumps around the cutoff or is significantly different to the left and right of the discontinuity. Figure VII shows that those who performed better in class XII are more likely to finish college education. However, there is no jump in this drop out rate around the admission cutoff and this the observed function is smooth around the cutoff.

The second problem is related to selective enrollment decisions that are governed by income effects. If poor students, who do not score above the cutoff, decide not to pursue college education and their ability or accumulated human capital is different than those who are able to enroll in private colleges, then the private college outcomes

will be biased. While we do not observe every student who did not enroll, evidence suggests that this is not a problem at the margin of selection. 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 able to avail one of the need based scholarships 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 seventy five percent fee concession, and 2 students received a 50 percent fee concession. Also, there are more private colleges in the district than public colleges. This might be one of the reasons that explains why the drop out rate is smooth and continuous around the admission cutoff.

One further concern might be peer effects which could be positive in public colleges. However,the colleges offer a prescribed curriculum and there is no evidence of academic tracking in Indian education system. The examinations are evaluated externally by the university using an absolute scale applied to everyone. 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 the group identity of the students is unknown to others. Hence, peer effects would not necessarily have a significant positive effect on the student outcomes.

From a policy perspective, it is important to understand the quality gap in the public versus private colleges at the margin of selection into these institutions. Given the excess demand for higher education[24] that is not being met by the current infrastructure, policy makers need to determine whether to expand government college infrastructure or to offer merit-cum-need based scholarships to students in private colleges. There is a trade off in increasing the public spending on government colleges expansion. An expansion of government institutions would lower the cutoff of 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 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

[24] 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.

yield better trained graduates. Hence, a more efficient policy may be to devise scholarship programs for private colleges that expand financial aid to the students who cannot afford college education. The state can extend its role in maintaining and monitoring the standards of education offered by the colleges and encourage the development of a market based tertiary education sector .

Appendix I: Data Collection and Formation of Samples

We obtained the admission records for students who applied to study humanities and social sciences, 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).

Twenty five percent 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.

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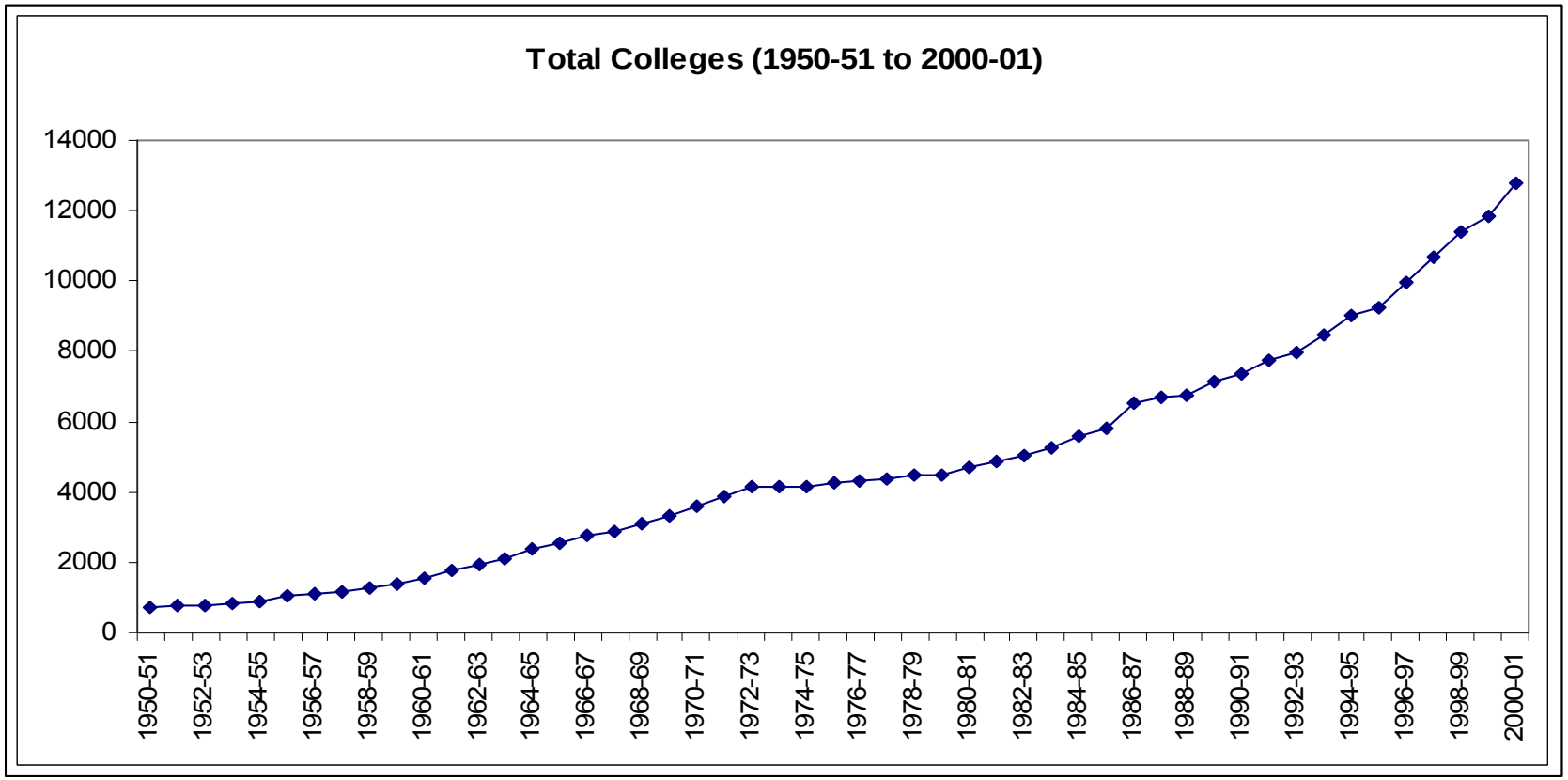
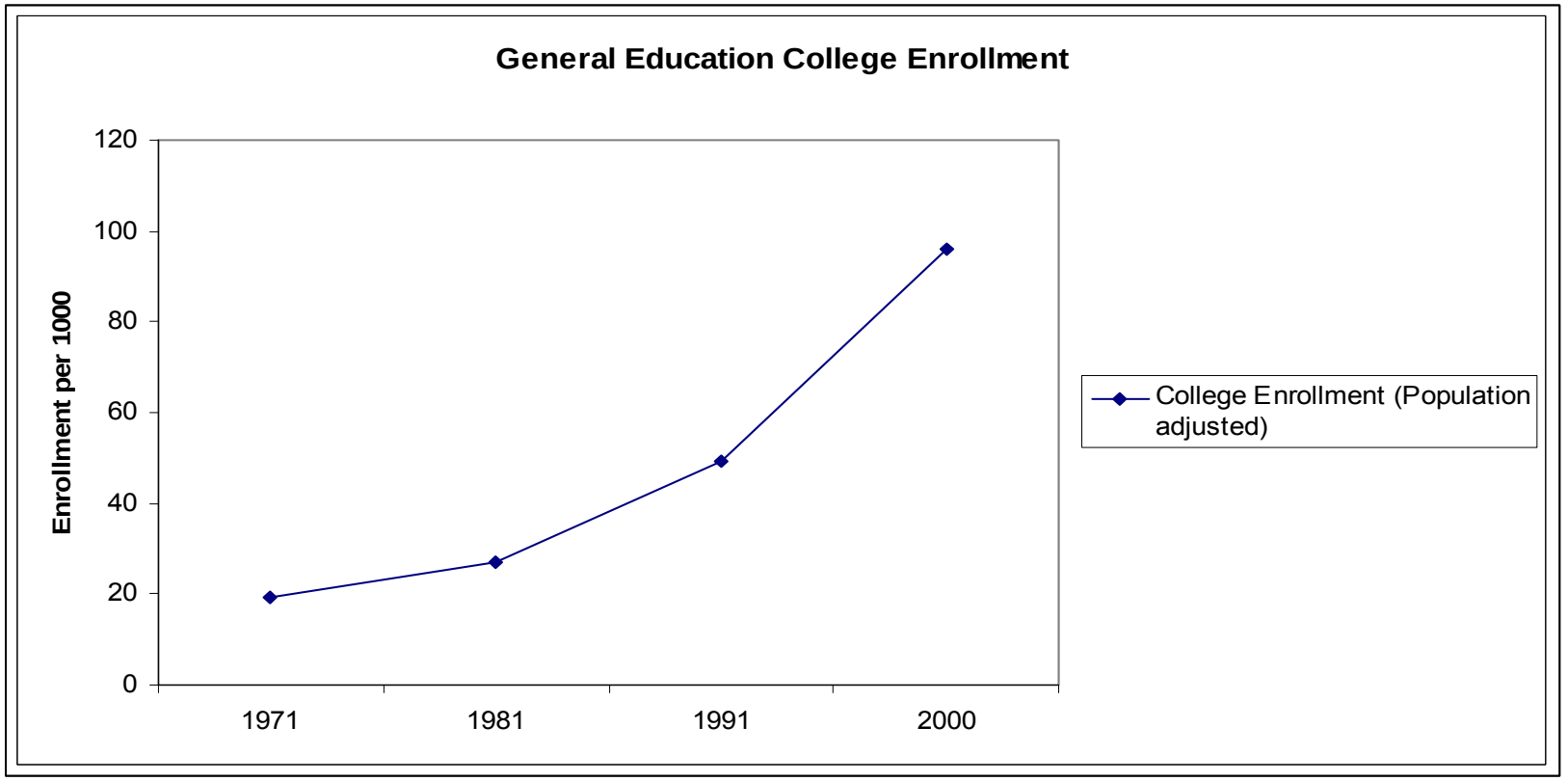
Figure I.a



Source: University Grants Commission, India

Data provided by Indiastat.com

Figure I.b

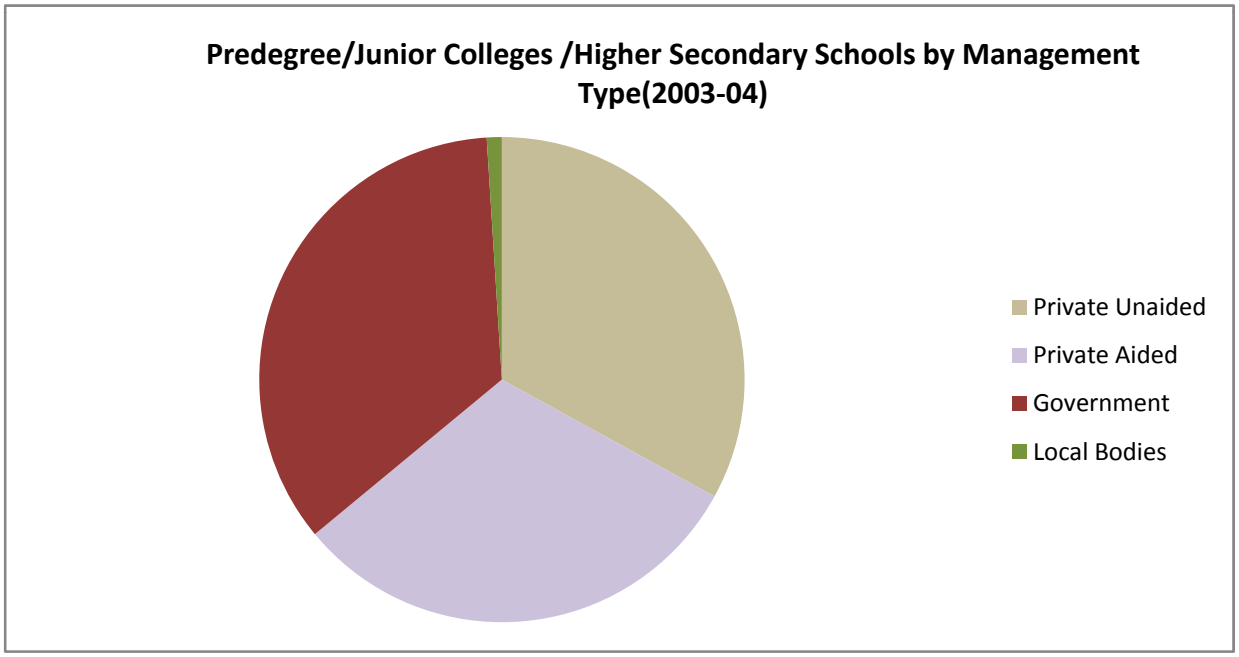


Source: Institute of Applied Manpower Research, GOI

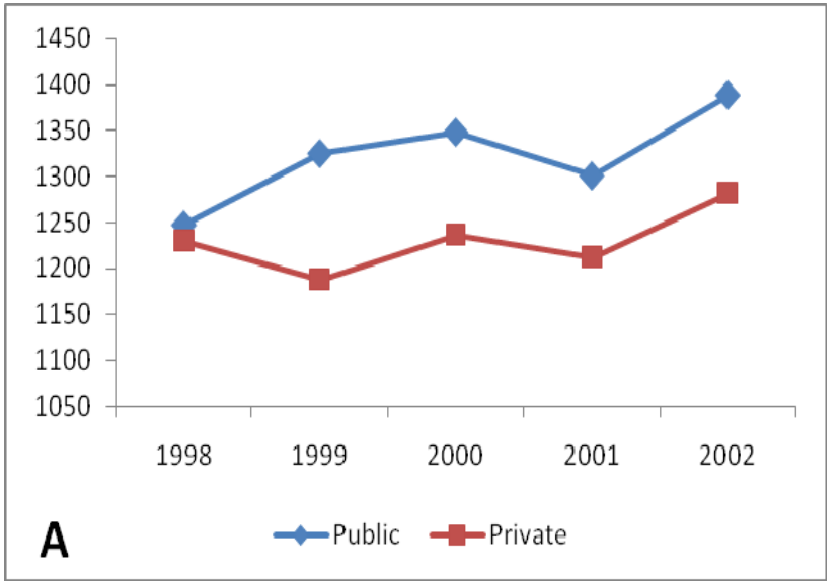
Data provided by: Indiastat.com

Population data from Census of India 1981,1991,2001

Figure IIa



Source: Department of Higher Education, Government of India



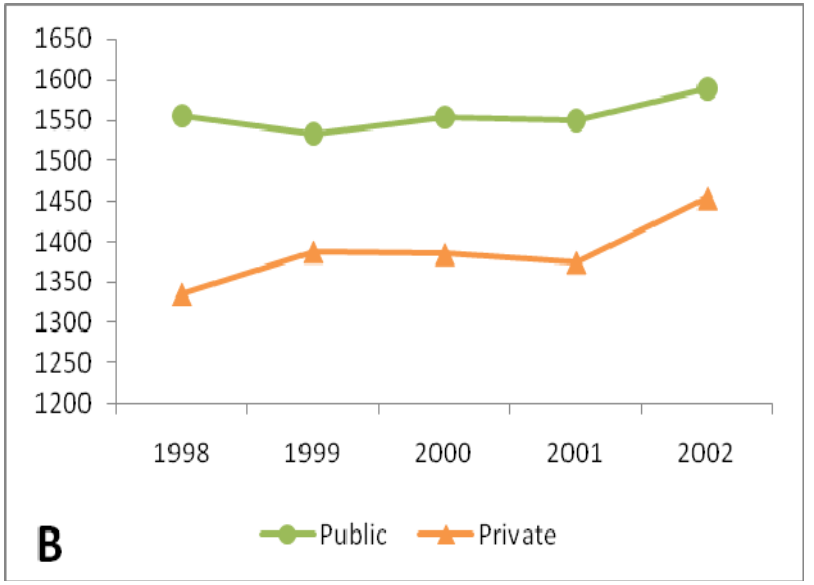


Figure III: Panel A and B show the college exit exam scores for Humanities and Social Sciences stream for men and women respectively. Difference between Public and Private Colleges is statistically significant at 1 percent level for all 5 years for both men and women (except for men in 1998)

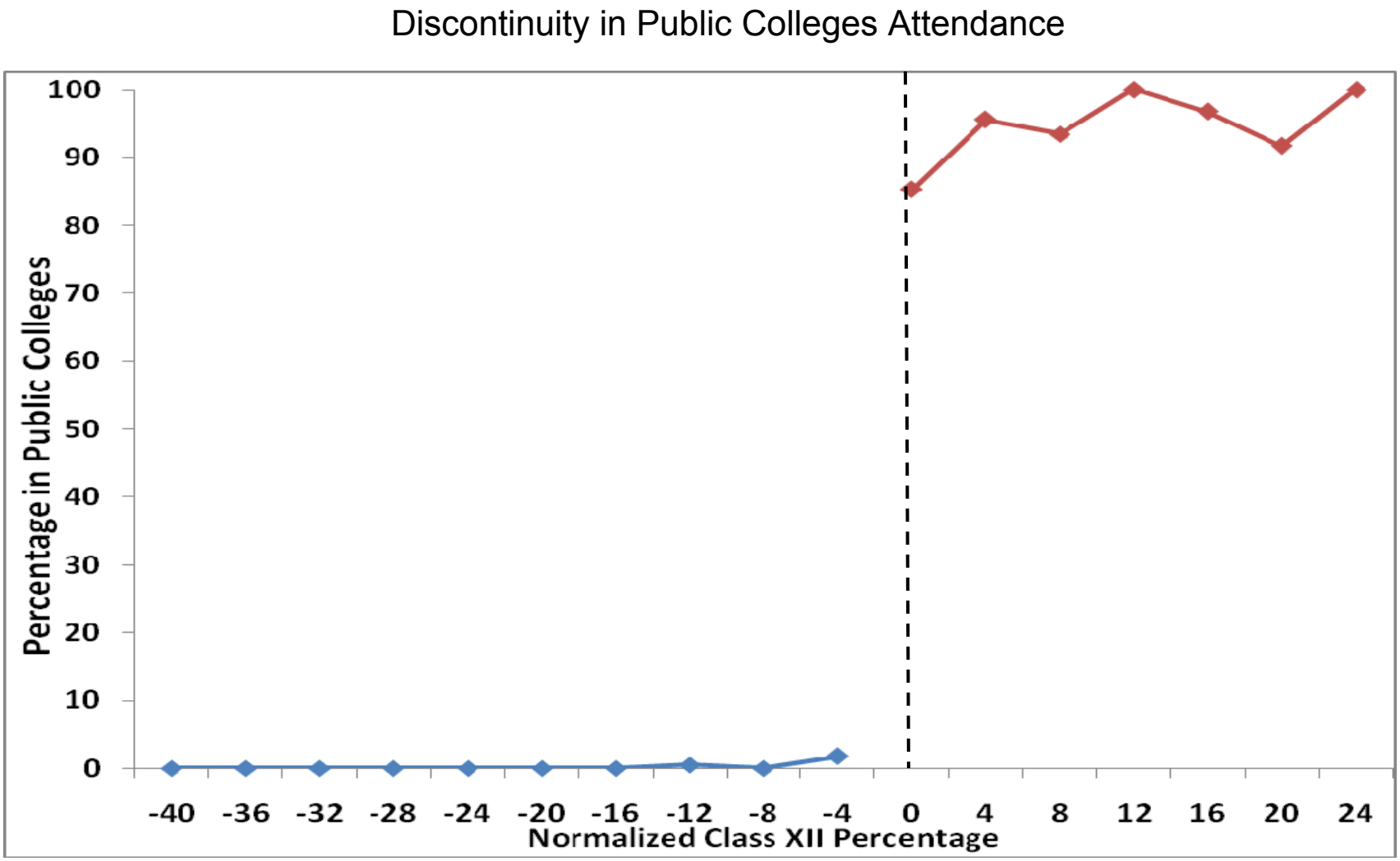


Figure IV: Percentage of Students in Public Colleges

This figure graphs the percentage of students in public colleges in 4 point intervals of Normalized Class XII Percentage Scores. The sample used is the 'Non-Reserved Graduating Sample' as described in Data Appendix. Class XII percentage scores pin down the entry score rank and have been normalized by subtracting admission cutoff from the actual score

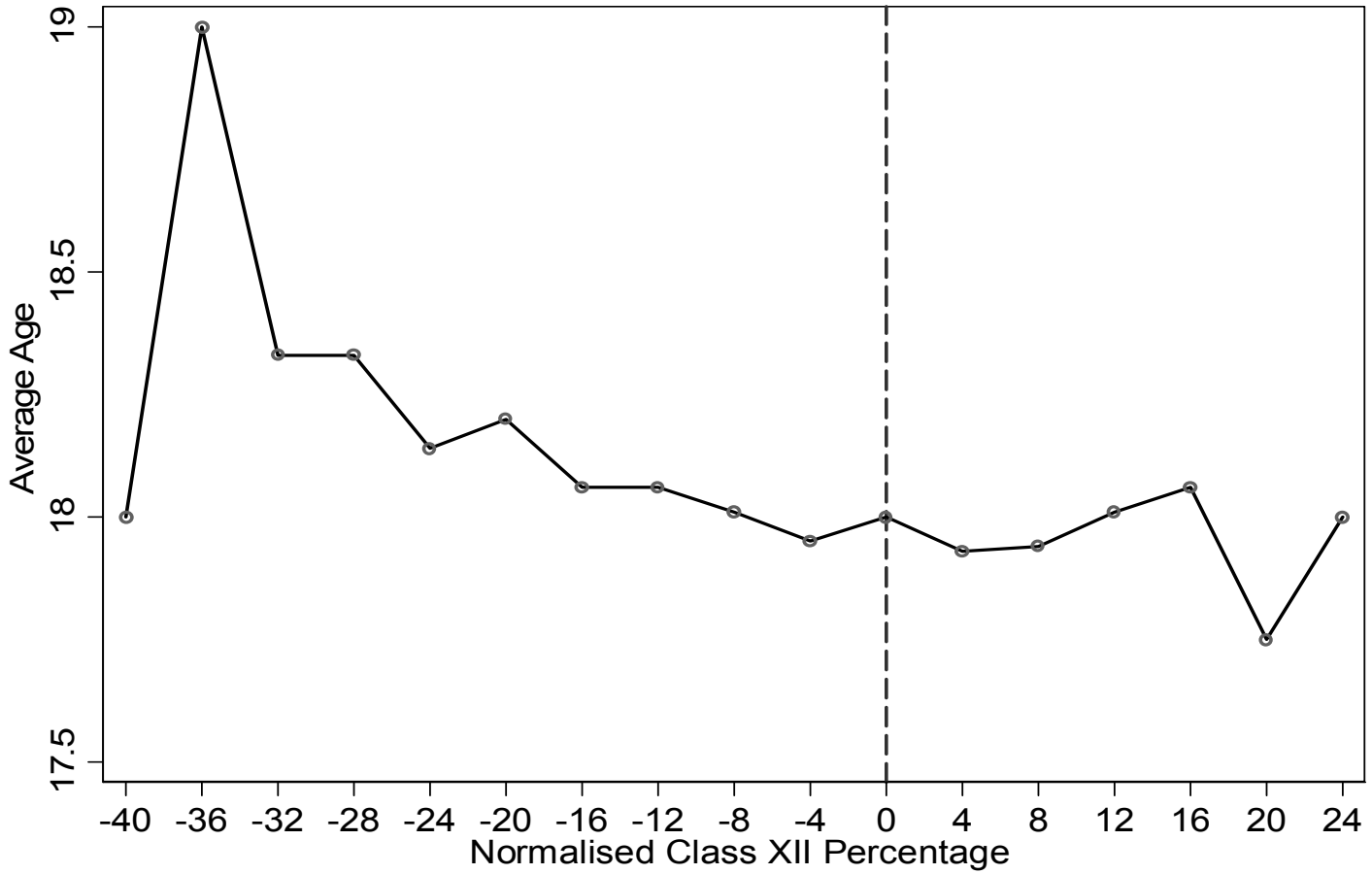


Figure Va: Age Distribution of Students in Liberal Arts

This Figure graphs the average age of students in 4 point intervals of Normalized Class XII Percentage.
The sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix.
Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score.

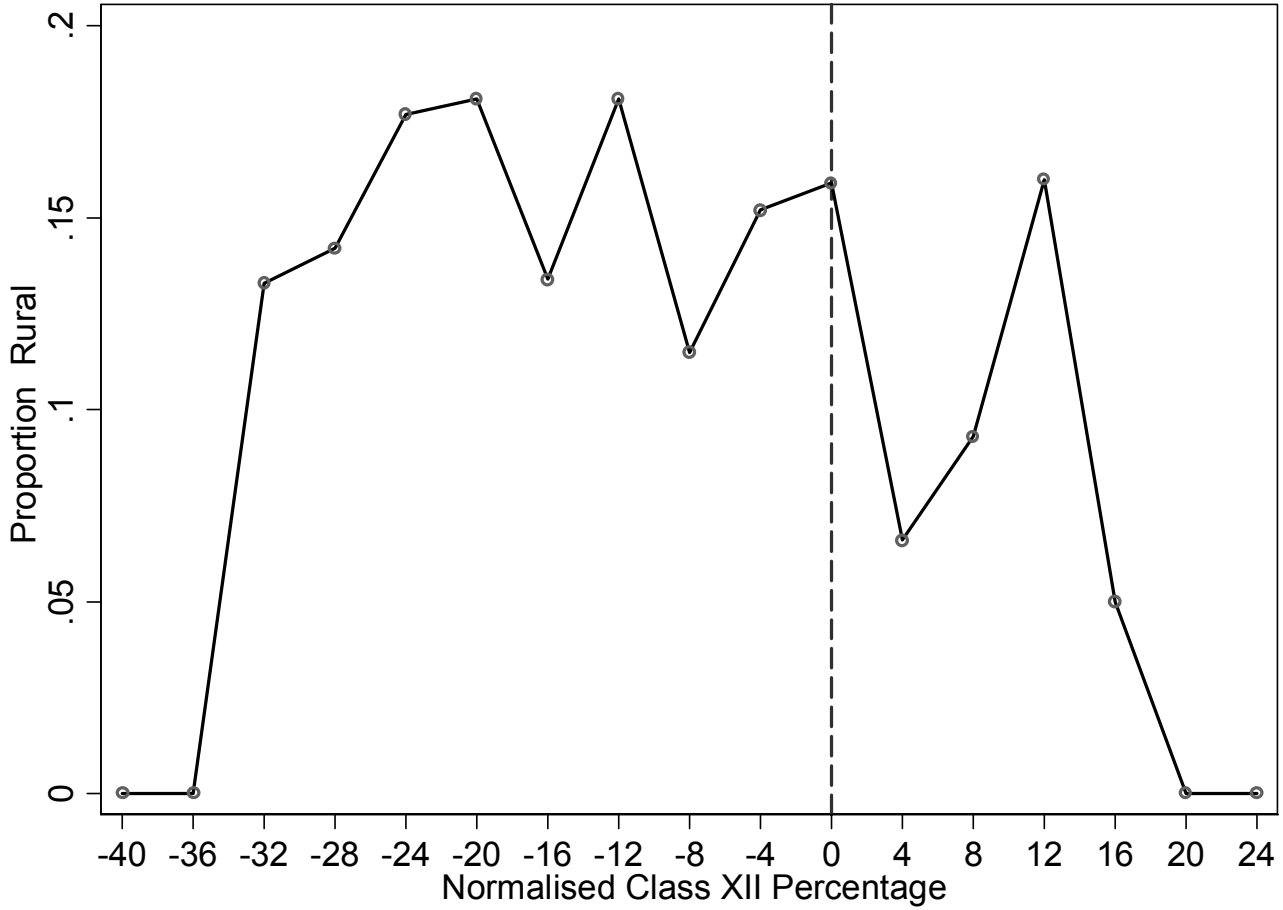


Figure V b: Percentage of Students from Rural Areas in Liberal Arts

This Figure graphs the percentage of rural students in 4 point intervals of Normalized Class XII Percentage. The sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix. Class XII Percentage has been normalized by subtracting admission cutoff from the actual score

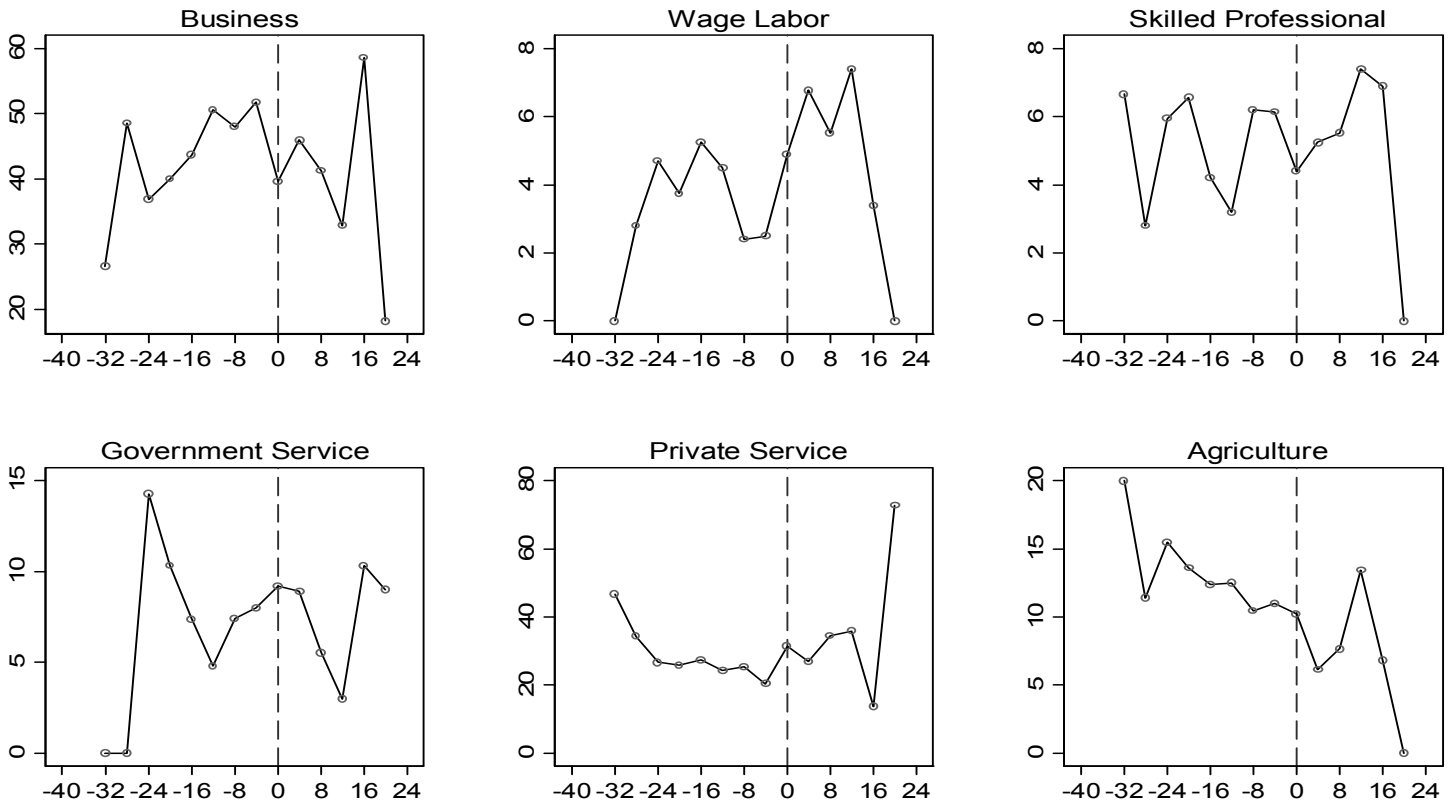


Figure Vc: Percentage of Students by Father's Occupation

This Figure graphs the percentage of students in 4 point intervals of Normalized Class XII Percentage by Father's occupation. The sample used is the 'Non Reserved Graduating Sample' as described in the Data Appendix.
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.

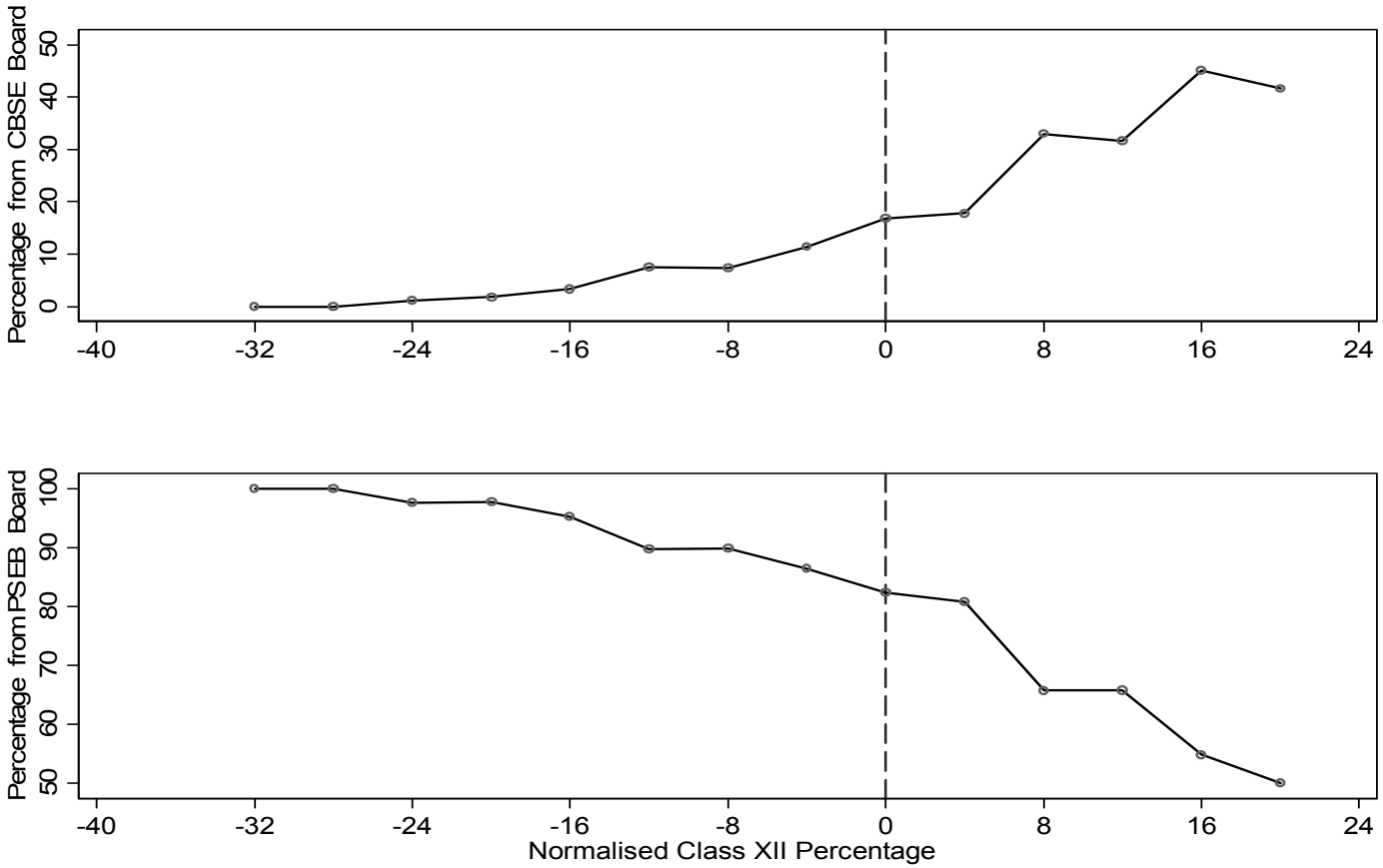


Figure V d: Percentage of Students from National (CBSE) & Regional (PSEB) Class XII Board

This Figure graphs the percentage of students from National (CBSE) and Regional (PSEB) Class XII Board in 4 point intervals of Normalized Class XII Percentage. The Sample used is the 'Non Reserved Graduating sample' as described in Data Appendix. Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score.

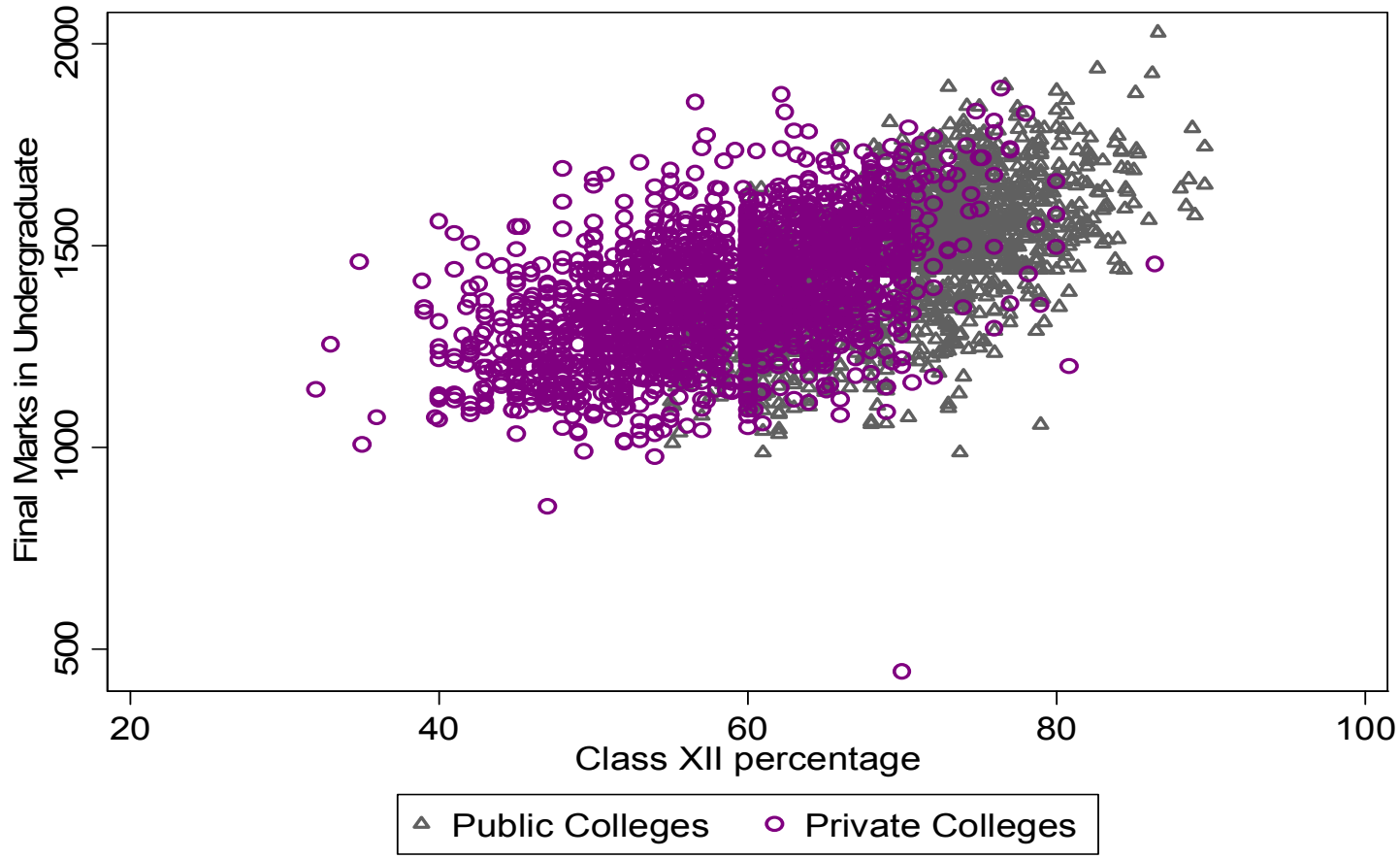


Figure VIa: Final Marks in Liberal Arts Undergraduate Degree
This figure graphs the marks obtained in the exit exams of the undergraduate degree in liberal arts for students in public and private colleges versus their class XII percentage. Sample used is the 'Non Reserved Graduating' sample as described in Data Appendix.

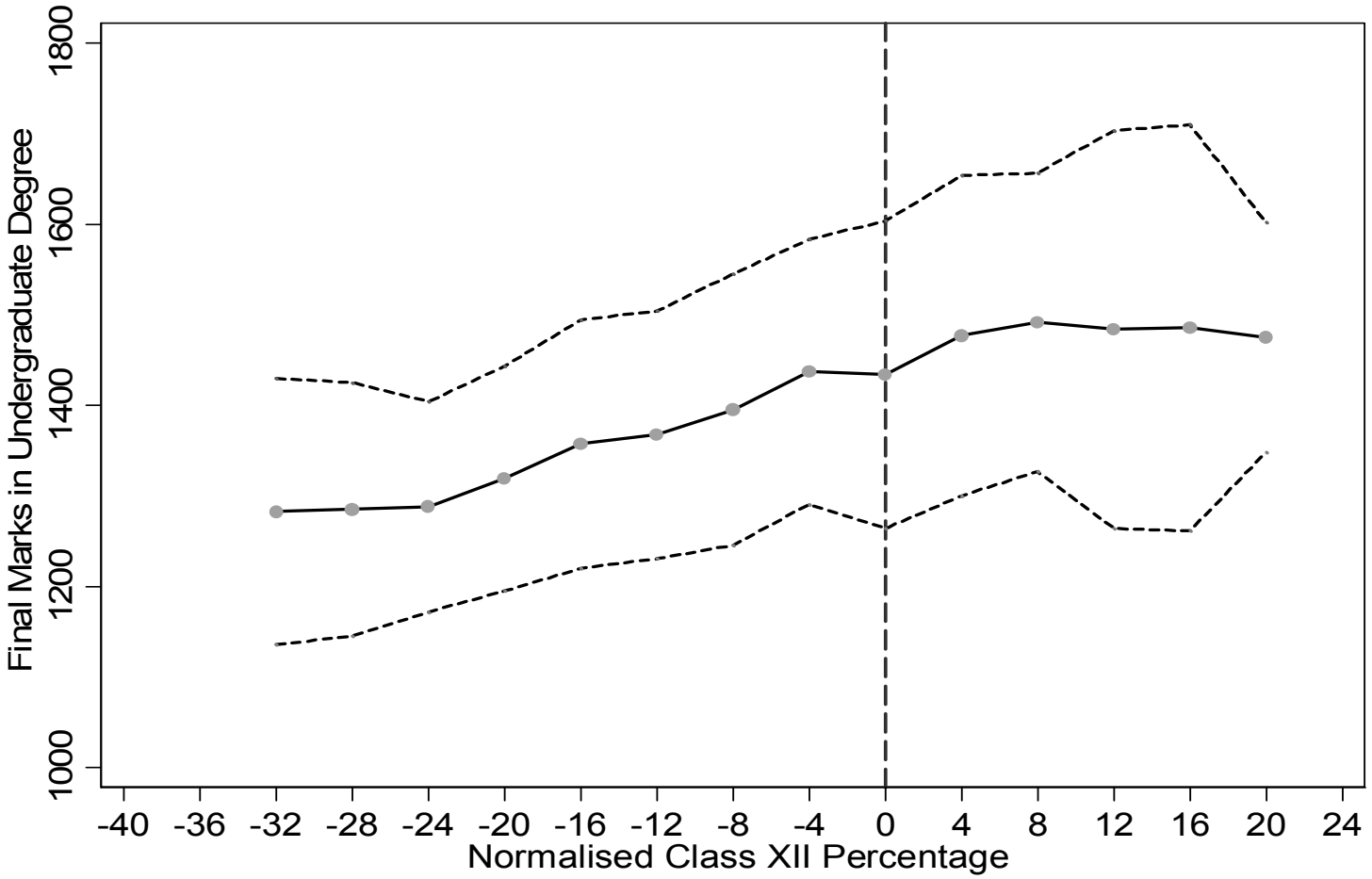


Figure VIb: Final Marks in Liberal Arts Undergraduate Degree

This figure graphs the average final marks obtained in the exit exams of the undergraduate degree in liberal arts in 4 point intervals of Normalized Class XII Percentage Scores(solid line). One STD Deviation above and below the average in each interval is also graphed (dashed line). Sample used is the 'Non Reserved Graduating sample' as described in Data Appendix. Class XII Percentage pins down the entry score rank and has been normalized by subtracting admission cutoff from the actual score.

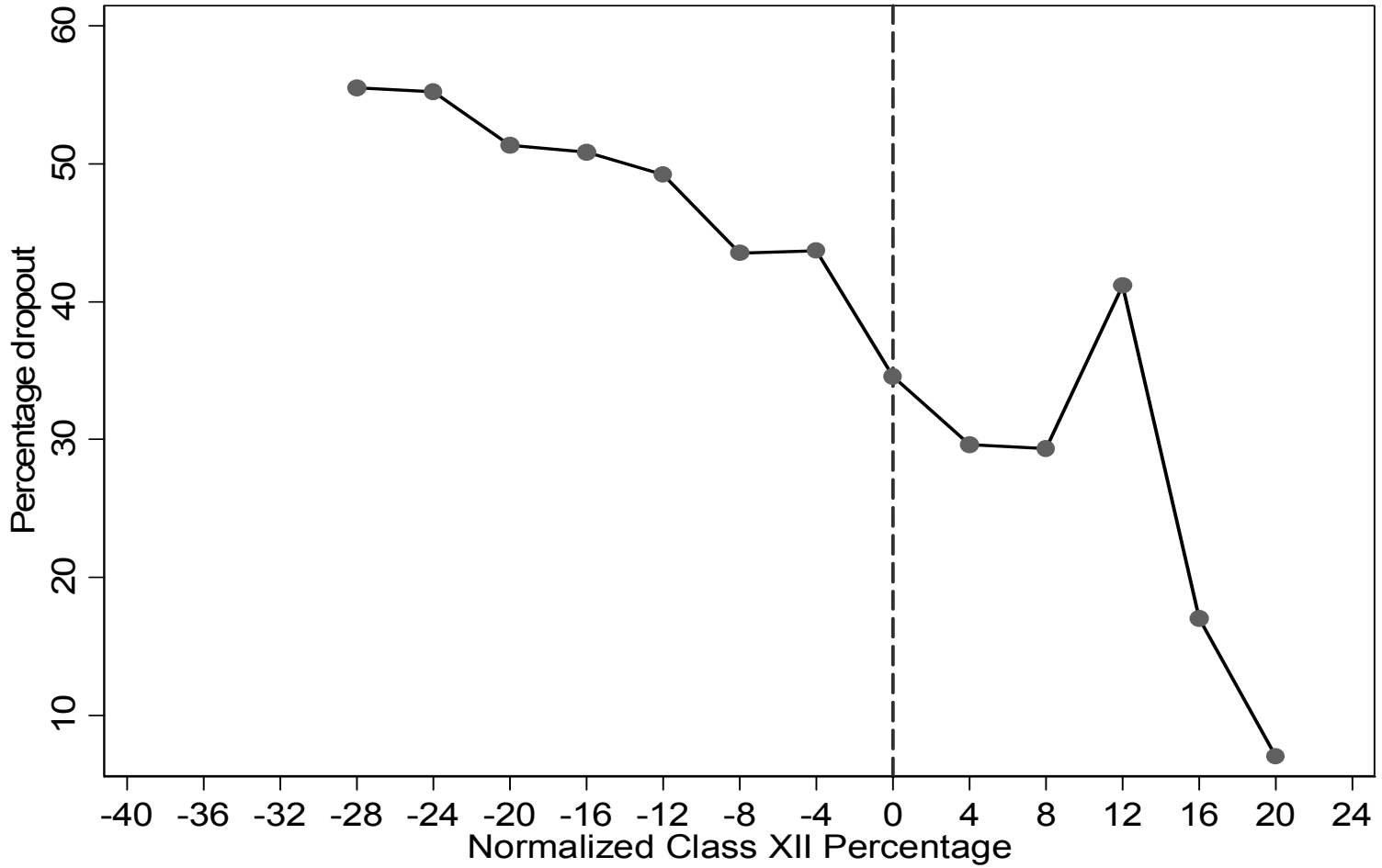


Figure VII: Percentage of Drop Outs

This figure graphs the percentage of students dropping out from college in 4 point intervals of Normalized Class XII Percentage Scores. Class XII Percentage Score pins down the entry score rank and has been normalized by subtracting the admission cutoff from actual score.

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			
Humanities and Social Sciences	58.55	70.07	-11.5
	(.172)	(.187)	(.258)
Commerce	70.62	80.34	-9.72
	(.268)	(.211)	(.38)
Science	60.98	69.2	-8.21
	(.25)	(.411)	(.466)

Table I (continued): Summary Statistics by College Type

	Private	Public	Difference
Variables			
College Exit Exams Scores			
Humanities and Social Sciences	1378.73 (3.43)	1461.08 (4.58)	-82.35 (5.6)
Commerce	843.59 (3.68)	903.71 (4.02)	-60.12 (5.65)
Science	1274.94 (5.94)	1310.17 (9.2)	-35.22 (10.52)

Note: The sample is the 'Non-Reserved Graduating Sample' described in the Data Appendix Data for all 5 years (1998-2002) are pooled in this sample.

Table II: Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts					
	(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.

Table IIIa: Effect of Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts

	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				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.

Table III b : 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				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 (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), 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 IV:The Effect of Attending Public Colleges on Educational Outcomes

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts

	(i)			(ii)			(iii)			(iv)		
	1	2	3	**1**	2	3	**1**	2	3	**1**	2	3
	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females
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
	(6.51)	(12.66)	(7.76)	(7.38)	(14.84)	(8.68)	9.8	(19.69)	(11.87)	(19.88)	(36)	(26.19)
Obervations	1978	577	1401	1499	465	1034	847	279	568	308	135	173
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
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
	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.

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

Dependent Variable : Final Marks in Undergraduate Degree for Liberal Arts

	(i)			(ii)			(iii)			(iv)		
	1	**2**	3	1	**2**	3	1	**2**	3	1	**2**	3
	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females	ALL	Males	Females
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
	(9.93)	(17.96)	(11.84)	(10.78)	(19.84)	(13.46)	(13.46)	(24.6)	(17.9)	(20.91)	(39.94)	(30.6)
Class XII %	10.3	9.14	10.34	10.7	11.4	10.92	7.5	4.53	10.23	7.86	6.84	13.83
	(.84)	(1.39)	(.92)	(1.14)	(2.06)	(1.44)	(2.5)	(4.87)	(3.64)	(7.64)	(27.41)	(22.01)
Obervations	1978	577	1401	1499	465	1034	847	279	568	308	135	173
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
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
	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.

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			Panel B		
	(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 for Liberal Arts

	Panel A			Panel B		
	(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.

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			
Humanities & Social Sciences	---	63.42	9.4
Commerce	---	74.34	7.95
Science	---	64.4	8.41
Age	---	17.97	0.809
Final Exit Exam Scores			
Humanities & Social Sciences	---	1413	166.46
Commerce	---	899.62	99.7
Science	---	1289.6	168.6

Table A.4 Differences in Outcomes of Public and Private College Students

		General Category open seats								
		2002			2001			2000		
		Public	**Private**	**Difference**	**Public**	**Private**	**Difference**	**Public**	**Private**	**Difference**
Men										
	Humanities	1388.183	1282.1	106.04***	1301.5	1212.1	89.28***	1348.45	1237.4	111.01***
	& Social Sciences	13.99	14.88		13.35	16.63		10.3	14.08	
	Commerce	840.86	825.48	15.38	862.27	794.5	67.67***	881.55	776.83	104.72***
		13.18	10.97		8.1	9.8		11.17	11.19	
	Science	1342.295	1296	46.32***	1180.2	1215	-35	1201.03	1150.8	50.28
		23.9	21.65		66.64	24.2		20.69	72.16	
Women										
	Humanities	1589.19	1454.9	134.3***	1550	1375.8	174.21***	1554.41	1385.9	168.552***
	& Social Sciences	9.89	7.52		9.68	12.3		10.6	11.01	
	Commerce	934.32	881.18	53.14***	946.31	868.19	78.12***	964.55	849.49	115.06***
		14.7	10.5		10.3	9.47		10.055	11.53	
	Science	1578.66	1308	270.25***	1362.2	1276.1	86.09**	1444.14	1261.5	182.66***
		21.5	11.4		33.5	13.69		16.1	11.4	
Overall										
	Humanities	1508.367	1424.1	84.26***	1469.6	1348.9	120.71***	1453.14	1361.7	91.43***
	& Social Sciences	10.02	7.48		10.57	11.05		9.5		
	Commerce	891.3	859.16	32.14**	892.76	839.43	53.33***	916.13	822.8	93.33***
		11.56	7.76		7.45	7.46		9.67	8.84	
	Science	1396.152	1293.2	102.9***	1269	1271.4	-2.45	1315.19	1257.8	57.39
		22.15	10.46		22.75	13.41		17.47	11.38	

*** significant at 1 %, ** significant at 5% and * significant at 10%

Table A.4 cont. Differences in Outcomes of Public and Private College Students

		General Category open seats					
		1999			1998		
		Public	**Private**	**Difference**	**Public**	**Private**	**Difference**
Men							
	Humanities	1325.863	1188	137.86***	1248.7	1230.2	18.49
	& Social Sciences	10.7	29.1		21.23	16.88	
	Commerce	894.02	791.42	102.6***	864.34	806.36	57.98***
		12.1	9.7		10.24	13.73	
	Science	1183.69	1095	88			
		22.2	44.4				
Women							
	Humanities	1533.32	1388.4	144.92***	1555.3	1336.3	218.99***
	& Social Sciences	10.7	7.3		9.84	16.04	
	Commerce	953.125	872.34	80.785***	951.11	915.27	35.835**
		13.5	7.8		10.47	12.05	
	Science	1355.18	1291.9	63.28**	1407.3	1250.4	156.88***
		20.35	16.51		29.9	17.5	
Overall							
	Humanities	1434.227	1358.4	75.827***	1426.8	1324.6	102.13***
	& Social Sciences	9.7	8.28		13.7	14.5	
	Commerce	920.68	844.19	76.49***	897.01	853.2	43.81***
		9.54	6.89		8.59	10.8	
	Science	1280.16	1280.2	0	1292.5	1250.4	42.12
		17.2	16.7		23.6	17.5	

*** significant at 1 %, ** significant at 5% and * significant at 10%