Determinants of undergraduate GPAs in China: college entrance examination scores, high school achievement, and admission route

Bai, Chong-en and Chi, Wei

School of Economics and Management, Tsinghua University, China

April 2011

Determinants of Undergraduate GPAs in China: College Entrance

Examination Scores, High School Achievement, and Admission Route

Chong-en Bai
School of Economics and Management
Tsinghua University
Beijing, China 100084
baichn@sem.tsinghua.edu.cn

Wei Chi (Corresponding author)
School of Economics and Management
Tsinghua University
Beijing, China 100084
chiw@sem.tsinghua.edu.cn
Tel. (8610) 62795072
Fax: (8610) 62772021

Determinants of Undergraduate GPAs in China: College Entrance Examination
Scores, High School Achievement, and Admission Route

Abstract:

Each year, millions of Chinese high school students sit the National College
Entrance Examination (CEE). For the majority of students, the CEE score is the
single determinant in whether they gain admission into a college and to what college
they enter. Despite the significance of the exam, there is very little empirical
evidence on the predictive power of the CEE with respect to students' later academic
performance in college. The purpose of this paper is to determine whether and how
well the CEE score predicts college academic success. We also consider high school
achievement and admission route in predicting college grades. We find that the CEE
total and subject test scores predict undergraduate GPAs for all four years in college.
High school achievement is also a significant predictor of college grades. Moreover,
students' academic performance in college varies significantly with regard to their
admission route.

1. Introduction

Each year, millions of high school students in China sit the Chinese National College Entrance Examination (CEE; *gaokao*). The CEE is only offered once a year. For the majority of students, the CEE score is the sole determinant of college admission—students gain entry into ranked schools based solely on their CEE results. Only a very small number of students are exempt from the exam, because of a special talent, and they enter university via a recommendation ("*bao-song*"). In 2010, 9.5 million students sat the exam, of whom 6.5 million were admitted into a college (an admission rate of 68%); 5,000 students gained admission to a college without taking the test, accounting for less than 0.1% of the total exam-takers.[1] As the number of applicants far exceeds the admission quota, the competition to gain entry into a college, especially a prestigious one, is fierce, and the pressure to perform well in the exam is immense. Those who do not gain admission into a college may re-take the exam the following year or, instead, find employment.

Despite the significant role that CEE plays in college admission decisions, there is very little empirical evidence on the validity of the CEE as an admission criterion; that is, whether the CEE score predicts the students' subsequent performance in college. This paper intends to fill this gap in empirical literature by studying the following four questions. (1) How well does the CEE score predict college GPAs? (2) Has the predictive power of CEE changed over time? (3) Do some high school achievement indicators predict college success for Chinese students? (4) Is a student's admission route (ie. CEE or recommendation) predictive of a particular level of performance in college? Specifically, do those who are exempt from the CEE due to special talents perform better or worse than the students admitted on the

---

[1] Data is sourced from gaokao.eol.cn and gaokao.chsi.com.cn, the two most prominent websites authorized by the Chinese Ministry of Education to release gaokao-related information and policy details.

basis of their CEE score?

The answers to these questions have significant implications for Chinese educational administrators and policy makers. Chinese universities have predominantly relied on CEE scores to select students. Evidence of CEE validity would provide strong justification (or opposition) to this kind of admission practice. In recent years, universities have also attempted to reform admission policies and explored alternative admission routes. For example, some universities have been piloting a more flexible policy where students may be recommended by their high school or apply directly to the university, and after a very extensive screening including written tests, physical exams, and interviews organized by the university, those who passed are promised admission with a 10-40 point lower CEE score (known as *"zi zhu zhao sheng"*). One way to judge the effectiveness of these practices is to evaluate whether students admitted via these alternative routes appear to outperform those via CEE (the traditional route) in college. If these practices are proved to be effective, they may be recommended for widespread adoption among universities. Besides, as universities gain greater autonomy in admission, they also need to be aware of other predictors of students' quality, such as high school performance indicators.

Empirical research on the CEE exam would also be of some benefit to Western educators for two reasons: first, the CEE is a different scholastic ability test from the SAT. A detailed description of CEE is provided in Section 3. From the perspective of comparative education, a study of the CEE may serve as a reference for other countries. Western educators could draw lessons from China's experience to improve college admission tests in their own countries. Second, in recent years, increasing numbers of Chinese students have pursued graduate study at universities in the

United States and other Western countries. Insights into the Chinese educational system in general, and the CEE in particular, could help Western universities to select quality students from China.

The remainder of the paper is organized as follows. Section 2 reviews related studies. Section 3 provides an overview of the CEE and college admission policies in China. Section 4 presents the data and empirical model used in the study. Section 5 reports the empirical results. Section 6 summarizes the results and concludes the paper.

2. Related studies

Compared with the limited literature on CEE, there are many empirical studies examining the link between Scholastic Aptitude Test (SAT) scores, high school performance, and college academic success in the United States. For example, Betts and Morell (1999) analyzed the sample of 5000 students from the University of California, San Diego, and found that both SAT scores and high school GPA were significant predictors of college GPA. Cohn et al. (2004) used the data collected from undergraduates in the University of South Carolina and also found a significant relationship between high school GPA, SAT, and college performance. Since 2005 the SAT has undergone some substantial changes. Thus, recent studies have also examined how well the new SAT, particularly the new writing section, can predict undergraduate GPAs, using data from the University of Georgia (Cornwell, Mustard, and Van Parys, 2008).

Some researchers have examined various admission policies, such as early admission decisions (Jensen and Wu, 2010; Avery and Levin, 2010), making SATs optional for admission (Robinson and Monks, 2005), and replacing affirmative action with a race-neutral top 10% rule (Dickson, 2006; Niu, Tienda, and Cortes,

2006), and their impact on college admission and students' academic success. This research highlights the importance of different admission policies in determining quality of admitted students and their later academic performance.

Although not directly related, our study fits into the small literature of economic analysis of Chinese higher education programs, which features two recent and important studies. Li and Zhang (2010) showed that college GPAs are significant predictors of students' employment success at graduation, especially for females, and with the inclusion of college GPAs, CEE scores are insignificant in predicting employment outcomes. Ding and Li (in press) analyzed the determinants of admission to the Graduate Study Joint Training (GSJT) program offered by Chinese universities and found the important role of social network in the process of school application.

3. CEE and College Admission in China

The College Entrance Examination (CEE) was introduced in China in the 1950s. The Cultural Revolution, 1965–1976, put the CEE on hold until it was resumed in 1977. The CEE consists of three mandatory subjects—mathematics, Chinese, and foreign language (for the majority of students, English)—and optional subjects including chemistry, physics, biology, geography, history, and politics. After several major reforms, the CEE adopted the current "3+X" format in 1994. The "3" represents the three mandatory subjects required for all college applicants. The "X" component consists of a group of subject tests that differ for students depending on whether they pursue liberal arts or science and engineering majors in college. For those pursuing liberal arts (liberal art track), the "X" component consists of history, politics, and geography, and for those pursuing science and engineering (science–engineering track) it includes physics, chemistry, and biology (Liu and Wu,

2006; Wang, 2006; Davey, Lian, and Higgins, 2007).

Before 2000, identical national CEE tests were given across provinces with the exclusion of the municipality of Shanghai, which had been piloting their own version of exams with the permission of the Ministry of Education since the mid 1980s. In the early 2000s, Beijing and Tianjin were permitted to develop and administrate their own exams. By 2006, a total of 16 provinces, municipalities, and autonomous regions were providing exams independently under the national curricular guidelines (Wang, 2006). For majority of provinces, a perfect CEE score is 750 points, with 150 points for each mandatory subject test and 300 points for the "X" component. In a few provinces such as Guangdong, standardized scores within province are calculated and reported to students.

The college admission process in China begins with a college application. In some provinces, students must file the application form before taking the CEE; in other provinces students file an application after they have taken the exam but before they know their score; in the remaining provinces students file an application after receiving the CEE score reports. The college application form consists of four sections. The first is for special universities, such as military or police academies—students may apply to two special universities. In the second section, students may select up to three first-tier 4-year degree universities. The third section asks that students choose a further three universities from the remaining second-tier 4-year degree universities, which are not as prestigious as the first-tier choices. Finally, in the fourth section, students may also choose three 3-year degree junior colleges. Each year the Ministry of Education publishes a selection of universities and colleges for each section. There are approximately 150 first-tier universities and

300–400 second-tier universities.[2]

Each year, under the guidance of the Ministry of Education, each college and university sets the target number of examinees to be admitted from each province. Universities and colleges typically provide a greater admission quota to their home province and admit substantially more students from the local area than from other provinces. Based on the CEE score distribution of each province and its admission quota for each province, a university or college determines its minimum CEE score for admission for each province. Then, universities and colleges begin their admission in the following order: first, special colleges; second, the first-tier universities; third, the second-tier universities; and finally, junior colleges. Each university and college selects applicants based on the applicants' CEE score from the highest to the lowest until the admission quota is reached.

There are also policies that enable students to enter a university with a low CEE score. These students include those from ethnic minorities, students with an art or sports specialty, and those with disabilities. These policies vary slightly across the provinces. Generally, these students may be accepted by a university with a score that is 10–30 points lower than the minimum score required for admission (Davey, Lian, and Higgins, 2007).

A small number of students may be exempt from the CEE and, instead, are recommended to a university. The Ministry of Education (2010) has specified eight types of students that are eligible for such recommendations, including those who are awarded the provincial-level title of outstanding student (usually only a few students are awarded this title in a province each year) and winners of national competitions in mathematics and science (such as physics, chemistry, biology, and

---

[2] The list of the first- and second-tier universities is somewhat different for each province. The 2010 list of universities and colleges for each province is published at gaokao.eol.cn.

information technology). Not all universities accept recommended students. In 2010, only 50 or so universities in China had permission from the Ministry of Education to accept recommended students.[3] It is generally the more prestigious universities that are given a larger admission quota for recommended students.

Finally, some universities have been experimenting new admission methods. High school seniors with high enough GPAs or class ranks may be recommended or apply directly to the university. They will take a series of tests offered by the university, including written, physical tests and interviews, which usually take place roughly half a year before the CEE exam. Those who perform well on these tests are promised admission to the university with a lower CEE score. Although students still need to sit CEE exams, the CEE is no longer the only chance to enter into the university. By 2010, over thirty universities have adopted this practice.

4. Data and empirical model

4.1 Data

We obtained the administrative records of students who entered Tsinghua University, China, from Fall 1995 to Fall 2005. The data were sourced from the school's admission and registrar's offices. The data from the admission office contained information regarding *admission route*, specifically, whether a student entered the university via the entrance exam or by recommendation without a CEE score. If the student gained entry through the CEE exam, then the student's total CEE scores and subject test scores were obtained, as was whether the student was a liberal arts or science–engineer track exam-taker, a first-time test-taker or re-taker, and whether the student was accepted with a lower test score due to art and sport specialty. Since 2003, Tsinghua University has started accepting students with a

---

[3] The list of the universities that accept recommended students is published at
http://gaokao.eol.cn/baosong_3126/.

lower CEE score who passed university-administered screening tests. In the dataset, there is also an indicator of whether students were admitted with a lower CEE score for this reason.

The admission office also held data on the students' personal characteristics, such as gender, birth year and month, ethnicity, the province from which they are admitted (which is usually also where they completed high school), and whether the students were from a rural or urban area. In China, urban areas offer better education opportunities and greater access to higher education than rural areas (Liu and Wu, 2006). In terms of access to higher education, it is only in recent years that the gap between rural and urban areas has decreased (Li et al., 2008).

As high school GPAs are not used to determine admission, the admission office does not collect high school GPA data. However, there are some indicators of the students' high school performances in the dataset, specifically, whether a student received any award in high school. Generally, there are two types of awards. The first is the title of "outstanding student" awarded to students who demonstrate excellence in both academic and extracurricular activities. The title may be awarded by a school, district, city, or at the highest level, by a province. The higher the level of the title, the greater the competition is to win it. The second award is given to the winners of competitions in mathematics, science, and technology, organized at district, city, province, and national levels. The winners of the lower level competitions continue competing until they reach the national championships. In addition to the above two types, students may receive other awards, e.g. winners of speech, calligraphy or painting contests. Based on this information, we create two award-level and three award-type variables. The base groups are those who did not receive any award.

The registrar's office provided us with GPA data for 4-year undergraduates who entered school from Fall 1995 to Fall 2005. In addition to the first, second, and third year GPAs, we also obtained the students' cumulative GPAs for their 4 years of study, for both core and elective courses. The GPAs are calculated on a 100-point scale. There are four majors, economics, accounting, finance, and management information system. The curriculum for the first 2 years consists of mandatory courses for all the majors, including college calculus, linear algebra, statistics, and principles of economics. In the final 2 years, the students enroll in a greater number of elective courses pertaining to their major, such as accounting, finance, and management courses for business majors, and economics courses for economics majors. In the second semester of the fourth year, the students are required to complete an undergraduate thesis to graduate and obtain a bachelor degree.

The data from the admission and registrar's offices were merged using a unique student ID number. The final sample consisted of 1,436 students, with 1,264 having CEE scores, and 172 gaining entry to the school via recommendations without CEE. We convert CEE scores in different years to a 100-point scale. Figure 1 shows the distribution of scores in 1995 and 2005. The distribution has moved to right from 1995 to 2005, and the average CEE score increased.

Among those admitted to the school via the entrance exam, 90% were first-time exam-takers; 3% were admitted with a lower score because of an art or sports specialty. Most of the students are of Han majority ethnicity and from urban areas. Females account for approximately half of the admitted students. As can be seen in Table 1, the first and second year undergraduate GPAs for students admitted by recommendation without CEE was approximately 1 point higher than those entering via the entrance exam. However, the GPA differences between the two types of

students became significantly smaller in the third and fourth years. Table 1 lists definition and summary statistics for the variables used in the study.

   4.2 Empirical Model

   First, we estimated the predictive power of the CEE on the undergraduate GPAs, using the sample of students admitted via the entrance exam, as those admitted by recommendation do not have a CEE score. The models are specified as follows:

$$Y_i = \alpha + \beta X_i + \delta CEE_i + \gamma_t + \varepsilon_i \qquad (1)$$

$$Y_i = \alpha + \beta X_i + \delta_1 CEE\_math_i + \delta_2 CEE\_Chin_i + \delta_3 CEE\_lang_i + \gamma_t + \varepsilon_i \qquad (2),$$

where Y_i denotes undergraduate GPA including the first, second, and third year GPAs, and the 4-year cumulative GPAs for the core courses and total courses. X_i is a vector of explanatory variables including *female*, *minority*, *age at enrollment*, *urban*, *first-time exam-taker*, *liberal-art track, academic majors,* and *high school award*. Other than X_i, the total CEE score is included in equation (1), while the CEE subject test scores are used to predict college GPAs in equation (2). For the convenience of interpreting coefficient estimates, the CEE total and subject test scores are converted to a 100-point scale. γ_t denotes enrollment year dummies that control for any time-specific effect.

   An econometric challenge we faced was that the estimation of equations (1) and (2) was subject to the problem of restriction of range. The range is restricted because admission to the school is highly selective, and admitted students tend to have significantly higher average scores and a narrower range of scores than the larger examinee pool (Kobrin et al., 2008). With this problem, regression coefficients were estimated without bias, but the estimate of R^2 may be inconsistent. This problem is common in all previous studies that use data from a single university or institute. If

the CEE score is found to still predict college GPAs in Tsinghua data with a narrow range of scores, it would likely be more predictive in a larger dataset.

Second, we tested whether students with different admission status perform differently in college by estimating the following equation:

$$Y_i = \alpha + \beta X_i + \delta_1 recommendation-1_i + \delta_2 recommendation-2_i \\ + \delta_3 arts\_sports\_specialty_i + \gamma_t + \varepsilon_i \tag{3}$$

The entire sample of students was used to estimate equation (3). "*Recommendation-1*" is a dummy variable indicating whether a student was admitted by recommendation without the CEE score. "*Recommendation-2*" indicates whether a student passed university pre-CEE screening tests and was accepted with a lower CEE score. "*Arts_sports_speciality*" is another dummy variable that indicates whether a student was admitted with a lower CEE score owing to an arts or sports specialty. The remainder of the students who were admitted via the CEE exam with a standard admission score were omitted and used as a reference group.

5. Results

First, we estimated equation (1) with and without controls for personal characteristics X_i as the CEE scores may be correlated with X_i. For example, females may be likely to have a higher CEE score and also higher college GPA. The estimates are reported in Table 2. Even with restriction of range, the CEE scores predicted undergraduate GPAs for all four years. The coefficient estimate of the CEE score is slightly higher for the first 2 years, suggesting that the CEE score is a better predictor of the first 2 years' academic performance. As the CEE scores are converted to a 100-point scale, the coefficient estimates imply that a 1-point increase in the CEE total score is associated with a 0.17-0.25 point higher undergraduate GPA. If the CEE total score increases by 1 standard deviation from the mean,

freshman-year GPA would increase by 0.22 standard deviation.

After controlling for personal characteristics, the model's fitness (adjusted R^2) increased by 0.1, suggesting that personal characteristics add to the explanatory power of the model. But personal characteristics cannot explain all the correlation between CEE and college GPAs, as the estimates for CEE decreased a little in Columns (6)-(10) but are still significant.

Moreover, several individual characteristics are highly correlated with college performance. Females have higher undergraduate GPAs than males throughout the 4 years of study, and that this gender difference in academic performance becomes more pronounced in the later years. The first-time exam takers have significantly higher GPAs than re-takers. The liberal-art track students perform worse than science-engineering track students. Among the four majors under study, students in the finance major have a one-point higher GPA than the base group (economics major), and there is no significant difference between the other three majors. The other personal characteristics are not generally significant predictors of undergraduate GPAs, except that ethnic minorities have a 1-point lower freshman GPA.

In Table 3, we added CEE subject test scores into the regressions. Among the CEE subject tests, mathematics and foreign language test scores have a larger coefficient estimate than the Chinese test score, suggesting that mathematics and foreign language test scores are stronger predictors of college academic performance than the Chinese. This suggests that either the CEE Chinese test may not be a good test instrument or the Tsinghua curriculum does not require particular Chinese verbal skills.

To examine the predictive power of the CEE over time, we estimated equation (1)

using data for each entry class from 1995 to 2005. To save space, we only reported the coefficient estimate for the CEE score and adjusted R^2. As shown in Figure 1, the predictive power of the CEE notably declined after 1998. Prior to 1998, the model's adjusted R^2 was as high as 0.35–0.4, which was similar to the levels reported by Cohn et al. (2004) using the US data. After 1998, adjusted R^2 was generally smaller than 0.1. The magnitude of the coefficient estimate for the CEE score also dropped after 1998. This result raises concerns regarding the use of CEE scores as the only criterion for admission.

In Table 4, we further explore the predictive power of high school performance with respect to college GPAs. We added high school award levels and types into the regressions – the estimates are reported in Columns (1)-(5) and Columns (6)-(10), respectively. The results show that students who have won the national, province or lower level award all have significantly higher college GPAs than those who did not win an award in high school. Those who have won a higher level award performed slightly better than those with a lower level award, but the difference is insignificant based on F-test statistics. This finding supports the use of high school award as a criterion to select students while the level of award is not important.

With regard to the type of award, we found that students who won a science competition or were awarded an "outstanding student" title had a better academic performance in college than those without any award, but other types of awards did not predict college performance. Moreover, in the first two years, those winning a science competition had a better performance than those with an outstanding student title, but the performance in the last two years and overall performance were not different between these two types of students. These results provide some justification for admission policies that favor students who have won awards in high

school.

Finally, we examined whether students with different admission routes performed differently in college. We estimated equation (3) both with and without controls for *Xs*. The estimates are reported in Table 5. As can be seen from Columns (1) to (5), compared with the students entering school via the entrance exam with a regular admission score, students admitted by recommendation without CEE (*Recommendation-1*) had a higher GPA (by approximately 1 point) in the first two years as well as higher cumulative GPAs; those admitted with a lower CEE score due to an arts or sports specialty had a lower GPA by 5–6 points; those who passed university-administered tests and were admitted with a lower CEE score (*recommendation-2*) had a slightly higher GPA but the differences were insignificant. In Columns (6) to (10), after controlling for personal characteristics and high school awards, students admitted by recommendation still had significantly higher GPAs, while those admitted with a lower admission score because of an arts or sports specialty underperformed regularly admitted students by 5–6 points in undergraduate GPAs. This result indicates that although admitting students with an arts or sports specialty has some advantages, the school needs to carefully monitor the academic performance of these students.

6. Conclusions

The CEE is one of the most important exams in the academic life of Chinese students. Except for a very small number of students, the CEE score is the sole determinant of admission to a university. Despite the importance of the CEE, there have been no previous validity studies. In the absence of any empirical evidence, it is unclear whether the CEE score predicts a student's future academic performance in college. Our study contributes to the literature by investigating four empirical

questions concerning the predictive power of the CEE with respect to college performance.

The main findings of the study include the following. The CEE is a significant predictor of undergraduate GPAs for all 4 years. Among the CEE subject tests, the mathematics and foreign language tests scores showed a stronger correlation with college GPAs than the Chinese test score. Moreover, there is some evidence suggesting that the predictive power of the CEE has declined in recent years. In addition to the CEE, high school performance measured by whether the students received any award in high school and the level and types of award also significantly predict academic performance in college. Finally, students with differing admission routes earned different GPAs in college: those entering the school by recommendation without taking CEE ("*bao-song*") had a better academic performance than those who took the CEE test and were admitted with a regular admission score. In contrast, those with special arts or sports talents and a lower admission score had a significantly lower GPA.

These findings have some important implications for the admission policies and practices of universities. While the use of CEE scores as an admission criterion is a valid process for Chinese universities, they should also consider other information when making admission decisions, such as students' high school performance, including high school GPA and class ranks. As shown in our study, high school achievement, measured by student awards in high school, was a significant predictor of college GPAs for our student sample.

Moreover, the current practice of admitting students by recommendation with an exemption of CEE score has been proven to be effective – those admitted via recommendation appear to outperform students who had entered by the entrance

exam. On the other hand, while admitting students with an arts or sports talent may add to the diversity of the school's student body, these students had a considerably lower undergraduate GPA, which requires serious attention. The recent policy of accepting students with a lower CEE score, but who passed university pre-screening tests, is a good attempt but needs further investigation.
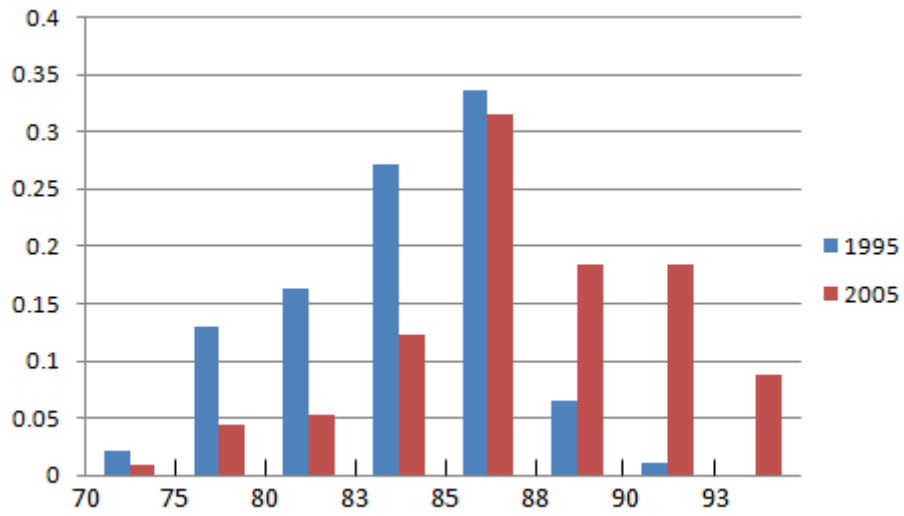
References

Avery, C., & Levin, J. (in press). Early admissions at selective colleges. *American Economic Review*.

Betts, J. R., Morrell, D. (1999). The determinants of undergraduate grade point average. *Journal of Human Resources*, 34(2), 268–293.

Cohn, E., Cohn, S., Balch, D. C., Bradley, J. (2004). The determinants of undergraduate grade point average. *Economics of Education Review*, 23(6), 577–586.

Cornwell, C. M., Mustard, D. B., & Van Parys, J. (2008). How does the new SAT predict academic achievement in college? University of Georgia working paper.

Davey, G., Lian, C.D., and Higgins, L. (2007). The university entrance examination system in China. *Journal of Further and Higher Education*, 31(4), 385-396.

Dickson, L. M. (2006). Does ending affirmative action in college admissions lower the percent of minority students applying to college? *Economics of Education Review*, 25(1), 109–119.

Ding, L., Li, H. (2011). Social networks and study abroad- The case of Chinese visiting students in the US. *China Economic Review*, in press.

Jensen, E.J., & Wu, S. (2010). Early Decision and College Performance. *Economics of Education Review*, 29(4), 517-525.

Kobrin, J.L., Patterson, B.F., Shaw, E.J., Mattern, K.D., & Barbuti, S.M. (2008). Validity of the SAT for predicting first-year college grade point average. College Board report No. 2008-5. New York: the College Board.

Li, T., Zhang, J. (2010). What determines employment opportunity for college graduates in China after higher education reform? *China Economic Review*, 21, 38-50.

Li, Y., Whalley, J., Zhang, S., & Zhao, X. (2008). The higher educational transformation of china and its global implications. NBER working paper 13849.

Liu, H., & Wu, Q. (2006). Consequences of college entrance exams in China and the reform challenges. *KEDI Journal of Education Policy*, 3(1), 7-21.

Ministry of Education (2010). Regulations for universities' admission of students by recommendation (In Chinese). Beijing, China: Ministry of Education.

Niu, S. X., Tienda, M., & Cortes, K. (2006). College selectivity and the Texas top 10% law. *Economics of Education Review*, 25(3), 259–272.

Robinson, M., & Monks, J. (2005). Making SAT scores optional in selective college admissions: a case study. *Economics of Education Review*, 24(4), 393–405.

Wang, X. B. (2006). An introduction to the system and culture of the College Entrance Examination of China. Research Notes RN-28, November 2006. New York: the College Board.

Figure 1 Distribution of CEE scores in 1995 and 2005

Note: the figure shows the proportion of students with scores in 70-75, 75-80, 80-83, 83-85, 85-88, 88-90, 90-93, and above 93, in 1995 and 2005, respectively.

Table 1 Variable definition and summary statistics

		Entire sample (Obs.=1436)		Admitted via CEE (Obs.=1264)	
	Variable Definition	Mean	Std. dev.	Mean	Std. Dev.
CEE	The total CEE score (0-750 points)			84.780	5.216
CEE_math	The CEE subject test score for mathematics (0-150 points)			87.034	8.210
CEE_chin	The CEE subject test score for Chinese (0-150 points)			77.107	7.332
CEE_lang	The CEE subject test score for Foreign language (0-150 points)			85.688	6.657
Arts_sports_specialty	The CEE exam takers admitted with a lower score due to an art or sports specialty			0.030	
First-time exam taker	=1 if a student is a first-time CEE taker, and 0 for re-takers			0.899	
Liberal-art track	=1 for liberal art track students			0.049	
Female	=1 for female students	0.501		0.503	
Minority	=1 for ethnic minority	0.058		0.059	
Age at enrollment	Age when entering the school	17.425	0.767	17.423	0.780
Urban	=1 for students from urban areas and 0 for those from rural areas	0.822		0.850	
MIS	=1 if academic major is management information system	0.243		0.234	
Finance	=1 if academic major is finance	0.228		0.229	
Accounting	=1 if academic major is accounting	0.381		0.387	
Economics	=1 if academic major is economics	0.148		0.150	
High school award	=1 if winning a national-level				
National level	science completion or awarded a province-level outstanding title	0.206		0.204	
Province and lower level	=1 if receiving a lower level award in high school	0.245		0.305	
High school award type					
Science competition	=1 if winning a science competition in high school (math., physics, chemistry, biology, or computer science)	0.189		0.160	
Outstanding student title	=1 if awarded "outstanding student" title in high school	0.269		0.284	
Other	=1 for other types of award in high school	0.048		0.043	
First year GPA	1st year undergraduate GPA	82.034	4.845	81.902	4.808
Second year GPA	2nd year undergraduate GPA	81.827	6.210	81.714	6.184
Third year GPA	3rd year undergraduate GPA	82.328	6.457	82.352	6.417
Cumulative GPA- core course	4-year cumulative GPA for core courses	82.346	5.142	82.279	5.065
Cumulative GPA- all courses	4-year cumulative GPA for all courses	82.182	5.333	82.120	5.296

Note: mean and standard deviation are reported for continuous variables; and the sample proportion is reported for dummy variables.

Table 2 Predictive power of CEE total score

	First year	Second year	Third year	Cumulative-core courses	Cumulative-all courses	First year	Second year	Third year	Cumulative-core courses	Cumulative - all courses
	Dependent variables: undergraduate GPAs									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CEE	0.258***	0.201***	0.170***	0.214***	0.190***	0.229***	0.190***	0.158***	0.196***	0.176***
	(0.024)	(0.031)	(0.032)	(0.026)	(0.026)	(0.024)	(0.030)	(0.032)	(0.026)	(0.026)
Female						1.477***	3.191***	3.119***	2.533***	2.635***
						(0.227)	(0.277)	(0.295)	(0.239)	(0.244)
Minority						-1.224**	-0.429	-0.452	-0.706	-0.640
						(0.470)	(0.575)	(0.613)	(0.496)	(0.508)
Age at enrollment						0.002	0.004	0.003	0.003	0.003
						(0.002)	(0.003)	(0.003)	(0.003)	(0.002)
Urban						-0.361	-0.376	-0.404	-0.301	-0.313
						(0.325)	(0.398)	(0.425)	(0.344)	(0.352)
First-time exam-taker						1.301**	2.009***	1.923***	1.488***	1.620***
						(0.507)	(0.621)	(0.662)	(0.536)	(0.549)
Liberal- art track						-3.889***	-3.122***	-1.964***	-2.753***	-2.509***
						(0.551)	(0.675)	(0.712)	(0.583)	(0.597)
Academic Major MIS						0.369	0.061	1.162**	0.598	0.536
						(0.385)	(0.471)	(0.502)	(0.407)	(0.416)
Finance						0.923**	0.858*	1.670***	1.319***	1.187***
						(0.398)	(0.463)	(0.494)	(0.400)	(0.410)
Accounting						0.216	-0.413	-0.425	-0.296	-0.363
						(0.345)	(0.423)	(0.451)	(0.365)	(0.374)
Year fixed effect	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	yes
Constant	58.891***	64.789***	67.979***	63.945***	65.858***	60.104***	63.324***	66.802***	63.774***	65.224***
	(2.141)	(2.748)	(2.844)	(2.350)	(2.375)	(2.236)	(2.738)	(2.987)	(2.416)	(2.420)
Observations	1264	1264	1264	1264	1264	1264	1264	1264	1264	1264
Adjusted R^2	0.168	0.142	0.150	0.117	0.140	0.233	0.239	0.241	0.217	0.234

Note: coefficient estimates are reported. Standard errors are in parentheses. *, **, and *** indicates the significance level at 10, 5, and 1percent, respectively. CEE score is converted to a 100-point scale. The base groups are male, Han-majority, students from rural areas, repeated exam-takers, science-engineering track, and economics major.

Table 3 Predictive power of CEE subject scores

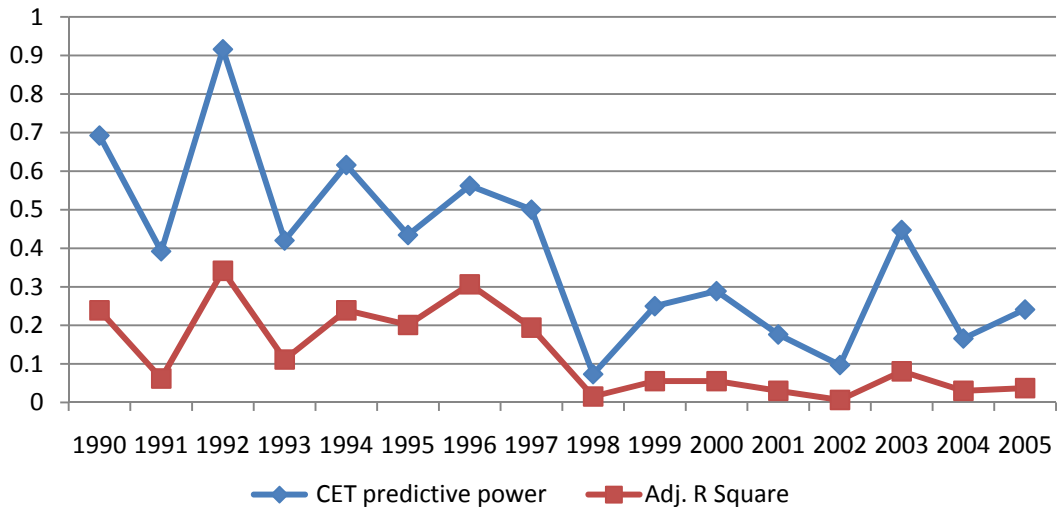|	Dependent variable: Undergraduate GPA				
	First year	Second year	Third year	Cumulative-core courses	Cumulative - all courses
	(1)	(2)	(3)	(4)	(5)
CEE_math	0.157***	0.128***	0.097***	0.129***	0.116***
	(0.015)	(0.019)	(0.020)	(0.016)	(0.016)
CEE_chin	0.004	0.030	0.015	0.011	0.015
	(0.019)	(0.023)	(0.025)	(0.020)	(0.020)
CEE_lang	0.175***	0.183***	0.199***	0.184***	0.177***
	(0.017)	(0.022)	(0.023)	(0.018)	(0.019)
Personal characteristics	Yes	yes	yes	yes	yes
Year fixed effect	Yes	yes	yes	yes	yes
Constant	51.361***	55.421***	56.361***	54.949***	56.633***
	(2.260)	(2.823)	(2.998)	(2.373)	(2.451)
Observations	1264	1264	1264	1264	1264
Adjusted R^2	0.308	0.290	0.285	0.287	0.294

Note: coefficient estimates are reported. Standard errors are in parentheses. *, **, and *** indicates the significance level at 10, 5, and 1percent, respectively. CEE, CEE_math, CEE_chin, and CEE_lang are all converted to a 100-point scale. Undergraduate GPAs are also in a 100-point scale. Regressions include control for personal characteristics and year dummies. Personal characteristic variables are female, minority, age at enrollment, urban, first-time exam taker, liberal-art track, and academic majors.

Figure 2 Predictive power of CEE total score for different years

Notes: The figure shows the coefficient estimate of CEE total score and adjusted R^2 of the model for each year.

Table 4 CEE, high school performance and undergraduate GPAs

	Dependent variable: Undergraduate GPA									
	First year	Second year	Third year	Cumulative-core courses	Cumulative - all courses	First year	Second year	Third year	Cumulative-core courses	Cumulative - all courses
	(1)	(2)	(3)	(4)	(5)					
CEE	0.208***	0.176***	0.142***	0.179***	0.160***	0.206***	0.175***	0.145***	0.180***	0.161***
	(0.024)	(0.030)	(0.032)	(0.026)	(0.026)	(0.024)	(0.030)	(0.032)	(0.026)	(0.026)
High school award level										
National	1.179***	0.926**	1.049***	0.992***	0.962***					
	(0.294)	(0.362)	(0.386)	(0.312)	(0.320)					
Province and lower	1.084***	0.783**	0.819**	0.882***	0.938***					
	(0.002)	(0.347)	(0.369)	(0.299)	(0.306)					
High school award type										
Science competition						1.356***	1.079***	0.708*	0.878***	0.907***
						(0.317)	(0.391)	(0.416)	(0.337)	(0.345)
Outstanding student title						0.805***	0.526*	0.856**	0.743***	0.765***
						(0.252)	(0.311)	(0.332)	(0.268)	(0.275)
Other						0.286	0.179	0.256	0.057	0.047
						(0.554)	(0.683)	(0.728)	(0.589)	(0.603)
Personal characteristics	Yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes
Year fixed effect	Yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes
Constant	63.944***	64.406***	66.891***	65.701***	65.768***	64.150***	64.523***	66.688***	65.676***	65.809***
	(3.617)	(4.454)	(4.745)	(3.837)	(3.930)	(3.608)	(4.448)	(4.740)	(3.833)	(3.925)
Observations	1264	1264	1264	1264	1264	1264	1264	1264	1264	1264
Adjusted R^2	0.244	0.241	0.244	0.223	0.240	0.247	0.242	0.244	0.223	0.240

Note: coefficient estimates are reported. Standard errors are in parentheses. *, **, and *** indicates the significance level at 10, 5, and 1percent, respectively. CEE and undergraduate GPAs are in a 100-point scale. Regressions include control for personal characteristics and year dummies. Personal characteristic variables are female, minority, age at enrollment, urban, first-time exam taker, liberal-art track, and academic majors. The base group is those who did not receive any award in high school.

Table 5 Admission routes and undergraduate GPAs

	Dependent variables: Undergraduate GPAs									
	First year	Second year	Third year	Cumulative-core courses	Cumulative-all courses	First year	Second year	Third year	Cumulative-core courses	Cumulative-all courses
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Recommendation-1	1.166***	1.084**	0.554	0.887**	0.946**	0.986***	0.936**	0.454	0.714*	0.794**
	(0.342)	(0.434)	(0.451)	(0.372)	(0.377)	(0.353)	(0.433)	(0.461)	(0.376)	(0.383)
Recommendation-2	0.452	0.541	0.572	0.477	0.615	0.370	0.322	0.353	0.299	0.432
	(0.412)	(0.522)	(0.543)	(0.448)	(0.454)	(0.394)	(0.482)	(0.516)	(0.421)	(0.427)
Arts_sports_specialty	-5.854***	-4.767***	-4.326***	-5.002***	-4.524***	-5.535***	-4.673***	-4.096***	-4.771***	-4.335***
	(0.666)	(0.844)	(0.877)	(0.724)	(0.734)	(0.646)	(0.792)	(0.843)	(0.724)	(0.701)
Personal characteristics						Yes	yes	yes	yes	yes
Year fixed effect	Yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes
Constant	79.895***	81.099***	81.503***	81.267***	81.207***	79.145***	79.229***	79.029***	79.396***	79.344***
	(0.880)	(1.115)	(1.160)	(0.957)	(0.970)	(1.028)	(1.259)	(1.341)	(1.099)	(1.115)
Observations	1436	1436	1436	1436	1436	1436	1436	1436	1436	1436
Adjusted R^2	0.139	0.130	0.134	0.092	0.119	0.216	0.222	0.227	0.195	0.216

Note: Recommendation-1 refers to students who enter the school by recommendation without taking CEE; Recommendation-2 are those who enter the school by recommendation but have taken CEE and were admitted with a 10-20 point lower score . Arts_sports_specialty are those admitted with a lower score due to art and sports talent. Coefficient estimates are reported. Standard errors are in parentheses. *, **, and *** indicates the significance level at 10, 5, and 1percent, respectively. CEE and undergraduate GPAs are in a 100-point scale. Regressions include control for personal characteristics and year dummies. Personal characteristic variables are female, minority, age at enrollment, urban, first-time exam taker, liberal-art track, and academic majors.