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April 2011

Online at https://mpra.ub.uni-muenchen.de/31240/
MPRA Paper No. 31240, posted 02 Jun 2011 15:16 UTC

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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.

JEL classification: I21; I23

Keywords: Undergraduate GPA; Student Attributes; 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. 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?

Compared with the limited literature on CEE, there are many empirical studies examining the link WChi-389 between Scholastic Aptitude Test (SAT) scores, high school performance, and college academic success in the United States. Betts and Morell (1999), Cohn, Cohn, Balch, and Bradley (2004), and Cornwell, Lee, and Mustard (2005) have all found SAT scores to be significant predictors of college GPAs. In contrast, Barron and Normal (1992) found that SAT scores made a relatively small contribution to the prediction of college GPAs once high school class rank and achievement-test scores are controlled for. Rothstein (2004) showed that although SAT scores predict freshmen GPAs, they had a high correlation with high school demographic variables, and the predictive power of SAT scores was smaller than that implied using the usual methods. Betts and Morell (1999) showed that personal background and high school resources added an explanatory power to predicting college performance after controlling for SAT scores and high school GPAs.

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 (Cornwell, Mustard, and Van Parys, 2008; Kobrin, Patterson, Shaw, Mattern, and Barbuti, 2008). Moreover, 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.

Although there have been many studies regarding the predictive power of SATs in the United States, empirical research on the CEE exam would still be of some

benefit to Western educators for two reasons: (1) the CEE is a different scholastic ability test from the SAT. A detailed description of CEE is provided in Section 2. 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. (2) 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 provides an overview of the CEE and college admission policies in China. Section 3 presents the methodology, including the data and empirical model used in the study. Section 4 reports the empirical results. Section 5 summarizes the results and concludes the paper.

2. CEE and College Admission in China

2.1 The CEE exam

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 in China's 22 provinces, 3 municipalities (Beijing, Tianjin, and Chongqing), and 5 autonomous regions—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).

A perfect CEE score is 750 points, with 150 points for each mandatory subject test and 300 points for the "X" component. In 2010, 382 of the 1.5 million SAT-takers obtained a perfect score (2,400 points) on the SAT composite (critical reading + mathematics + reading) (College Board, 2010). Compared with SATs, it is nearly impossible to obtain a perfect CEE score. In 2010, the highest score among students of the science–engineering and the liberal arts tracks in Beijing were 703 and 675, respectively. Other provinces also obtained similar high scores. Not a single student in China achieved a perfect CEE score.[2]

2.2 College admission in China

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

[2] Information on CEE scores was obtained from gaokao.eol.cn.

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.[3]

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

[3] 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.

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).

Finally, 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 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.[4] It is generally the more prestigious universities that are given a larger admission quota for recommended students.

3. Methodology

3.1 Data

We obtained the administrative records of students who entered the School of Economics and Management (SEM), 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

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

first-time test-taker or re-taker, and whether the student was accepted with a lower test score due to an arts or sports specialty.

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, Whalley, Zhang, and Zhao, 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. The winners of the provincial-level "outstanding student" title or national competitions in mathematics and science are exempt from the CEE and may be recommended to a university.

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. At the School of Economics and Management, Tsinghua University, as with other economic and management schools in China, the curriculum for the first 2 years consists of mandatory courses for all the business and economics majors, including college calculus, linear algebra, statistics, and principles of economics. During the first 2 years, the students all take similar courses. 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 BA degree in business or economics.

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. The average CEE score was 637, which is significantly higher than the national average and the average CEE of other first-tier universities. Tsinghua is ranked among the best universities in China; it was ranked first in the Chinese university ranking for 2007–2010, and second by China's Education Center in 2008–2010.[5] In 2010, Tsinghua was ranked 54th worldwide and second in mainland China by *US News and World Report*'s World's Best Universities ranking.[6] Admission to Tsinghua is very competitive. Economics and management are two of most popular majors in Tsinghua. Therefore, the minimum score required for admission to the school is

[5] Chinese university rankings are conducted by China Academy of Management, available at http://edu.sina.com.cn/focus/utop.html; the China Education Center's ranking is available at http://www.chinaeducenter.com/en/universityranking1.ph

[6] World's Best Universities: US News and World Report, available at http://www.usnews.com/articles/education/worlds-best-universities/2010/09/21/worlds-best-universities-top-400-.html.

among the highest in the country. For example, in 2009, the average score of science–engineering track students admitted into the School was 653, 152 points higher than the minimum admission score required by other first-tier universities in the nation.[7]

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; and 43% had won awards in high school. 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 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.

3.2 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:

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

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

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*, *urban*, *first-time exam-taker*, and *any award*. "*Any award"* is an indicator of high school performance

[7] Data source: gaokao.eol.cn

and expected to predict undergraduate GPAs. 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. To test whether the predictive validity of the CEE had declined or increased over time, we estimated equation (1) for each entry class from 1995 to 2005.

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, Patterson, Shaw, Mattern, and Barbuti, 2008). Because of this restriction of range, the estimate of R^2 may be inconsistent, although regression coefficients were estimated without bias. To correct for restriction of range, a population variance–covariance matrix was used in place of the within-sample variance–covariance matrix in the calculation of R^2 (Rothstein, 2004). As the data of population variance–covariance matrix for the CEE examinees were not available, we were unable to calculate the corrected R^2. Thus, we will need to be cautious in generalizing the results for all the examinees. This problem is common in studies that use data from a single university or institute.

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

$$Y_i = \alpha + \beta X_i + \delta_1 recommendation_i + \delta_2 arts\_sports\_specialty_i + \varepsilon_i \qquad (3)$$

Analogous to equations (1) and (2), Y_i indicates the undergraduate GPA and X_i the vector of predictors of college GPAs. The entire sample of students was used to estimate equation (3). "*Recommendation*" is a dummy variable indicating whether a

student was admitted by recommendation without the 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.

4. Results

First, we estimated equation (1) without the CEE scores as the CEE scores may be correlated with personal characteristics X_i. For example, females may be likely to have a higher CEE score and also higher college GPA. The results are reported in Table 2. Columns (1) to (5) document the estimates for personal characteristics, and columns (6) to (10) include the high school performance indicator into the estimation, i.e., whether a student received any award in high school. The results suggest that 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 other personal characteristics are not generally significant predictors of undergraduate GPAs, except that ethnic minorities have a 1-point lower freshman GPA. However, this effect is only marginally significant. In addition, whether a student received any award in high school significantly predicts undergraduate GPAs, especially in the freshman year. Even though this measure of high school performance is not as accurate as high school GPAs, it still has significant explanatory power in college performance. Finally, Table 2 shows that the models including only personal characteristics demonstrated a very modest predictive power (R^2 ranges from 0.025 to 0.082). After the high school award is added into the models, R^2 increased slightly by 0.01–0.02.

In Table 3, we added CEE total scores and subject test scores into the

regressions—the estimates are reported in Columns (1) to (5) and Columns (6) to (10), respectively. Even with restriction of range, the CEE scores predicted undergraduate GPAs for all four years. As the CEE scores are converted to a 100-point scale, the coefficient estimates for the CEE imply that a 1-point increase in the CEE total score is associated with a 0.25–0.29-point higher undergraduate GPA. 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.

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 SEM curriculum does not require particular Chinese verbal skills.[8] Moreover, by comparing the corresponding entries in Tables 2 and 3, it can be seen that the incremental contribution of the CEE to R^2 ranges from 0.06 to 0.16, and is largest for the freshmen year. This result is comparable to the findings regarding SATs. Jensen and Wu (2010) showed that the SAT verbal and math scores had a greater contribution to first-year GPA than the 4-year cumulative GPAs.

After including the control for CEE scores, *female* and *any award* still have a significant effect on undergraduate GPAs, although compared with the corresponding values in Table 2, the magnitude of the estimates has somewhat decreased. This result suggests that the predictive power of gender and high school awards cannot be entirely explained by these students having a higher CEE score.

[8] At Tsinghua SEM, 90% of undergraduate courses are offered in English to create a more internationalized school.

Specifically, in the freshmen year, the GPA for female students was 1 point higher than that of male students with all else controlled for. In contrast, in the second and third years, females' GPAs were approximately 3 points higher, and with regard to the 4-year cumulative GPAs for core courses and total courses, females had a GPA approximately 2.2–2.8 points higher than male students. Students who received an award in high school outperformed those who did not by approximately 1 point in undergraduate GPAs throughout all 4 years in college.

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, R^2, and the number of observations for the regression (Table 4). As shown in Table 4, the predictive power of the CEE notably declined after 1998. Prior to 1998, the model's 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, R^2 was generally smaller than 0.2, and only in one year was it greater than 0.2. 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.

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 had a higher freshmen year GPA (by approximately 1 point). Those admitted with a lower CEE score due to an arts or sports specialty had a lower GPA by 5–6 points. In Columns (6) to (10), after controlling for personal characteristics and high school awards,

students admitted by recommendation no longer had a significantly higher freshman year GPA, while those admitted with a lower admission score because of an arts or sports specialty still 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.

5. 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 also significantly predicts academic performance in college. Finally, students with differing admission routes earned different GPAs in college: those entering the school by recommendation had a similar academic performance to 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 practices of admitting students by recommendation or by favoring students with an arts or sports talent have not been proven to be particularly effective. For example, those admitted via recommendation did not appear to outperform students who had entered by the entrance exam; and while admitting students with an arts or sports talents may add to the diversity of the school's student body, these students had a considerably lower undergraduate GPA. Based on these findings, we recommend that universities should explore alternative admission practices to select quality students.

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Table 1 Variable definition and summary statistics

		Entire sample (Obs.=1436)		Admitted via CEE (Obs.=1264)		Admitted via recommendation (Obs.=172)	
	Variable Definition	Mean	Standard deviation	Mean	Standard deviati the on	Mean	Standard deviation
CEE	The total CEE score (0-750 points)			636.931	40.881		
CEE_math	The CEE subject test score for mathematics (0-150 points)			130.167	12.416		
CEE_chin	The CEE subject test score for Chinese (0-150 points)			116.606	10.767		
CEE_lang the	The CEE subject test score for Foreign language (0-150 points)			128.639	10.210		
Arts_sports_specialty	The CEE exam takers admitted with a lower score due to an art or sports specialty			0.030	0.173		
First-time exam taker	=1 if a student is a first-time CEE taker, and 0 for re-takers			0.899	0.301		
Any award	=1 if a student received any award in high school and 0 otherwise.	0.449	0.498	0.432	0.496		
Female	=1 for female students	0.501	0.500	0.503	0.500	0.488	0.501
Minority	=1 for ethnic minority	0.058	0.233	0.059	0.235	0.052	0.223
Urban	=1 for students from urban areas and 0 for those from rural areas	0.822	0.382	0.850	0.357	0.616	0.488
First year GPA	1st year undergraduate GPA	82.034	4.845	81.902	4.808	83.009	5.016
Second year GPA	2nd year undergraduate GPA	81.827	6.210	81.714	6.184	82.658	6.351
Third year GPA	3rd year undergraduate GPA	82.328	6.457	82.352	6.417	82.156	6.759
Cumulative GPA- core course	4-year cumulative GPA for core courses	82.346	5.142	82.279	5.065	82.839	5.675
Cumulative GPA- all courses	4-year cumulative GPA for all courses	82.182	5.333	82.120	5.296	82.638	5.591

Table 2 Personal characteristics, high school performance, 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)
Female	1.465***	3.547***	3.467***	2.629***	2.850***	1.441***	3.525***	3.445***	2.608***	2.830***
	(0.270)	(0.337)	(0.352)	(0.279)	(0.291)	(0.268)	(0.336)	(0.351)	(0.277)	(0.289)
Minority	-1.054*	-0.533	-0.409	-0.649	-0.594	-1.023*	-0.505	-0.382	-0.623	-0.568
	(0.570)	(0.712)	(0.743)	(0.588)	(0.613)	(0.564)	(0.708)	(0.739)	(0.583)	(0.609)
Urban	-0.596	0.371	-0.633	-0.471	-0.478	-0.511	-0.297	-0.558	-0.398	-0.407
	(0.383)	(0.478)	(0.498)	(0.394)	(0.411)	(0.379)	(0.476)	(0.497)	(0.392)	(0.409)
First-time	-0.030	0.781	0.034	0.272	0.212	-0.446	0.415	-0.333	-0.090	-0.138
exam-taker	(0.545)	(0.681)	(0.711)	(0.562)	(0.586)	(0.545)	(0.685)	(0.715)	(0.564)	(0.589)
Any award						1.422***	1.250***	1.254***	1.235***	1.198***
						(0.270)	(0.339)	(0.354)	(0.279)	(0.292)
Constant	81.761***	79.547***	81.137***	81.141***	80.929***	81.474***	79.295***	80.884***	80.892***	80.687***
	(0.588)	(0.734)	(0.766)	(0.606)	(0.632)	(0.585)	(0.734)	(0.766)	(0.605)	(0.631)
Observations	1264	1264	1264	1264	1264	1264	1264	1264	1264	1264
R^2	0.025	0.082	0.072	0.067	0.072	0.047	0.092	0.081	0.081	0.084

Notes: Standard errors are in parentheses. * Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

Table 3 CEE scores 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)
CEE	0.284***	0.292***	0.267***	0.248***	0.255***					
	(0.023)	(0.030)	(0.031)	(0.025)	(0.026)					
CEE_math						0.150***	0.126***	0.092***	0.114***	0.110***
						(0.016)	(0.020)	(0.021)	(0.016)	(0.017)
CEE_chin						0.025	0.068***	0.119***	0.044**	0.067***
						(0.018)	(0.023)	(0.024)	(0.019)	(0.020)
CEE_lang						0.172***	0.204***	0.204***	0.184***	0.183***
						(0.019)	(0.025)	(0.026)	(0.020)	(0.021)
Female	1.361***	3.444***	3.371***	2.538***	2.758***	1.150***	3.011***	2.820***	2.165***	2.351***
	(0.253)	(0.324)	(0.341)	(0.266)	(0.278)	(0.252)	(0.325)	(0.342)	(0.264)	(0.277)
Minority	-0.944*	-0.424	-0.308	-0.554	-0.497	-0.340	-0.019	-0.058	0.003	-0.024
	(0.534)	(0.683)	(0.719)	(0.561)	(0.587)	(0.537)	(0.692)	(0.728)	(0.561)	(0.590)
Urban	-0.050	0.177	-0.125	0.004	0.007	-0.020	0.228	-0.047	0.047	0.044
	(0.360)	(0.461)	(0.486)	(0.379)	(0.396)	(0.358)	(0.462)	(0.485)	(0.374)	(0.393)
First-time exam-taker	0.068	0.944	0.150	0.359	0.323	-0.236	0.804	0.121	0.079	0.113
	(0.518)	(0.662)	(.698)	(0.544)	(0.569)	(0.509)	(0.656)	(0.690)	(0.532)	(0.559)
Any award	1.108***	0.927***	0.959***	0.961***	0.916***	1.211***	1.082***	1.159***	1.103***	1.083***
	(0.257)	(0.329)	(0.346)	(0.270)	(0.282)	(0.252)	(0.325)	(0.342)	(0.264)	(0.277)
Constant	56.666***	53.775***	57.564***	59.249***	58.377***	51.273***	45.101***	45.565***	51.470***	45.798***
	(2.111)	(2.700)	(2.845)	(2.220)	(2.320)	(2.172)	(2.801)	(2.945)	(2.271)	(2.387)
Observations	1264	1264	1264	1264	1264	1264	1264	1264	1264	1264
R^2	0.147	0.156	0.131	0.150	0.151	0.209	0.202	0.184	0.211	0.207

Notes: 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. Standard errors are in parentheses. * Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

Table 4 Predictive power of CEE for different years

Dependent variable: Undergraduate GPAs					
Explanatory variable: CEE score	First year	Second year	Third year	Cumulative-core courses	Cumulative-all courses
	(1)	(2)	(3)	(4)	(5)
1995	0.381***	0.432***	0.416***	0.380***	0.356***
	(0.085)	(0.105)	(0.106)	(0.096)	(0.094)
	R^2=0.347	R^2=0.352	R^2=0.282	R^2=0.318	R^2=0.303
	N=93	N=93	N=93	N=93	N=93
1996	0.535***	0.631***	0.630***	0.636***	0.588***
	(0.093)	(0.137)	(0.192)	(0.124)	(0.148)
	R^2=0.401	R^2=0.370	R^2=0.208	R^2=0.365	R^2=0.289
	N=83	N=83	N=83	N=83	N=83
1997	0.521***	0.339***	0.410***	0.419***	0.393***
	(0.091)	(0.118)	(0.139)	(0.091)	(0.101)
	R^2=0.359	R^2=0.338	R^2=0.238	R^2=0.348	R^2=0.312
	N=111	N=111	N=111	N=111	N=111
1998	0.073	0.072	0.087	0.089	0.082
	(0.047)	(0.074)	(0.077)	(0.061)	(0.060)
	R^2=0.063	R^2=0.122	R^2=0.094	R^2=0.098	R^2=0.102
	N=107	N=107	N=107	N=107	N=107
1999	0.276***	0.268*	0.071	0.201**	0.164
	(0.089)	(0.139)	(0.115)	(0.099)	(0.101)
	R^2=0.148	R^2=0.185	R^2=0.171	R^2=0.155	R^2=0.182
	N=135	N=135	N=135	N=135	N=135
2000	0.180*	0.082	0.212**	0.150*	0.151*
	(0.099)	(0.108)	(0.093)	(0.088)	(0.089)
	R^2=0.203	R^2=0.113	R^2=0.222	R^2=0.191	R^2=0.189
	N=124	N=124	N=124	N=124	N=124
2001	0.202***	0.204**	0.188*	0.208***	0.168**
	(0.076)	(0.090)	(0.108)	(0.076)	(0.081)
	R^2=0.106	R^2=0.139	R^2=0.092	R^2=0.151	R^2=0.132
	N=141	N=141	N=141	N=141	N=141
2002	0.102	-0.020	-0.061	-0.002	-0.022
	(0.072)	(0.108)	(0.110)	(0.086)	(0.089)
	R^2=0.090	R^2=0.089	R^2=0.093	R^2=0.096	R^2=0.088
	N=120	N=120	N=120	N=120	N=120
2003	0.392***	0.372**	0.157	0.340**	0.302**
	(0.130)	(0.142)	(0.130)	(0.133)	(0.125)
	R^2=0.229	R^2=0.226	R^2=0.215	R^2=0.236	R^2=0.237
	N=114	N=114	N=114	N=114	N=114
2004	0.173**	0.102	-0.100	0.062	0.056
	(0.078)	(0.079)	(0.075)	(0.076)	(0.070)
	R^2=0.082	R^2=0.059	R^2=0.104	R^2=0.058	R^2=0.056
	N=122	N=122	N=122	N=122	N=122
2005	0.246***	0.141	0.045	0.137	0.106
	(0.105)	(0.123)	(0.140)	(0.121)	(0.122)
	R^2=0.092	R^2=0.064	R^2=0.083	R^2=0.069	R^2=0.064
	N=114	N=114	N=114	N=114	N=114

Notes: in each cell, we report the coefficient and standard error estimates for the CEE, and R^2 and the number of observations (N) for the regression of CEE total score on undergraduate GPAs using data for each year. The regression models also control for individual characteristics including female, minority, urban, first-time exam-taker, and any award. The CEE score and undergraduate GPAs have been converted to a 100-point scale. Standard errors are in parentheses.

* Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

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	0.907**	0.765	-0.358	0.389	0.354	0.483	0.428	-0.676	0.045	-0.087
	(0.384)	(0.499)	(0.522)	(0.412)	(0.429)	(0.401)	(0.508)	(0.532)	(0.422)	(0.437)
Arts_sports_specialty	-6.507***	-5.789***	-5.241***	-5.548***	-5.307***	-6.252***	-5.732***	-5.068***	-5.440***	-5.178***
	(0.767)	(0.998)	(1.042)	(0.824)	(0.856)	(0.761)	(0.963)	(1.010)	(0.800)	(0.829)
Female						1.313***	3.438***	3.323***	2.549***	2.750***
						(0.247)	(0.313)	(0.328)	(0.260)	(0.270)
Minority						-1.023*	-0.691	-0.786	-0.821	-0.745
						(0.525)	(0.665)	(0.697)	(0.552)	(0.573)
Urban						-0.496	-0.507	-0.764	-0.464	-0.558
						(0.354)	(0.448)	(0.470)	(0.372)	(0.386)
First-time exam-taker						-0.565	-0.280	-1.009*	-0.367	-0.625
						(0.459)	(0.581)	(0.609)	(0.483)	(0.500)
Any award						1.127***	1.276***	1.335***	1.136***	1.160***
						(0.250)	(0.316)	(0.331)	(0.263)	(0.272)
Constant	82.102***	81.893***	82.513***	82.450***	82.283***	81.957***	80.344***	81.897***	81.459***	81.497***
	(0.135)	(0.175)	(0.183)	(0.145)	(0.150)	(0.468)	(0.592)	(0.621)	(0.492)	(0.510)
Observations	1436	1436	1436	1436	1436	1436	1436	1436	1436	1436
R^2	0.053	0.025	0.017	0.032	0.027	0.089	0.112	0.096	0.106	0.106

Notes: Standard errors are in parentheses. * Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.