Gender and Competition:
From the Lab into the Classroom

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September 20, 2010

Abstract

Evidence from the experimental economics literature suggests that females perform less effectively than males in competitive environments. I assess the external validity of this finding in a regular non-experimental setting: that of the classroom. The 1997 Ontario Secondary School reform created a 'double cohort' of secondary school graduates, drastically increasing the number of university applicants in September 2003. Given the limited number of places available in universities, the quality of accepted students was significantly higher in that year than in previous years, significantly increasing competition for high grades in the classroom. Examining student academic performance of the 2001 and 2003 entering cohorts at a large Ontario university, I find that male students coped better with the increased competition than females. In particular, the male university average increased relative to females, as did the proportion of male students graduating 'on time'. These results emphasize the presence of gender differences in performance under increased competition in important real-life situations; supporting the findings of the experimental economics literature.

Keywords: competition, gender, higher education, performance.

JEL classification: J16, I21.

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*I would like to thank Michael Baker, Pierre Brochu, Nicole Fortin, Caroline Hoxby, Robert McMillan, Hessel Oosterbeek, Richard Romano, Aloysius Siow, Linda Welling, and seminar and conference participants at the University of Ottawa, Wilfrid Laurier University, the 2008 CEA meeting, the November 2009 NBER Education Program Meeting, and the 2010 EALE/SOLE Meeting for helpful comments. I am grateful to George Altmeyer, Khuong Doan, Susan Pfeiffer, Pekka Sinervo, and the Faculty of Arts and Science at the University of Toronto for making this project possible. All remaining errors are mine. Contact info: Louis-Philippe Morin, Department of Economics, University of Ottawa, Ottawa, Ontario, Canada, K1N 6N5. Telephone: (613) 562-5800 ext. 4867. Email: lmorin@uottawa.ca

†Disclaimer: The views, opinions, findings, and conclusions expressed in this paper are strictly those of the author. For confidentiality reasons, the data used in this paper cannot be released by the author. All requests about these data should be directed to the Faculty of Arts and Science at the University of Toronto.

1 Introduction

A growing number of studies, primarily from the experimental economics literature, suggest that males and females respond differently to competition. Especially noteworthy, experimental papers by Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004) indicate that males perform better in competitive environments than females. In turn, this suggests an alternative explanation, aside from discrimination and differences in preferences, as to why the highest paid executives in the U.S. are almost entirely composed of men (Gneezy, Niederle and Rustichini 2003).[1]

Experimental designs are useful for measuring differences in performance in competitive environments since they can overcome the obvious selection problem whereby competitive environments attract competitive individuals (and repel non-competitive individuals)—a problem which is very difficult to deal with in settings with observational data. This is especially true if men and women have different tastes for competition. Against this, the external validity of the Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004) lab and field results has not been verified, which could limit the relevance of their findings. These experiments asked participants to perform uncommon tasks which might not be especially relevant in day-to-day life. For example, participants in Gneezy, Niederle and Rustichini (2003) were asked to solve computerized mazes, and in Gneezy and Rustichini (2004), they were asked to sprint over a short distance. These studies also concentrate on tasks performed over very short time spans, while real-life competitive environments (such as the workplace environment) typically require individuals to exert effort over long periods.[2] Hence, without support from important real-life situations, the gender differences found in the experimental economics literature may not be generalizable.

A recent Ontario secondary school reform allows me to investigate whether the findings from the experimental economics described above hold in a regular environment: the classroom. As a consequence of the abolition of Ontario's Grade 13, two cohorts of students graduated from high school in June 2003, drastically increasing competition for post-secondary institution places. This in turn increased the quality of students admitted to university, as measured by students' high school averages. If universities grade students on a fixed bell-curve, as many Ontario universities do, then it becomes harder to get high grades when learning with better quality students. In this case, the Ontario 'double cohort' represents a unique exogenous shock to the level of competition in university classrooms, and it becomes possible to see whether females and males perform similarly in a 'natural' competitive environment.

Only a few papers look at the effect of an exogenous change in competition level on performance

[1]The experimental economics literature on competition and gender differences in performance has been mainly motivated by the findings of Bertrand and Hallock (2001). Bertrand and Hallock (2001) noted that women only represent 2.5% of the 1992-97 ExecuComp dataset, consisting of top five executives in each firm of the S&P 500, S&P Midcap 400, and S&P Smallcap 600.

[2]See Gneezy and List (2006) for evidence of important outcome differences between short run (*hot*) and long run (*cold*) decision making using a set of field experiments. Other often cited distortions are the size of the stakes of the experiments, participants' self-selection into experiments, group differences in their reaction to the lab environment, and 'Hawthorne' effects. Levitt and List (2007a, 2007b, 2009) discuss these potential problems for lab and field experiments.

in natural environments, and they only concern *very specific* groups of individuals. Price (2008) looks at the effect of the instauration of the Graduate Education Initiative (GEI), which increased competition within Ph.D. programs, on time to candidacy for students attending elite U.S. universities. Price (2008) finds that while males decreased their time to candidacy by ten percent, women were not affected by the GEI. To my knowledge, the only study looking at gender performance differences in a work-related competitive environment is Lavy (2008). Lavy (2008) studies the effects of the implementation in Israel of a pay scheme among teachers rewarding those who perform better than their peers. Contrary to previous studies, Lavy (2008) does not find gender performance differences in reaction to competition.

This study is the first to estimate the impact of a clear exogenous change in competition level on gender differences in performance in a natural environment for a sample of individuals representative of a *large* portion of the population: undergraduate students.[3] Using administrative data from the University of Toronto, the largest University in Canada, I look at the impact of the increased competition (following the Ontario double cohort) on student academic performance. While I focus mainly on student first year university performance, I also look at performance in upper years, drop-out rates, credit accumulation, and 'on-time' graduation rates.

The main finding of the paper is that, after controlling for ability, male students gained about 1 point on a 100 point scale or 11 percent of a standard deviation in university grades over female students during their first year in university as a consequence of the increased competition. While modest in size, the effect is still present in the senior year. The increased competition did not affect the gender gap in dropout rate, or in attrition rate. Although, the findings for on-time graduation rates and credit accumulation both suggest that males significantly benefited from the increased competition. The effect of the increased competition on gender differences in on-time graduation rates and credit accumulation is larger for 'below average' students—for students that are more likely to fail or drop courses. Overall, these results present evidence supporting the validity of the findings from the experimental economics literature.

Since the Ontario secondary school reform was announced in 1997 and that the double cohort occurred only in 2003, students had time to react to the reform, and some did. In particular, their is evidence that some students postponed while others advanced their university application by a year to avoid the double cohort (Morin 2010). If males and females reacted differently to the prospect of increased competition in university by selecting in or out of the double cohort, then the results presented in this paper could be biased. This concern must be taken especially seriously in the context of this paper as many studies from the experimental economics literature also suggest that males and females differ in their taste for competition.[4] In order to investigate

[3] In 2005, 40 percent of Canadians aged 24 to 26 had attended or were attending university (Shaienks, Gluszynski and Bayard 2008).

[4] For example, Gupta, Poulsen and Villeval (2005), and Niederle and Vesterlund (2007) found that males are more inclined to participate in competitive activities. Dohmen and Falk (forthcoming) suggest that risk attitudes play a role in explaining this finding, while Booth and Nolen (2009) and Gneezy, Leonard and List (2009) suggest that the role of nurture is important in this context. Interestingly, Gneezy, Leonard and List (2009) found that females' and males' taste for competition differs whether we are looking at a patriarchal or matrilineal society. Males are more

whether females tried to avoid the competition environment more than males, I use application data that allow me to observe not only students that enrolled in 2003, but also students that applied but did not enroll in 2003 (i.e. students that were rejected and students that were accepted, but decided not to enroll). The evidence found in this paper suggests that the double cohort did not affect either females' program selection or university application/enrollment decisions more than males'—suggesting that the threats of self-selection bias in this context may not necessarily be, in practice, cause for concern.

Finally, I also investigate the possibility that the double cohort might, by increasing competition in secondary school classrooms, have affected the way male and female high school averages measure academic ability. In particular, the academic ability of 2003 male students *could* be underestimated by their high school average which would then translate into overestimating the impact of increased competition on the gender university-performance gap. As a robustness check, I re-estimated my regressions only using students whose ability measurement is not likely to have been affected by the double cohort (e.g. out-of-province students and students that attended a university prior to the University of Toronto in 2003). The results are very similar to the ones using Ontario secondary school students.

The rest of the paper is structured as follows. The next section briefly surveys the experimental economics literature on competition and gender. Section 2 describes the Ontario double cohort in some detail, and Section 3 presents the data used to capture the effect of increased competition on academic performance. Evidence of increased competition for university admission is quantified in Section 4, while the estimation strategy is described in Section 5. Results and robustness checks are presented in Section 6. Finally, Section 7 concludes.

2 The Ontario Double Cohort

As part of a major reform to its secondary school system, the government of Ontario announced, in 1997, the abolition Grade 13. Prior to this reform, Ontario students were entering college or university after completing Grade 13 which contrasted with most surrounding secondary school programs. Students would now be expected to complete secondary school in four years (after Grade 12), as in most Canadian provinces, instead of five.[5] The first cohort of the new program (G12 program) began secondary school (Grade 9) in September 1999. Since the new program is completed faster than its predecessor (G13 program), the first cohort of the G12 program and the last cohort of the abolished program were expected to graduate and apply to post-secondary institutions in spring 2003, giving birth to the Ontario 'double cohort.'

Figure 1 clearly shows the effect of the double cohort on the number of post-secondary institution

competitive than females in a patriarchal society, while the opposite is true in a matrilineal society. See Croson and Gneezy (2009) for a more complete and general discussion on gender differences in preferences.

[5] See King et al. (2002, 2004, 2005) and Morin (2010) for more details.

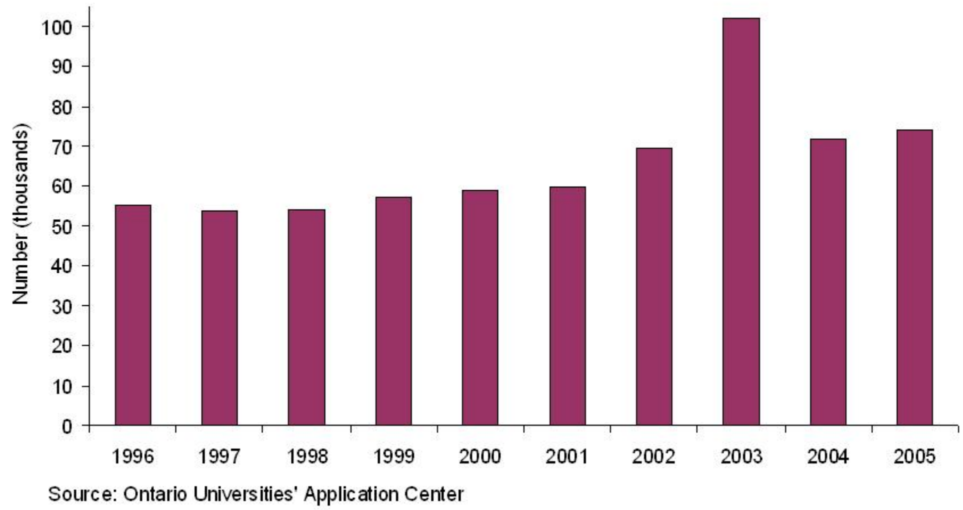

Figure 1: Number of Ontario University Applicants (in thousands)

applicants.[6] There is a significant spike in the number of applicants in 2003; increasing from about 60,000 to more than 100,000 between 2001 and 2003.

Since universities have limited capacities, this large increase in the number of applicants made university access more difficult in 2003; I present evidence of the increased competition for a specific university below. By increasing competition for university admission, the double cohort also affected the quality of students enrolled in university in 2003. It is natural to expect students admitted to a specific university during the double-cohort year to be better than students admitted to the same institution a few years before. The level of competition in university should also be greater since each student would be facing better classmates (in terms of high school average). This is especially true if universities grades are purely based on relative performance.

3 Data

In order to look at the effect of the increased competition in university classrooms on academic performance, I focus on students who enrolled at the University of Toronto—the largest Canadian university. I use an administrative data set provided by the University of Toronto Faculty of Arts and Science that is composed of first-year students who started in Arts and Science in September 2001 or September 2003. In 2010, close to 22,000 undergraduate full-time students were attending University of Toronto's Faculty of Arts and Science—making it the largest faculty of the University.[7]

The Faculty of Arts and Science combines two features necessary for the analysis of competition on grades: large introductory classes—some of them have more than 1,000 students—and subjects

[6] Figure 1 is from Morin (2010).

[7] More information about the Faculty can be found at `http://www.artsci.utoronto.ca/main/about/`.

which were not affected by the Ontario Secondary School reform.[8] This is not the case with other faculties.

The data comes from two sources of information that were linked using students' identification numbers: pre-university admission information and university academic history. The university academic history contains 1) the numerical grades for all Arts and Science courses that the student completed, 2) the list of courses that the student dropped (along with the dates these courses were dropped), and 3) a dummy variable indicating whether the student had graduated from university by July 1st of her fourth year (e.g. July 1st 2007 for 2003 students). The main dependent variable in consists of students' first-year (credit-weighted) averages, on a 100 point scale.[9] The number of credits earned by a student is obtained using course numerical grades—indicating if the student successfully completed the course—and the number of credits allocated to the course.

Pre-university admission information is available for students that applied to the Faculty of Arts and Science, regardless of whether their application was accepted or rejected. Hence, this information will be used not only to control for students' background but also to look for evidence of increased competition for university admission. This information will also be crucial to investigate whether females tried to avoid the increased competition (more than males) by choosing 'less competitive' programs, or simply by not applying/enrolling to the university in 2003—which is plausible if one thinks that females are more likely to "shy away from competition" (Niederle and Vesterlund 2007).

For each applicant, I have the following information: a student identification number, the applicant's high school average, her/his year and month of birth, and her/his gender, the name of the school attended by the applicant, the Faculty program applied to (Commerce, Computer Science, Humanities and Social Sciences, or Life Science), and an application status (enrolled, accepted, canceled, or refused).[10]

I restrict the sample to Ontario high-school graduates born in 1984 and 1985 for the 2003 student cohort, and in 1982 for the 2001 cohort in order to avoid having the results affected by

[8]The compression of the Ontario secondary school curriculum affected the delivery of material for some subjects and not others. For example, the Mathematics curriculum is believed to have been affected, while the Biology curriculum is not (Morin 2010).

[9]Students earn 0.5 credits for successfully completing a one-semester courses and 1.0 credit for successfully completing a two-semester course. As students take one- and two-semester courses, the student first-year average is weighted by the credit units. I computed first-year averages for all students for which I observe two numerical grades by the end of the first year. Restricting the sample to students who took more courses or weighting the observations by the number of courses taken does not affect my results. I consider that students that report grades under 30 percent have, in fact, dropped the course. These course outcomes will be used, with the courses that were officially dropped, to see whether females (or males) were more likely to drop courses (or 'stop competing') in 2003. Again, including these grades when computing student average grades does not affect my results.

[10]Students interested in a specific study program offered by the University of Toronto Faculty of Arts and Science have first to apply to one of the following general programs: Commerce, Computer Science, Humanities and Social Sciences, or Life Science. An application has the 'accepted' status if the application was accepted by the Faculty of Arts and Science but the student decided not to enroll.

older students.[11] Out-of-province students and students who already had some university experience before applying to the Faculty will be used in Section 6.2.4 for robustness checks.[12]

The data contains an indicator of the secondary school curriculum (Grade 12 or Grade 13) the student graduated from. The G12/G13 indicator is necessary for performing the analysis with or without G12 students. There are pros and cons to including G12 students in the sample. The exclusion of G12 students guarantees that, aside for potential differences in academic ability, students from 2001 and 2003 should be quite similar in terms of academic background (e.g. they come from the same secondary school program), and other dimensions like maturity—since students have the same age. But, if Grade 13 had a significant impact on students' university preparation and if gender composition differs across G12 and G13, then not including G12 students could over- or underestimate the effect of the double cohort on gender differences in performance. Also, Morin (2010) presents evidence that G12 students who entered university in 2003 were better-than-average students. Hence, in the presence of higher ability G12 students, a difference in gender composition across G12 and G13 students, and in the absence of differences in university preparation, excluding G12 students could also result in biased estimation of the competition effect. For this reason, the estimations were all done with, and without G12 students. Results show that including or excluding G12 students give very similar results.

Finally, the secondary-school Mathematics curriculum was clearly affected by the reform (Morin 2010). Since female and male students might have reacted differently to the change in Mathematics curriculum, all Mathematics courses were excluded from the analysis.[13] This should mitigate any potential bias due to differences across G12 and G13 university preparation. In practice though, including Mathematics performance in their university average does not affect my results.

4 Evidence of Increased Competition

Table 1 presents descriptive statistics of the data used to look at the effect of increased competition on student university performance. One can notice that the average high school grade increased by close to 2.6 percentage points between 2001 and 2003, pointing to an increase in competition for university admission due to the double cohort.[14] This difference is statistically significant and considerable—representing an increase of 55 percent of a standard deviation (relative to 2001). The university average was around 70 percent in 2001 and increased by about 1.5 percentage points in 2003. The student population is composed of a majority of female, representing more than sixty

[11] The cut-off date in Ontario is December 31st. Hence, students from the first G12 cohort are supposed to be born in 1985, while students from the last cohort of the G13 program should be born in 1984. As a robustness check, I also estimated the regression model including older students. The inclusion of these students does not affect the results.

[12] Pre-admission information from many out-of-province students is missing since they do not necessarily apply through the same process as Ontario high-school graduates. Admission information for these out-of-province students is kept by the colleges to which they applied to, and not by the Faculty of Arts and Science.

[13] There is a large literature on the gender gap in Mathematics. Interested readers should read Ellison and Swanson (2010), Fryer and Levitt (2010), and Niederle and Vesterlund (2010) for recent developments on the topic.

[14] Results presented in this paper were obtained using the interim average, as the final average was missing for some enrolled students, but the analysis was also carried out using the final average and *max*(interim, final), with very similar results.

Table 1: Descriptive Statistics

	2001	2003	
	G13	G12	G13
HS Average	85.4	88.2	87.9
	(4.85)	(4.41)	(4.43)
University Average	70.2	71.9	71.4
	(9.02)	(9.57)	(9.28)
Female Percentage	61.2	62.4	61.3
	(48.7)	(48.5)	(48.7)
Age	19.2	18.2	19.2
	(0.31)	(0.28)	(0.28)
Observations	2,483	1,702	1,835

Note: Standard deviations are in parentheses.

percent of the population. Of note, the proportion of female did not change significantly between 2001 and 2003. As expected, G12 students are on average exactly one year younger than G13 students.

Table 2: University Applicants and Enrollment

	Applicants	Enrollment	Enr./App.	App. Increase	Enr. Increase
2001	10,349	7,300	0.71	-	-
2003	16,697	9,124	0.55	61.3 %	25.0 %

Source: University of Toronto Admissions and Awards.

University of Toronto application numbers for 2001 and 2003 are presented in Table 2.[15] The increase in the number of applicants between 2001 and 2003 was approximately 62 percent which is impressive compared to the increase in enrollment (25 percent). This led the ratio enrollments-to-applicants to drop from 71 to 55 percent suggesting that university admission got much more competitive compared to the previous years.

The increased competition can be clearly illustrated by comparing the distributions of enrolled students' high school averages. Figure 2 plots estimated densities of high school averages for students enrolled at the Faculty of Arts and Science in 2001 and 2003. Clearly, students enrolled in 2003 have higher high school averages than students who enrolled in 2001. Evidence from Figure 2, and Tables 1 and 2 all suggest that competition in classrooms increased significantly as a consequence of the double cohort. The next two sections look more closely at the potential effects of increased competition on university performance and, more importantly, whether males and females were affected in similar fashion.

[15]This is the number of students that put the University of Toronto as their first choice institution when applying through the Ontario Universities' Application Centre (OUAC). The number of students that put the University of Toronto as their first, second, or third choice was 64,000 for 2003-2004. Source: University of Toronto Admissions and Awards.

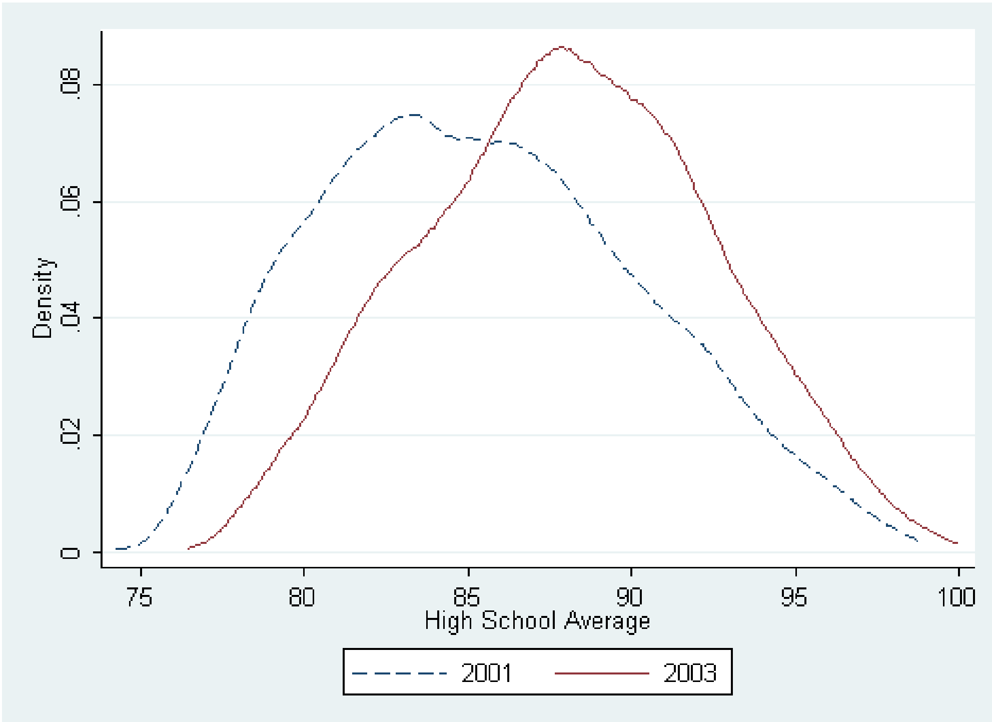

Figure 2: High School Average Marks Distribution

5 Estimation

The main estimation strategy used to capture the effect of increased competition on gender performance differences is to regress student university performance measures (e.g. university average, earned credits, or an on-time graduation dummy) $U_{i,t}$ on a male dummy $Male_i$, a double-cohort dummy DC_t ($DC_t = 1$ if the student entered university in 2003), a measure of student ability (high school average) H_i, two interaction terms ($DC_t \times H_i$ and $DC_t \times Male_i$), and a vector of other personal characteristics $\boldsymbol{X_i}$[16]

$$U_{i,t} = \alpha + \gamma H_i + \pi DC_t + \rho(DC_t \times H_i) + \delta Male_i + \beta(DC_t \times Male_i) + \boldsymbol{X_i}\boldsymbol{\Gamma} + \omega_{i,t} \quad (1)$$

The coefficient of interest is β and it represents the difference, across genders, in the effect of the double cohort. The coefficients π and ρ will capture common effects (to males and females) of the increased competition. Details about the expected signs of π and ρ are given below. δ allows one to test whether (*ceteris paribus*) males perform better than females in university. $\boldsymbol{X_i}$ will consist of controls like program fixed-effects and age which will be added to the equation in some specifications. Controlling for age could be useful when including G12 students in the analysis. The main explained variable of interest is students' first-year university average. One of the main benefits of looking at first-year performance is that during this year the choice of courses is not as

[16]Quantile regressions are also estimated in Section 6.2.1 to investigate the possibility of heterogeneous effects of competition on the university performance distribution.

large as for later years which can mitigate potential course selection issues. Furthermore, first-year courses usually have very large enrollment.

Before looking at the results, I provide a simple example that illustrates the expected changes in university grading-policy slope and intercept coefficients between 2001 and 2003 (π and ρ in equation (1)) if the university grades its students based on a bell-curve.

Imagine, for simplicity, that each year a university accepts five students. In a 'typical' year the high school grade distribution of accepted students is as follows: the weakest accepted student has a high school average of 60 percent while the best one has an average of 100 percent. The three other students have 70, 80, and 90 percent averages. If high school grades are good indicators of academic ability one would imagine that the better students will get the higher grades in university. Imagine that the university only gives five grades, 0, 20, 40, 60, and 80, respectively. The university average will be 40 and the standard deviation 31.6. This situation is illustrated in the top panel of Table 3.

Table 3: Competition and Bell-Curving

	Student Quality				
Typical Year	Worst				Best
High School Average	60	70	80	90	100
University Grade	0	20	40	60	80
Competitive Year	Worst				Best
High School Average	80	85	90	95	100
University Grade	0	20	40	60	80

Now imagine that competition for university admission increases, making the lowest accepted average equal to 80 with other accepted students having 85, 90, 95, and 100 percent averages. If the university wants to keep the same average and standard deviation, it can simply rank these students from best to worst and give the same grades it did in previous years. As we can see in the bottom panel of Table 3, the grades given in this highly competitive year are the same as in the typical year—leaving the average and standard deviation unchanged. What would happen if one were to run two separate regressions of university grades on high-school grades for these two years—which is essentially what is done when running a regression on a restricted version of equation (1), imposing $\delta = \beta = \mathbf{\Gamma} = 0$? The high school grade slope coefficient would be equal to 2 for the typical year and 5 for the more competitive year. The intercept coefficients would be equal to -120 and -140 for typical and competitive years, respectively. This example predicts that, if the university grades on a bell-curve, we should expect the slope coefficient to be greater ($\rho > 0$) and the intercept smaller ($\pi < 0$) in competitive years than in typical years. Notice that the effect of increased competition is not homogeneous across student ability: the best student is not affected (in terms of university performance) by the increased competition while a student with an 80 percent high-school average suffers a 40 percentage point disadvantage by entering university in a competitive year.

6 Results

6.1 Competition and First-Year Performance

Figure 3 clearly shows the evolution of the university first-year average distributions between 2001 and 2003 for males and females separately—already pointing to gender differences in reactions to the increased competition following the double cohort. First, we notice that male and female pre-double cohort(2001) performance distributions are similar. A Kolmorov-Smirnov test for equality of distribution suggests that the two distributions are identical. Things are different in 2003. We see a clear shift to the right for both males and females, suggesting that the unconditional student performance increased in 2003. More importantly, the males' distributional shift is more important—the male and female performance distributions are now statistically different. Interestingly, when comparing the female and male 2003 performance distributions, the male distribution looks, more or less, like a translation (to the right) of the female distribution. Although, Figure 3 only looks at 'unconditional' performance distributions, the regression results presented in Table 4 and quantile regression results presented in Section 6.2.1 will support the idea that the difference the shifts in performance distribution captures the effect of the increased competition.

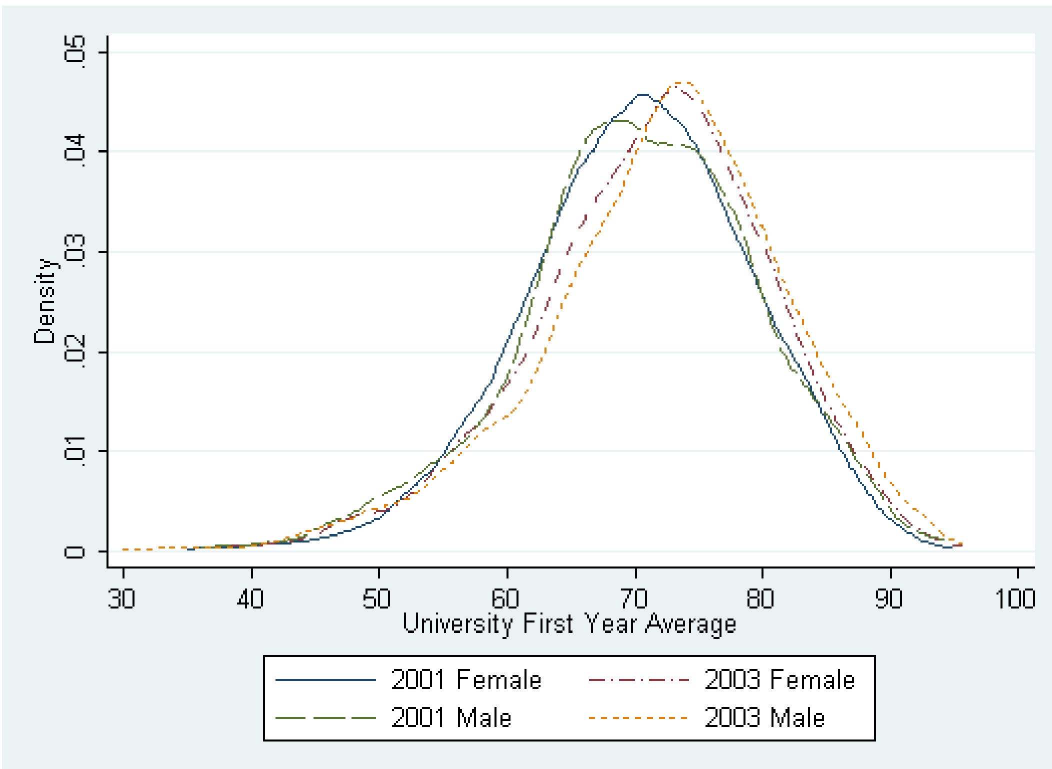

Figure 3: University Average Distribution

Table 4 presents results from estimating equation (1) with student first-year university average as dependent variable for different sets of controls, and for different subsamples. The results in Table 4 will shed light on 1) whether it became harder to get high grades as a consequence of the

Table 4: The Impact of the Double Cohort on the Gender Performance Gap

	G13 Students Only			G12 and G13 Students		
	(1)	(2)	(3)	(4)	(5)	(6)
HS Average	1.079	1.138	1.139	1.079	1.122	1.123
	(0.029)***	(0.030)***	(0.030)***	(0.029)***	(0.030)***	(0.030)***
Double Cohort	-11.311	-12.616	-12.472	-16.336	-17.270	-17.287
	(4.379)***	(4.414)***	(4.416)***	(3.614)***	(3.648)***	(3.648)***
Male	0.682	0.888	0.910	0.682	0.812	0.825
	(0.307)**	(0.312)***	(0.312)***	(0.307)**	(0.311)***	(0.311)***
HS Average × DC	0.107	0.120	0.118	0.165	0.174	0.173
	(0.050)**	(0.050)**	(0.050)**	(0.041)***	(0.042)***	(0.042)***
Male × DC	**1.009**	**0.941**	**0.926**	**1.006**	**0.967**	**0.965**
	(0.481)**	**(0.481)****	**(0.481)***	**(0.409)****	**(0.408)****	**(0.408)****
Computer Science		-0.916	-0.972		-0.691	-0.711
		(0.546)*	(0.547)*		(0.480)	(0.480)
Humanities		0.680	0.672		0.357	0.371
		(0.358)*	(0.358)*		(0.300)	(0.300)
Life Science		-1.128	-1.148		-0.946	-0.957
		(0.396)***	(0.396)***		(0.327)***	(0.326)***
Age			-0.747			-0.376
			(0.375)**			(0.203)*
Constant	-22.18	-27.19	-12.93	-22.18	-25.78	-18.66
	(2.50)***	(2.58)***	(7.60)*	(2.50)***	(2.56)***	(4.62)***
Observations	4,318	4,318	4,318	6,020	6,020	6,020
R-squared	0.33	0.34	0.34	0.34	0.35	0.35

Notes: The dependent variable in these sets of regressions is the student's first year university average. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

double cohort (i.e. whether the university graded on a 'bell-curve'), and 2) whether, on average, male performance significantly improved relative to females.

Columns (1) to (3) only include students who graduated from the G13 program while Columns (4) to (6) also include students who graduated from the G12 program. The effect of the increased competition on the university grading policy slope and intercept coefficients (π and ρ in equation (1)) are captured by 'Double Cohort' and 'HS Average × DC' respectively. 'Male × DC' gives an estimate of the difference across genders in the effect of the increased competition (β).

Results under column (1) do not include any personal characteristics aside from student's high school average and gender. The results suggest that estimates of changes in the university grading policy slope and intercept coefficients have expected signs ($\rho > 0$ and $\pi < 0$) supporting the idea of increased competition in the classrooms in 2003. These results suggest that university grades did not fully adjust for the increased quality of students in their classrooms. This is not surprising if we think that many universities suggest implicitly (e.g. this university) or explicitly a bell-curve marking scheme.[17] Not surprisingly, the effect of the double cohort on university

[17] In "Academic Handbook: Course Information for Instructors" available on the University of Toronto Faculty of

grades is statistically significant. An 'average' 2003 female student—with an 88-percent high-school average—had a 1.88 percentage point (about 0.21 s.d.) disadvantage when compared to a similar student who entered university in 2001.[18]

The estimate for the gender difference in performance due to the increased competition (1.01 percentage points) is statistically significant at a 5 percent level but modest (0.11 s.d.) suggesting that males have better coped with the increased competition than females, giving some support to the findings of Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004).[19] Note that, contrary to Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004), I do not know whether males were positively stimulated (e.g whether they studied more for exams) by the increased competition. Since the university seems to be grading on a bell-curve, I can only measure the change in relative (female vs. male) performance.

The effect of the double cohort varies significantly across the student population. Two female students, with high school averages one standard deviation (4.4 percentage points) below and above the 2003 mean high school average (88 percent) respectively would have had a 2.35 and 1.40 percentage point disadvantage from being part of the double cohort. Male students with high school averages one standard deviation below the 'average' student would have suffered from a 1.34 percentage point disadvantage due to the increased competition.

Allowing for program-fixed effects and age control (columns (2) and (3)) does not alter the findings. The coefficients of high-school average and 'Male × DC' are very stable across specifications. Marking schemes do differ across programs. After controlling for high school average, the 'toughest' program would be Life Science while the 'easiest' would be Humanities and Social Sciences. Finally, the age effect is statistically significant but small and negative: when comparing the youngest and oldest student coming out of the G13 program, we expect the youngest student to have a 0.75 percentage point advantage over the oldest. Krashinsky (2006) and Morin (2010) also find similar negative age-effect when looking at university preparation of G12 and G13 students.

Columns (4) to (6) replicate the estimations done in columns (1) to (3) using the complete sample of Ontario students—including both G13 and G12 students. The inclusion of G12 students does not affect the estimated effect of increased competition on the gender difference in performance; it remains around 1 percentage points. One could think that the effect is modest enough not to have any impact on students' GPA. Using student GPA (on a four point scale) instead of the credit-weighted average (on a 100 point scale) used in Table 4 gives very similar results. The estimates

Arts and Science website (http://www.artsci.utoronto.ca) we can read that, although not required, experience suggests that there will normally be between 5% and 25% of A's, not over 75% of combined A's and B's, and not over 20% of combined E's and F's in large classes.

[18] $88 \times 0.107 - 11.311 \approx -1.88$. The null hypothesis $H_0 : \pi + 88\rho = 0$ is rejected at a 1 percent confidence level. In order to convert the effect in terms of standard deviations, I use the 2001 university-average standard deviation (9.02) as found in Table 1. $-1.88/9.02 = -0.208$.

[19] Although the results suggest that males coped better with the increased competition than females, they were still negatively affected (in terms of performance) by this increased competition. A 2003 male student with an 88-percent high-school average had a statistically significant (at a 5 percent level) 0.87 percentage point disadvantage when compared to a similar student who entered university in 2001.

for 'Male × DC' when using students' GPA fluctuates between 0.10 and 0.11 standard deviations (or 0.1 GPA points).[20]

Since gender composition could have changed at the course level (even if it did not at the program level), I estimated similar regressions replacing student university average as dependent variable by individual course grades, and added course-fixed effects in some specifications to see whether the estimated effect of competition on performance gender gap is affected by controlling for course selection. Results (not presented here) suggest that the inclusion of course fixed-effects does not affect the estimated impact of competition on the performance gender gap; the estimated effect is around 1.1 percentage point.[21]

6.2 Robustness Checks

The results presented so far suggest that male students better coped with the increased competition than females. These results do not take into account that the effect of the double cohort on the performance gender gap can vary across the student population, or that students are more or less free to drop out of courses/programs, to enroll, and to apply to university. This section investigates for the possibility of heterogeneity in the effect of competition and for the presence of significant of self-selection problems.

6.2.1 Heterogeneity

The least-squares regressions capture the effect of increased competition on the *average* female-male performance difference. Although informative, it might also hide important heterogeneity in the impact of competition. The least-squares estimates could, for example, be driven by a specific group of students—such as male students in the upper tail of the performance distribution—that react more to competition than the rest of the student population. In this case, the increased competition would affect the shape of the performance distribution. In order to investigate this possibility, I estimated Specification (6) in Table 4 using a quantile regression methodology proposed by Firpo, Fortin and Lemieux (2009). This methodology allows one to estimate the impact of 'Male × DC' on the quantiles of the unconditional university performance distribution—shedding light on a possible increase in performance dispersion due to the increased competition.

Figure 4 plots the quantile regression 'Male × DC' estimates for the 5th to the 95th quantiles and its 90 percent confidence interval band.[22] The effect of competition on the gender performance difference seems relatively stable over the performance distribution as the least-squares point estimate is covered by all of the quantile regression band. What is clear from the quantile regression results above is that estimates of the gender performance difference effect found in Table 4 are not overwhelmingly driven by students performing well in university, and that the difference in the

[20]The detailed results are available upon request.

[21]These results are available upon request.

[22]The 90 percent confidence band is based on bootstrapped standard errors. Standard errors of each quantile is obtained from 500 replications.

Figure 4: Quantile Regression Estimates

shifts in performance distributions found in Figure 3 might not be such a misleading illustration of the impact of the increased competition on the performance gender gap.

6.2.2 Dropouts

If there are important gender differences when it comes to dropping a course, then the estimates presented above may over- or under-estimate the full impact of the increased competition on university performance. If, for example, 2003 male students dropped out of courses in a disproportionate way, then the findings presented in Section 6 could be due to selection. In order to investigate this issue, I looked at individual courses, and constructed a dummy variable equal to 1 if a course was dropped and 0 otherwise.[23] I then estimated a linear probability model, using the same six specifications used to estimate the effect of competition on grades, to test whether female and male dropping out decisions were affected differently by the increased competition.[24]

Table 5 shows that males did not drop out more than females when facing the increased competition, supporting the idea that the gender differences found above are not due to omitting students who failed to complete courses. The double cohort did increase the percentage of courses being dropped, all else equal: the estimated increase in dropout rates for an 'average' student is between 0.9 and 1.8 percentage points. This is significant since dropped-out courses only represent about 8

[23] Note that courses for which the final grade is below 30 percent are also considered as dropped.
[24] Probit estimation gives almost identical results.

Table 5: Competition and Dropped Courses

	G13 Students Only			G12 and G13 Students		
	(1)	(2)	(3)	(4)	(5)	(6)
HS Average	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Double Cohort	0.208	0.204	0.199	0.068	0.047	0.046
	(0.077)***	(0.078)***	(0.078)**	(0.063)	(0.063)	(0.063)
Male	0.005	-0.001	-0.001	0.005	-0.001	-0.001
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
HS Average × DC	-0.002	-0.002	-0.002	-0.001	0.000	0.000
	(0.001)**	(0.001)**	(0.001)**	(0.001)	(0.001)	(0.001)
Male × DC	**-0.000**	**0.002**	**0.003**	**-0.004**	**-0.002**	**-0.002**
	(0.008)	**(0.008)**	**(0.008)**	**(0.007)**	**(0.007)**	**(0.007)**
Computer Science		0.025	0.027		0.033	0.034
		(0.010)**	(0.010)***		(0.008)***	(0.008)***
Humanities		-0.008	-0.007		0.002	0.001
		(0.007)	(0.007)		(0.005)	(0.005)
Life Science		-0.006	-0.006		-0.003	-0.003
		(0.007)	(0.007)		(0.005)	(0.005)
Age			0.022			0.016
			(0.007)***			(0.003)***
Constant	0.764	0.763	0.340	0.764	0.744	0.437
	(0.046)***	(0.048)***	(0.139)**	(0.046)***	(0.047)***	(0.079)***
Observations	19,988	19,988	19,988	27,851	27,851	27,851
R-squared	0.02	0.02	0.02	0.01	0.02	0.02

Notes: The table reports the estimates of regressions of a dummy dependent variable equal to 1 if the course was dropped, 0 otherwise, using a linear probability model. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

percent of observed course outcomes in the sample. Overall, results from Table 5 do not suggest that results presented in Table 4 are due to gender differences in the dropping out decision process.

6.2.3 Participation

The experimental economics literature not only suggests that males perform better in competition than females, but also that females might shy away from it (e.g. Niederle and Vesterlund (2007)). If a large number of females avoided the double cohort (by delaying university application by a year for example), and these students would have been more likely to be adversely affected by the increased competition, then the estimates presented in Table 4 might underestimate the impact of competition on the performance gender gap. In order to investigate this possibility, Table 6 presents numbers on the proportion of female students by status (i.e. applied, accepted, enrolled) and by year. Female students do not seem to have tried to avoid the double cohort more than males. In fact, for each of the possible student status in Table 6, the proportion of female students increased slightly—the difference being only significant for 'Accepted' students.[25] Once, we control for high school average, this difference disappears. These results are not sensitive to the inclusion or exclusion of G12 students. I also tested whether 2003 female applicants were less likely to enroll (compared to 2001 female applicants), given that they were accepted. They are not. The cost of delaying university enrollment by a year might be large compared to the cost of entering a more competitive environment which could explain why we do not see changes in the female proportions of applicants and enrolled students between 2001 and 2003.

Table 6: Female Participation by Student Status and Year

Student Status	Number of Students		Female Proportion		Difference in Proportions
	2001	2003	2001	2003	$\%_{2003}$ - $\%_{2001}$
Applied	10,060	17,991	0.576	0.579	0.003
Accepted	6,576	10,803	0.583	0.604	0.021***
Enrolled	2,660	3,707	0.606	0.615	0.009

Notes: The table displays the number of Grade 13 and Grade 12 (combined) students by status (i.e. applied, accepted, or enrolled) and by year. The last column presents the difference in female student proportion and results from testing the null hypothesis of equal proportions across years against the alternative hypothesis that they are different. * significant at 10%; ** significant at 5%; *** significant at 1%.

Another way female students could have tried to avoid the increased competition is by enrolling in programs that are less 'less competitive'. Looking at the proportion of female students per program across time does not suggest that this possibility is cause for concern. The only program for which the proportion of female students changed significantly between 2001 and 2003 is Computer Science. This program is the smallest in terms of enrollment—473 students out of the 6020 observed in this paper are enrolled in Computer Science—and it has smallest proportion of female students (around 23 percent).

6.2.4 Pre-University Competition

Results presented so far assume that a student high school grade is a good indicator of academic ability. Since students knew (since 1997) that university admission would be more competitive in 2003 than in previous years, it is possible that they reacted by studying more in high school. The competition level would therefore increase not only in university, but also in high school. In this case, the link between academic ability and high school grade might have changed between 2001 and 2003—representing a potential source a bias for the estimator. In order to have an idea of the sign of the potential bias, consider two possible scenarios.

First, assume that competition was intense at the high school level which stimulated males more than females—as suggested by the experimental economics literature—resulting in males outperforming females with similar academic ability. Consequently, 2003 male academic ability *could* be overestimated by their high school average which would then translate into underestimating

[25]Demography could explain the change in the proportion in female applicants between 2001 and 2003 (48.5 percent of births in Ontario were females in 1982 while they were 48.6 and 48.8 percent in 1984 and 1985 respectively).

the impact of increased competition on the gender university-performance gap. This situation should not be a major concern since I already find a positive effect, and it would only make it larger.

Another scenario would be that females were actually more stimulated by the increased high school competition than males.[26] In this case, it is possible that the 2003 high school average overestimates females' ability which could result in overestimating the impact of increased competition on the gender university-performance gap.

I investigate this possibility by re-estimating the regressions presented in Table 4 using Ontario students—the students analyzed in Table 4—and adding out-of-province students and students that attended a university prior to the University of Toronto in 2003.[27] The link between ability and high school grades is not likely to have changed between 2001 and 2003 for these added students. By adding a introducing variable equal to 1 for these added students and a set of interaction terms, one can test whether the academic ability of Ontario female students is significantly overestimated in 2003 (relative to Ontario male students). Regression results (not reported here) do not suggest that the academic ability of Ontario female students is significantly overestimated in 2003.

As a robustness check, I also estimate regressions similar to the ones in Table 4, but using only students whose ability measurement is not likely to have been affected by the double cohort (i.e. out-of-province students and students that attended a university prior to the University of Toronto in 2003). The results are very similar to the ones using Ontario secondary school students. In particular, the coefficient estimates for 'Male $\times$ DC', although imprecise, fluctuate between 0.85 and 1.61 depending on the model specification. This finding further supports the idea that what I estimates presented in Table 4 are not due to Ontario female student academic ability being significantly overestimated in 2003.

6.3 After the First Year

Results from Table 4 suggest that the increased competition following the Ontario double cohort had an impact on the gender gap in first-year university performance. I now show that the double cohort actually affected the gender performance gap during most of these students' undergraduate years. Table 7 presents estimates of the competition effect on the gender performance gap for students' first (Year 1) to fourth year (Year 4) in university. Estimates next to 'Year 1' are taken from Table 4. The estimation strategy is exactly the same as the one used above, except that the dependent variables are students' upper years averages. Aside from a small drop for students' third year, the effect of the increased competition is surprisingly stable across years. The estimated coefficients using students's fourth year averages vary between 0.75 and 1.18, being very close to the ones obtained using students' first year averages. Despite being of modest size initially, the

[26]Although unlikely given the results presented above, it would be possible in principle that females were more stimulated by competition in both high school and university. For that to be true and to find a positive coefficient to 'Male $\times$ DC'—as I do—females' high school performance would have to have improved significantly more than their university performance. The 2003 female high school average would have to severely overestimate ability.

[27]Note that these students were excluded from the analysis so far.

Table 7: Evolution of the Impact of the Increased Competition on the Gender Performance Gap

	G13 Students Only			G12 and G13 Students		
	(1)	(2)	(3)	(4)	(5)	(6)
Year 1	1.009	0.941	0.926	1.006	0.967	0.965
	(0.481)**	(0.481)**	(0.481)*	(0.409)**	(0.408)**	(0.408)**
Observations	4,318	4,318	4,318	6,020	6,020	6,020
Year 2	1.232	1.135	1.109	1.089	1.007	1.006
	(0.512)**	(0.509)**	(0.509)**	(0.435)**	(0.434)**	(0.433)**
Observations	3,916	3,916	3,916	5,470	5,470	5,470
Year 3	0.594	0.499	0.481	0.839	0.710	0.716
	(0.529)	(0.527)	(0.526)	(0.455)*	(0.455)	(0.454)
Observations	3,409	3,409	3,409	4,840	4,840	4,840
Year 4	1.177	0.978	0.973	0.951	0.749	0.754
	(0.530)**	(0.529)*	(0.529)*	(0.451)**	(0.451)*	(0.451)*
Observations	3,173	3,173	3,173	4,502	4,502	4,502

Notes: The table reports 24 coefficient estimates of '**Male** × **DC**' for university years 1 through 4. Each estimate comes from a separate regression. The estimates next to 'Year 1' are from Table 4. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

competition effect could accumulate over time. The increase competition could affect the gender gap in attrition rates, in credit accumulation, and, ultimately, in on-time graduation rates.

6.3.1 Attrition

From year-to-year, the sample size of observed students decreases as can be seen in Table 7. Some students will change program, change university, or simply quit school. If males and females differ in the way they decide to stay in school (or in the Faculty), the estimates found in Table 7 could misrepresent the evolution of the competition effect. In particular, if some females were forced to quit school due to a bad performance in their first year, then the results from Table 7 might be underestimating the effect of competition on the performance gender gap. Table 8 investigates this possibility. Using a similar estimation strategy as above, I regress (using a linear probability model) a dummy variable equal to 1 if the student dropped out of the sample after one, two, or three years respectively. 18 estimates of the 'Male × DC' parameter are presented in Table 8. All estimates are relatively small, and statistically insignificant—suggesting that dropouts are not driving the results in Table 7, but also that the increased competition effect was not strong enough to significantly affect gender differences in attrition rates. While not strong enough to affect important decisions like dropping out of university, the competition effect might have been strong enough to slow down students and affect credit accumulation, and the probability that they graduate on time.

Table 8: Effect of Competition on Attrition Rates

Dependent Variable	G13 Students Only			G12 and G13 Students		
Dropped from Sample:	(1)	(2)	(3)	(4)	(5)	(6)
a) After 1 Year	-0.018	-0.017	-0.017	-0.010	-0.008	-0.008
	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)
b) After 2 Years	-0.023	-0.024	-0.024	-0.009	-0.008	-0.008
	(0.025)	(0.025)	(0.025)	(0.021)	(0.021)	(0.021)
c) After 3 Years	-0.006	-0.002	-0.002	0.006	0.013	0.013
	(0.028)	(0.028)	(0.028)	(0.023)	(0.024)	(0.024)
Observations	4,318	4,318	4,318	6,020	6,020	6,020

Notes: The table presents 18 coefficient estimates for '**Male** × **DC**' capturing the effect of competition on the gender gap in the probability to drop out of the sample (used in Table 4). These estimates are obtained using a set of dummy dependent variables 'Dropped from Sample After *X* Years' equal to 1, for a specific student, if I don't observe any grades for this student after *X* years (in university). These dummy variables are regressed on the same regressors and under the same six specifications used in Table 4. The estimation was done using a linear probability model. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.3.2 Credit Accumulation

In order to better measure the magnitude of the long-lasting effect of competition on the performance gender gap, I now look at student credit accumulation. Table 9 presents coefficient estimates for the effect of competition on the gender differential in credit accumulation. The number of credits accumulated after *X* years includes the number of credits earned during year X, but also the number of credits earned over the previous years. Therefore, the estimated effects presented in Table 9 should be seen as cumulative effects.

The results in Table 9 do not suggest that the effect of the increased competition on the performance gender gap was strong enough to affect the number of earned credits after a year. But, when I look at the effect of competition of earned credits after two years, the estimate for 'Male × DC' becomes significant for four out of six specifications. What is also surprising is that the estimates seem to increase in magnitude as we look at the effect after three and four years, though the standard errors also become large. In fact, when I look at students with high school average 88 percent and below—students who are more likely to fail or drop a course—, the estimates show the same pattern, but they become larger (between 0.8 and 1.2 credits after four years)and statistically significant.

6.3.3 Graduation

One final aspect of the academic performance that I look at is on-time graduation. As the effect of increased competition seems long-lasting, it could affect the probability that a student graduates on time (i.e. during the summer following her fourth year). In Table 10, I present results from regressing an "on-time-graduation" dummy variable on similar control variables used in the previous

Table 9: Effect of Competition on Credit Accumulation

Dependent Variable	G13 Students Only			G12 and G13 Students		
Accumulated Credits:	(1)	(2)	(3)	(4)	(5)	(6)
a) After 1 Year	0.050	0.005	0.005	0.033	-0.018	-0.018
	(0.063)	(0.058)	(0.058)	(0.052)	(0.048)	(0.048)
b) After 2 Years	0.318	0.223	0.220	0.192	0.089	0.088
	(0.135)**	(0.131)*	(0.131)*	(0.115)*	(0.111)	(0.111)
c) After 3 Years	0.479	0.372	0.367	0.302	0.174	0.172
	(0.212)**	(0.208)*	(0.208)*	(0.178)*	(0.173)	(0.173)
d) After 4 Years	0.507	0.353	0.346	0.328	0.144	0.142
	(0.301)*	(0.296)	(0.296)	(0.252)	(0.247)	(0.247)
Observations	4,318	4,318	4,318	6,020	6,020	6,020

Notes: The table presents 48 coefficient estimates for '**Male** × **DC**' capturing the effect of competition on the gender gap in the number of credits accumulated after X years (in university). The number of credits accumulated after X years is regressed on the same regressors and under the same six specifications used in Table 4. The number of credits earned is zero for year X (X=2, 3, or 4) if the student is not observed in year X. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

regressions.[28] The "on-time-graduation" variable is equal to 1 if the student has graduated from university by July 1st of her fourth year. Unfortunately, I don't observe 2003 students after their fourth year. Estimates of the double cohort effect on the gender difference in the probability of graduating on time are statistically significant and large. They range from 6.2 to 8.0 percentage points. To put the size of the estimates in perspective, about 40 percent of students observed in Table 4 graduated on time. Prior to the double cohort, male students were less likely to graduate on time than females—the difference being around 6 to 8 percentage points. This difference completely vanished for double-cohort students.[29]

The estimates presented here must be interpreted with caution. As the abolition of Grade 13 affected university admission standards in 2003, so could it affect the admission standards for graduate school in 2007. Hence, while part of the effect estimated here can be due to performance, it is also possible that these estimates are capturing the effect of a strategic behavior. Some students may have been tempted to delay graduate school application by a year. As mention earlier, females may not 'embrace' competition as much as males. If graduate-school bound female students delayed (more than males) their graduation to avoid the double cohort, part of the competition effect presented above would be due to this behavior. Note that this behavior is not likely to explain all of the effect since only a fraction of undergraduate students will apply to graduate

[28]The results presented in Table 10 are from linear probability models. The results from estimating Probit models are very similar.

[29] The null hypothesis $H_0 : \delta + \beta = 0$ (i.e. that the sum of the 'Male' and 'Male × DC' coefficients is equal to zero) is not rejected at conventional confidence levels in any of the six regressions. Note that the effect of the double cohort is not statistically significant based on the 'Double Cohort' and 'HS Average × DC' coefficient estimates. Once I drop the 'HS Average × DC' variable from the regression the 'Double Cohort' coefficient estimate changes to around -0.1 and becomes significant at 1% percent. The 'Male × DC' coefficient estimate remains unchanged at around 0.07. These results are not presented here but are available upon request.

Table 10: Effect of Competition on On-Time Graduation Rates

	G13 Students Only			G12 and G13 Students		
	(1)	(2)	(3)	(4)	(5)	(6)
HS Average	0.023	0.026	0.026	0.023	0.026	0.026
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Double Cohort	-0.478	-0.330	-0.324	-0.529	-0.320	-0.322
	(0.265)*	(0.266)	(0.266)	(0.223)**	(0.225)	(0.224)
Male	-0.086	-0.065	-0.064	-0.086	-0.065	-0.064
	(0.019)***	(0.020)***	(0.020)***	(0.019)***	(0.020)***	(0.020)***
HS Average × DC	0.004	0.003	0.002	0.005	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)*	(0.003)	(0.003)
Male × DC	**0.080**	**0.069**	**0.068**	**0.073**	**0.062**	**0.062**
	(0.030)* **	**(0.030)** **	**(0.030)** **	**(0.025)*** **	**(0.025)** **	**(0.025)** **
Computer Science		-0.239	-0.242		-0.276	-0.277
		(0.030)***	(0.030)***		(0.026)***	(0.026)***
Humanities		-0.089	-0.090		-0.130	-0.129
		(0.024)***	(0.024)***		(0.021)***	(0.021)***
Life Science		-0.149	-0.150		-0.166	-0.167
		(0.026)***	(0.026)***		(0.022)***	(0.022)***
Age			-0.032			-0.031
			(0.024)			(0.013)**
Constant	-1.571	-1.707	-1.101	-1.571	-1.631	-1.047
	(0.165)***	(0.173)***	(0.485)**	(0.165)***	(0.171)***	(0.295)***
Observations	4,318	4,318	4,318	6,020	6,020	6,020
R-squared	0.06	0.08	0.08	0.07	0.08	0.08

Notes: The table reports the estimates of regressions of a dummy dependent variable equal to 1 if the student graduated by July 1st of her fourth university year; 0 otherwise. The estimation was done using a linear probability model. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

school. In order to have an idea of how much of the estimates found above can be due to a strategic behavior, I estimated similar regressions as those presented in Table 10 excluding students with high school average above 88 percent to concentrate on students who are less likely to apply to graduate school. The 'Male × DC' coefficient estimates are actually larger for 'lower-ability' students—as is the case for earned credits—, suggesting that the results presented in Table 10 are not due to the strategic behavior.[30] Interestingly, changes in unconditional on-time graduation proportions between 2001 and 2003 for females and males show that males' on-time graduation rate increased significantly (from 33.7 to 38.1 percent) while females' decreased slightly (43.8 to 41.4 percent). While comparison of changes in unconditional on-time graduation rates suggest that males' performance increased while females' did not change, comparison of changes in conditional graduation rates (results from Table 10) suggest that females' graduation rate was significantly (negatively) affected by the increased competition while males' was not. Overall, results from

[30]Detailed results for higher- and lower-ability students are available upon request.

Table 10 suggest a clear difference in the reaction to increased competition by females and males, and that results from Table 7 are certainly not due to male students taking more time to graduate.

7 Conclusion

In this paper, I investigate the external validity of recent findings from the experimental economics literature. In particular, I look at the possibility that females perform worse than males in a competitive environment. The 1997 Ontario Secondary School reform allows me to observe the effect of an exogenous increase in the level of competition in university classrooms on gender differences in academic performance. Hence, this reform allows me to verify whether the findings from the experimental economics literature can be replicated for a natural and long-lasting task: classroom performance. Results from this paper confirm the presence of gender differences in performance under increased competition previously found in lab and field experiments by Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004). While modest in size, the effect is persistent and not likely to be due to self-selection. Furthermore, the increased competition had an economically significant positive impact on males' on-time graduation rates.

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