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MINORITIES IN EASTERN EUROPE[†]

Gender Gap in Performance under Competitive Pressure: Admissions to Czech Universities

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Uri Gneezy, Muriel Niederle, and Aldo Rustichini (2003) presented experimental evidence suggesting that women are less effective than men in competitive environments, even if they perform similarly well in noncompetitive settings. Such gender performance gaps under competition could help explain the near absence of women from top-level managerial positions, which are awarded in repeated tournaments. Field data are now being used to test for the presence of such gaps. In particular, the competitive nature of the education process offers several testing opportunities, as illustrated by, e.g., Joseph Price (2008). In educational psychology studies, women tend to report higher levels of exam anxiety (see, e.g., Douglas A. Bors, Francois Vigneau, and Antonia Kronlund, 2006). Muriel Niederle and Lise Vesterlund (2010) suggest that the large gender gap in mathematics performance may in part be explained by the differential manner in which men and women respond to competitive test-taking environments. Evren Örs, Frederic Palomino, and Eloic Peyrache (2008) study the performance of applicants to a top-ranked French business school. They show that within this group, women outperform their male colleagues in noncompetitive comprehensive tests but lag behind men in the highly competitive school admission process.

In this paper, we perform a similar analysis. Instead of analyzing the admission process to one very selective school, we study the experience of an entire cohort of Czech secondary-school graduates applying to all available universities. We observe test scores from a 1999 pilot run of a national comprehensive examination conducted shortly before the university admission process. The 1999 test was used to evaluate schools but had no impact on individual student grades in secondary schools or on university admissions. For all tested students, we see which universities they apply to, together with the admission decision. Similar to Örs, Palomino, and Peyrache (2008), we can therefore compare the admission chances at a given university of men and women with similar test scores in the noncompetitive national test. Unlike the existing research, we can also compare the performance of women and men with similar test scores under a varying degree of competition—in university admissions characterized by a varying oversubscription rate. For students applying to several universities we can also control for their unobservable ability using a person fixed effect.

The Czech university admission system provides a useful framework for the study of gender performance gaps under competitive stress. At 12 percent, the country has one of the lowest tertiary attainment rates in the OECD (OECD 2004). Tuition-free public universities provide the bulk of tertiary education, and they tend to reject about a half of applicants each year. Looking across the 116 university faculties that our data distinguish, the school-specific fraction of applications admitted (the degree of competition) varies substantially around the mean of 0.34 (with a standard deviation of 0.21).

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We compare admission performance of men and women with similar scores in comprehensive, noncompetitive tests, but students' subject-specific and university-specific skills remain unobservable to us. In the presence of gender preferences for certain subjects of study, women (men) applying to highly "male" ("female") university programs are likely to have unusually strong program-specific skills, particularly so if they apply to very selective programs. Such selection on unobservables may therefore obscure our measurement of competition performance gaps among equally qualified applicants. We minimize the influence of gender differences in program-specific unobservables by focusing on gender-balanced pools of applicants, and we also compare the performance of men and women who wish to study the same subject (field), i.e., we control for subject-of-study preferences. In a subset of our analysis, we fully control for individual subject-specific ability using a person fixed effect. This is possible for the subset of applications where a student applies to several university programs of the same subject-of-study type that differ in their admission probability.

Unfortunately, we do not know which universities grade their entrance exams anonymously, which prevents us from effectively disentangling gender differences in performance under competitive pressure from gender discrimination in grading proportional to excess demand as the source of the observed gender admission gaps. However, our estimates change little when we focus on gender-balanced pools of applicants where gender stereotyping in admission may be expected to be unimportant. Furthermore, the magnitude of our estimates is in line with the effect Örs, Palomino, and Peyrache (2008) estimate using one university program where they know grading is anonymous, i.e., discrimination-free.

I. The Czech Education System and Our Data

We work with student test scores from a school-leaving comprehensive examination, "Maturita" in Czech, which is a prerequisite for tertiary education. "Maturita" approximately corresponds to the UK General Certificate of Secondary Education or the German "Abitur." These exams are administered at the end of four-year secondary programs and are prepared by each school individually based on national guidelines. In 1999, however, the first (and so far the last) *national* "Maturita" exam was administered on top of the school-specific exams. This test was held simultaneously in all schools, independently of the school's own examinations, and the results were processed centrally.

The 1999 pilot national exam covered all "Maturita" students, i.e., approximately 60 percent of the entire cohort of 18-year-olds:[1] over 100,000 students in 1,642 schools. We observe standardized test scores (on a 0 to 100 scale) corresponding to the students' mathematics skills and their command of native Czech. The tested students come from two types of Czech secondary four-year programs: vocational and academic.[2]

A subset of the students graduating with the "Maturita" exam in 1999 applied to universities in the same year. We have merged the "Maturita" test scores of these 41,486 students with the 1999 administrative register of applications to Czech universities.[3] On average, they submit about three university applications, resulting in a total of 116,479 applications to 116 distinct faculties of Czech universities. Of all "Maturita" students, 55 percent are women. This changes little, to 53 percent, when we focus on the subset of university applicants. The average number of applications submitted by female and male applicants is also very similar.

In Table 1 we present the "Maturita" noncompetitive test scores from mathematics and Czech language for university applicants. The table supports the typical ordering of study achievement with academic programs outperforming the vocational ones, even conditional on applying to a university program. Students graduating from academic programs also have much higher chances of being admitted to universities. The observed gender differences in average performance within school types are near universal, as recently documented by Luigi Guiso et al. (2008).

[1] The remaining 40 percent is in apprenticeship programs, which do not lead to the "Maturita" exam. In terms of the OECD classification of education levels, the apprenticeship programs without "Maturita" correspond to the International Standard Classification of Education (ISCED) 2 level. Secondary-school education with "Maturita" corresponds to ISCED 3A.

[2] Vocational programs typically provide specialized training in, for example, construction or nursing.

[3] All of the universities are public and tuition free. Enrollment in private colleges emerged only after 1999.

Table 1—Mean Test Scores of University Applicants

School type	Academic		Vocational	
Test score	Men	Women	Men	Women
Math	51.0	44.4	35.9	26.5
	(15.5)	(15.8)	(16.1)	(14.6)
Czech	73.7	75.3	60.4	64.0
	(11.6)	(11.4)	(11.9)	(12.0)
Pct. women	57		50	
Observations	17,637		23,849	

Note: Standard deviations in parentheses.

We analyze the admission performance of university applicants who have graduated from secondary programs in 1999 for whom we have available "Maturita" test scores and omit applicants who have completed secondary education before 1999. Applications by "fresh" 1999 secondary-school graduates constitute 55 percent of all applications and 61 percent of university admissions in 1999. However, we use all applicants, "fresh" as well as "old," to measure the degree of competition, i.e., the admission rate of university programs. Each university program selects its students in a separate competition, almost always using a program-specific written admission exam. There are strict quotas on total enrollment at each university faculty set by the Ministry of Education, resulting in an average overall admission rate of 0.29.

The gender composition of the pool of applicants varies widely across the 116 university faculties (with a standard deviation of 0.24). We consider a program to be "gender balanced" in terms of its pool of applicants if the share of women is between the twenty-fifth and seventy-fifth percentile of the school-specific distribution of applicants' "femaleness"; this confines our analysis to schools where the "femaleness" of applicants ranges from 40 to 69 percent. The average admission rate in this "balanced" subset of schools is similar (at 0.32) to the overall admission rate.

II. College Admissions

We ask whether women perform worse in university admissions compared to men of similar ability, as measured by "Maturita" test scores, and of similar secondary-school quality, as measured by school average university admission rate. To ascertain how such gender performance gap depends on the degree of competition (the university admission rate), we group the application data by the quartile of the university admission rate distribution and estimate least-squares admission regressions within each group.[4] To assess potential biases from selection on unobservable skills or gender stereotyping in admission-exam grading, we compare results based on all applications to those estimated off of applications to "gender-balanced" university programs (see Section I for definition). To find out whether gender gaps in performance are present in different parts of the ability distribution, we also separately estimate the admission regressions for the most and least able applicants.

Table 2 lists least-squares female-dummy coefficients from admission regressions conditioning on both the Czech and the math "Maturita" test score, the secondary-school type, the average success rate of students from a given secondary school in admissions, and a full set of dummy variables for the subject-of-study of university programs.[5] There are large and statistically significant gender gaps in favor of male admission for university programs with low admission rates, i.e., for very competitive programs. The negative gender gap of about 3 to 4 percentage points that we estimate for the most competitive college admissions, based on both all applications (in column 1) and only on those to "gender-balanced" programs (in column 2), suggests that women are significantly disadvantaged in their access to selective schools. In order to compensate for this gender admission gap, a female applicant would have to improve her "Maturita" math test score by one standard deviation. The small difference between results based on all applications and those based on only "gender-balanced" programs suggests that the effect of selection based on unobservable ability differences is small or balanced with respect to highly "female" and highly "male" types of programs.

Next, we reestimate the admission regressions on the subsets of the most and least able

[4] The admission-rate quartiles are based on all schools. The results are not materially affected when we group university programs into quartiles separately for each subject of study. We also obtain fully similar findings when using the probit model in place of the linear probability model.

[5] Medicine, humanities, natural sciences, technical (engineering), agriculture, arts, informatics, and pedagogy.

Table 2—Female Dummy Coefficients from University Admission Least-Square Regressions

University programs	All	"Gender balanced"	All	All
Applicants	All	All	Top ability	Bottom ability
Admission rate quartile	(1)	(2)	(3)	(4)
1st (most selective)	**−0.043**	**−0.033**	**−0.062**	**−0.033**
	(0.004)	(0.005)	(0.007)	(0.006)
Observations	36,566	15,952	17,478	10,858
2nd	**−0.016**	**−0.014**	−0.014	**−0.027**
	(0.005)	(0.005)	(0.009)	(0.007)
Observations	32,863	23,190	14,400	9,617
3rd	0.012	0.007	0.024	−0.001
	(0.007)	(0.008)	(0.015)	(0.011)
Observations	25,957	14,506	11,943	7,592
4th (least selective)	0.012	0.002	0.004	0.015
	(0.008)	(0.015)	(0.012)	(0.015)
Observations	19,587	4,347	8,383	6,914

Notes: Each coefficient comes from a separate regression. Standard errors allow for clustering at the applicant level. Bolded coefficients are statistically significant at the 1 percent level. All specifications control for "Maturita" test scores, secondary school type and average success rate, and university subject of study. The top (bottom) ability group consists of applicants with the math and/or the Czech test scores above (below) the seventy-fifth (twenty-fifth) percentile.

applicants in columns 3 and 4. The top-ability group consists of those who score above the seventy-fifth all-applicant percentile in either math or Czech tests (or both), while the bottom-ability group scores below the twenty-fifth percentile in at least one of the two tests. Using these two groups, we obtain results that are fully consistent with those presented in columns 1 and 2. Women appear to perform worse at the most selective programs and not elsewhere even when the gender comparison is based on the most and the least able group of applicants.[6]

Our data allow us to fully control for subject-specific individual ability. Secondary-school graduates submit several university applications, often to schools of the same field type. We can therefore compare admission probability of the same individual across university programs characterized by varying admission rates. We estimate admission regressions controlling for person–school type fixed effects; i.e., we compare admission probabilities only within groups of applications by the same person to university programs of the same subject-of-study type. In Table 3, we use data on "gender balanced" programs to regress the binary admission outcome of applications on these person-school-type fixed effects and on the university overall admission rate (degree of competition) separately for each gender. Consistent with our earlier evidence, we find that the competition "gradient" of admission probability is steeper for women. This holds also when we look separately at the group of more and less selective schools, separated by the median of the overall university admission probability. Although based only on a subset of applications, these results control for individual ability fully and thus effectively rule out selection on unobservable subject matter skills as an explanation for our earlier findings.

[6] In Stepan Jurajda and Daniel Münich (2008), we have reestimated the least-squares conditional gender gaps of Table 2 using a matching comparison. Specifically, we have performed one-to-one nearest neighbor propensity score matching without replacement and found results highly similar to those presented here. We have also estimated the gender gap for each university program separately, and the resulting evidence again confirmed the findings shown in Table 2.

III. Conclusions

We find that female applicants to university programs perform substantially less well than

Table 3—School–Admission Rate Coefficients from Fixed-Effect Admission Regressions

Applicants	Men	Women
All "gender balanced" programs	**0.998**	**1.263**
	(0.089)	(0.099)
Number of applications	15,206	23,311
Number of fixed effects	6,881	11,146
"Gender balanced" programs below median admission rate	**1.126**	**1.499**
	(0.233)	(0.204)
Number of applications	10,656	16,259
Number of fixed effects	5,916	9,066
"Gender balanced" programs above median admission rate	**0.416**	**0.731**
	(0.193)	(0.297)
Number of applications	4,550	7,052
Number of fixed effects	3,412	5,364

Notes: Each coefficient comes from a separate regression. Standard errors allow for clustering at the applicant level. Bolded coefficients are statistically significant at the 5 percent level. All specifications control for a person–school type fixed effect. School type corresponds to eight types of university subjects of study. The all-school median admission rate is 0.28.

similar men when the admission rate is below 19 percent (in the lowest quartile), but that they are similarly successful when admission rates are higher. This result is robust to controlling for unobservable subject-specific ability. Our findings are important for the formation of admission and educational support policies. We note that the Czech system is typical of several other EU tertiary systems that apply school-specific selection at entry.[7]

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[7] School-specific admission standards are used in the United Kingdom or Germany. There are also countries that apply centralized selection at entry, e.g., Sweden or Denmark, and countries where access is unrestricted and selection is applied after entry. See Bas Jacobs and Frederick van der Ploeg (2006) and Philippe Aghion et al. (2008).