The University Gender Gap: The Role of High School Grades

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MESA2009-4

MESAMEASURING THE EFFECTIVENESS OF STUDENT AID

Canadian Education Project | Queen's University School of Policy Studies | Canada Millennium Scholarship Foundation
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Toronto, Ontario, Canada - May 2009 www.mesa-project.org

The MESA Project

The Measuring the Effectiveness of Student Aid Project, or the MESA Project, is a four year research effort being conducted by the Canadian Education Project and the School for Policy Studies at Queen's University on behalf of the Canada Millennium Scholarship Foundation. It has been designed to answer the following four questions:

- After graduating from high school, teenagers coming from low-income backgrounds face a choice as to attend college or university, or not. For those who did attend, how do they compare to those who did not?
- Does providing more funding in a student's first few years of further education attract more low-income students to post-secondary education?
- Does providing more funding in a student's first few years of further education make it more likely for low-income students to stay in and graduate?
- Are low-income students different across Canada?

This paper is part of a series of research papers solicited from some of the leading Canadian researchers in the field of post-secondary education; the researchers were asked to write about issues of access and persistence in post-secondary education in Canada. The requirements for the papers were that the researchers use one of several currently-existing Statistics Canada databases or another source of Canadian data. Each of the papers commissioned during this project is available for downloading from the MESA Project website at www.mesa-project.org.

The findings and conclusions expressed in this paper are those of the authors and do not necessarily represent those of the MESA Project or its partners.

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Abstract

Given the different distributions of high school grades for male and female graduates, the rationing of university places using minimum admissions standards might potentially have produced the gender imbalance observed in Canadian universities. Why high school marks have been lower for males than females then becomes a question of some interest. The estimation of a grade production function was used in this paper to examine the role of different effort levels in generating gender differences in high school grades. Using data from the Youth In Transition Survey (YITS), the present analysis found that over half of the difference in mean grades between males and females could be accounted for by different levels of effort. Fewer males had aspirations for university education than females and this fact might account for the lower levels of effort among them. However, it is also true that males were not able to produce high school averages (and, therefore, the entry requirement for university) as efficiently as females.

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Please cite as:

Drewes, Torben (2009). *The University Gender Gap: The Role of High School Grades. MESA Project Research Paper 2009-4*. Toronto, ON: Canadian Education Project. (www.mesa-project.org/research.php)

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Acknowledgements

This research was financed by the Canada Millennium Scholarship Foundation through the MESA project. I wish to thank Ross Finnie for his advice and Stephen Childs for his excellent research assistance. Helpful comments were received from Felice Martinello, Lorne Carmichael, David Johnson and other participants in the MESA sessions in Vancouver and Montreal, as well as the MESA research committee. Any errors are the sole responsibility of the author.

Introduction

In a single generation, women have moved from minority representation in Canada's universities to a significant majority, accounting for 58 percent of full-time undergraduate enrolment in 2006 (AUCC, 2007). This phenomenon is not unique to Canada. Women now form a majority of university students in 19 out of 22 OECD countries. The dramatic evolution of gender patterns in university enrolment is a fascinating social and economic phenomenon, but its causes and consequences are, as yet, not entirely understood.

Most of the research on the causes of the changing gender gap has focussed on demand-side explanations, trying to understand why males are now less likely than females to *want* to continue on to a university education. Possible explanations range from sociological perspectives on the failure of schools to instil in males a desire for education to more orthodox economic paradigms suggesting that males face lower rates of return. This paper takes as its point of departure the question of why males are now less likely to be *able* to pursue a university education. University spaces are rationed on the basis of high school averages, a practice which, although gender neutral on the surface, may play a role in the gender gap, given that males have lower high school grades than females.[1] Indeed, as will be shown below, even if there were equal application rates, the current gender difference in participation rates could theoretically be generated by university admission standards.

Before concluding that low high school grades are what is preventing males from being admitted to universities, however, it must be recognized that these grades are endogenously determined by students. For all of its applications and importance in understanding the outcomes of education, the human capital perspective has only infrequently been applied to the process of education itself. Yet it seems only reasonable that high school grades reflect optimizing choices on the part of students, representing a balancing of the costs of producing higher averages against the benefits of doing so. For many students, the primary benefit of having higher grades is that they enable entry into postsecondary education (PSE). An American survey sought to determine the motivation for effort among high school students by asking the question: "When you work really hard in school, which of the following reasons are the most important for you?". 79 percent of the 36,000 high school respondents reported "I need the grades to get into college" (Bishop, 1999, 2). Lower high school grades among males may therefore not be the cause of their lower university participation rates; instead, their lower grades may be the result of decisions made by them not to attend university and, consequently, not to expend the effort required to meet admissions standards.

This paper does not unravel the thorny econometric issue of simultaneity between high school performance and university participation. Its contribution is rather to exploit the rich Youth in Transition Survey (YITS) data on high school behaviour and grades to ex-

1 This is, of course, true only for individuals seeking direct entry into universities from high schools. A small minority of university students are admitted as mature students.

plore the process by which high school grades are produced. In particular, this paper estimates the relationship between grades and effort levels to determine the extent to which the lower high school performance of males can be attributed to lower effort levels on their part. If all of their lower performance can be attributed to their lower effort, then the observed gender gap in university attendance may be the result of males' choices not to participate, for whatever reason. However, if less than all of this gap can be attributed to effort levels, then it might be concluded that males and females differ in the efficiency with which they can produce the entrance requirements, and the requirements themselves could be deemed a culprit in the production of the observed gender imbalance.

Background

If lower high school grades among males play any role in the university gender gap, it must be true that rationing on the basis of those grades occurs. Some indirect evidence in support of this case exists. For example, Coelli (2005) found a significant negative relationship between cohort size and university attendance and interpreted this finding as evidence of the rationing of university places. Fortin (2005) concurred, arguing that tuition levels are too low to clear the market in the face of large increases in the demand for university education, leaving the short side of the market to determine enrolment. The short side is the supply side and universities use rationing on the basis of grades to allocate government funding-determined spaces.

Direct evidence of rationing is much harder come by, as it requires information on individuals who applied to universities but were denied admission. However, the application process in Ontario produces a set of data that can directly show the existence of rationing in that province. All high school graduates seeking admission to any of the province's universities must apply through a centralized application centre (Ontario Universities Application Centre). Applicants supply some personal information and make unlimited choices of universities and programs to which they wish to apply.[2] The high schools attended by the applying students supply information on their grades in their final year. Universities to which the student applied provide information on whether individuals were offered admission to their program of choice and whether or not they eventually registered at the university. Figure 1 (below) illustrates the numbers of successful and unsuccessful applicants by high school grade average.

Not all 2005 applicants to Ontario universities were offered admission, with 6.5 percent of applicants not receiving an offer from any institution. Since different universities and programs have different admissions requirements, there is no clear demarcation of a single cut-off grade in Figure 1. Nevertheless, it is clear that rationing does take place largely on the basis of high school averages. Since the application process is costly in terms of time and money, and since students have fairly good information on minimum entrance requirements, OUAC applicants are self-selected in the sense that high school

2 A fixed fee permits 3 choices with each additional choice adding to the cost. The great majority of applicants make no more than 3 choices.

graduates with low grades may not incur the cost if there is no reasonable hope of success. With lower grades, males are less likely to apply (and appear in the data), even if they have aspirations for higher education similar to females. Therefore, one could not simply compare the gender distribution of applicants to that of successful applicants to determine the impact of rationing on the gender gap.

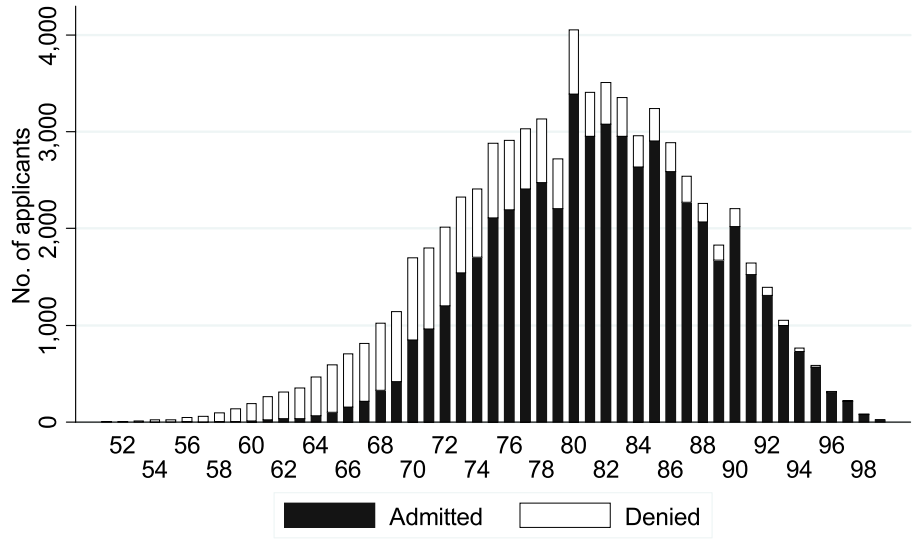
The YITS data does not contain unsuccessful applications for admission to university but does contain high school grades for all individuals, whether or not they were applicants. Table 1 reports the distribution of high school grades by gender.

To illustrate how rationing by grades might produce the observed gender gap, suppose that all males and females wanted to go to university but a minimum grade of 70% for admission had been established. For each 100 males and 100 females, how many would get in? There would be 74 males and 86 females admitted, with the resulting proportion of females in university being 54 percent. If the cut-off grade were set at 80%, the proportion of females would be 60 percent. Hypothetically, then, the use of high school grades to ration places in universities would have the potential to generate the gender gap actually observed.[3]

The YITS data then show that gender blind rationing on the basis of high school averages would theoretically be capable of producing the observed gender gap in university participation even if males were as likely to apply as females. But it is also theoretically possible that the grade distributions outlined above were the result of grade targeting by males, many of whom had no intention of pursuing a university education and who therefore have no reason to exert the effort required to obtain the minimum admissions cut-offs.[4] In fact, the reality is likely to be a combination of these two explanations, the possibility of which presumably explains Frenette and Zeman's

Figure 1: Admissions and Denials

Ontario Universities: 2005



Source: OUAC data, 2005

3 Changes in the gender composition are another matter. American evidence suggests that girls have held an advantage in high school grades relative to boys over a considerable period of time (see Cho (2007) and Goldin et al. (2006)). Canadian evidence on high school grades over time is not available, but if the same pattern holds true for Canada, we would have to appeal to an increase in the degree of rationing to produce the change in gender composition we have observed.

4 See Allgood (2001) for a model of grade targets.

(2007) attributing both grades and personal characteristics as underlying reasons for the gender gap. Indeed, their results indicate that slightly more than 30 percent of the gap was caused by differences in high school grades, although there was no correction for the endogeneity of grades.

The question then becomes why males have lower grades than females and, specifically, what role effort plays in the process. An education production function approach was deemed necessary to address this issue.

Literature Review

Several authors have taken into account the active role played by learners in producing outcomes and have sought to model their effort levels in a choice-theoretic framework. For example, Cho (2007) treated high school averages as an outcome that could be increased through greater effort, with the optimal level of effort chosen to balance marginal benefits and costs, where the benefit produced by more effort was a higher probability of admission to PSE and subsequent enjoyment of higher income. This model was used to examine how increases in women's high school performance have contributed to the changing gender composition of American university students. Improved performance was found to explain more than half of the change in the university enrolment gender gap over the past thirty years. The improvement in women's high school achievement was attributed partly to exogenous changes in how high schools prepare women for university and partly to increased effort levels induced by the greater benefits produced by the availability of expanded labour market opportunities for women.

Bishop (2006) argued that most of the education production function literature treats students as "goods in process" rather than active participants in the production of academic achievement. He provided evidence that student effort accounted for an important share of the variance across individuals in achievement but, unfortunately, did not investigate gender differences. A more complete model of student effort was provided in three equations: a learning function, a rewards for learning function, and a cost of student effort function. A Cobb-Douglas specification of the learning function was used to derive theoretical results, such as the optimal effort level, but the model was not implemented empirically.

Numerous studies have found that indicators of student effort, such as hours spent studying or on homework assignments, have significant effects on learning.[5] Although multivariate methods have been used to control for prior achievement and family background, effort indicators have typically been regarded as exogenously determined. The fairly large body of literature on the relationship between academic performance and working while in school is more directly related to the research in this paper, as the connection between working and performance is derived from choices of time allocation within a fixed time budget. The findings on the impact of working on academic achievement (and, by extension, the impact

5 See, for example, Betts (1996).

of time available for studies) have tended to be ambiguous.[6]

Stinebrickner and Stinebrickner (2004, 2007) have produced the research most directly related to the estimates to follow in this paper. In both papers referenced above, their objective has been to estimate the relationship between educational outcomes and students' study time and effort. Although the endogeneity of effort was acknowledged, the authors contended that the causal effect of studying could be identified by using a unique feature of the institution-specific data available to them. At the particular institution they studied, the assignment of roommates was made randomly and the data allowed for the observation of certain roommate characteristics. Specifically, some individuals found themselves housed with roommates who brought video games with them, while others did not. The resulting exogenous variation in the quantity and quality of studying induced by the presence or absence of such distractions allowed the authors to conclude that study efforts had a substantial causal role to play in the grade production function. Furthermore, the IV estimates were much larger than OLS estimates. These differences might have arisen from unobserved, permanent ability differences or through what the authors called a "dynamic selection" effect, whereby students receiving an unexpectedly low grade might have reacted by changing their effort levels. The latter effect was found to be the underlying cause of the difference between OLS and IV estimates.

Data and Descriptive Statistics

The data were drawn from the Youth in Transition Survey (YITS), a longitudinal survey designed to provide information about the education, training and work experiences of two target populations: a cohort of individuals who were 18 to 20 years old on December 31, 1999 (Cohort B) and a cohort who were 15 years old on that date (Cohort A). The analysis presented here made use of data from Cohort A. The YITS has now gone through 4 cycles, the first one conducted in 2000 on almost 30,000 students and the latest follow-up taking place in 2006 when Cohort A respondents were 22 years of age. Since almost all respondents were finished high school by the time of the last cycle, only the first three cycles were used in this paper. In the first cycle, YITS obtained information from students, parents and school administrators to produce a rich set of information on student behaviours and aspirations, family background, school resources available, and so on. In addition, Cohort A participated in the OECD's Programme for International Student Assessment (PISA) evaluations, writing standard tests in the areas of reading, mathematics and science skills.

YITS respondents were asked their overall grade average in their last year of high school in all cycles, with the results reported by grade category (as in Table 1). This self-reported measure served as the dependent variable. Three measures of effort were used in the estimates of the grade production function. First, YITS respondents were asked to report the number of hours per week they

6 See Oettinger (1999) for a careful analysis that takes into account choice-based endogeneity.

spent studying outside of class.[7] Second, the YITS collected information on the number of times the individual skipped classes. Finally, respondents were asked to report how often the statement that "they did as little work as possible, wanting to just get by" applied to their approach to their studies. Other variables included in the grade production function were derived from information on parental financial resources, education and support, as well as school resources. The YITS gathered this information directly from parents and school officials, but only in the first cycle of the survey.

Tables 2 through 5 provide a statistical preview of differences in grades and effort levels between males and females in their final year of high school. To get some preliminary sense of whether effort levels might have been driven by the need to satisfy university entrance requirements, the descriptive statistics were also broken down by aspirations for a university education. Clearly, simultaneity was a problem here (and one that has been left unresolved), since effort might have been motivated by aspirations for higher education but those aspirations might, in turn, have been affected by the student's assessment of his or her ability, as measured by high school grades. Only measures of university aspirations reported in the first YITS cycle were used in this analysis in order to avoid, as much as possible, the kind of dynamic endogeneity resulting from revisions to aspirations that might have occurred as individuals underwent periodic assessments of their abilities as they moved through high school.

Table 2 repeats the information in Table 1 and adds a comparison of grade distributions for only those students with stated aspirations for at least a university degree.[8] The proportion with grades of at least 80 percent were significantly higher when only those with university aspirations were considered, rising from 32.2 percent to 43.9 percent for males and from 46.5 percent to 56.0 percent for females. Again, whether higher grades among those with aspirations for university were the result of high school students' working harder in the knowledge that they would need to meet admissions standards or, rather, their higher grades were influencing those aspirations is a question not settled in this paper. It is interesting to note, however, that the gender gap in the proportion of "A" students fell from 14.3 percentage points in the population as a whole to 12.1 percentage points among those with university aspirations. If hopes for a university education drive efforts to earn grades in high school, this last finding might be seen as evidence that differences in such efforts matter.

Tables 3 through 5 show tabulations of the three measures of effort in the YITS data used in the estimates of the education production function. Table 3 shows the most direct measure of effort by tabulating the number of hours of study outside the classroom. Only 16 percent of males reported spending less than one hour studying per

7 Individuals were asked to report this information for the last year of high school, so effort levels were tied to the high school average in the same year.

8 In the sample used to estimate the grade production function, 56.5 percent of males and 66.9 percent of females had university aspirations.

week compared to six percent of females. Using the mid-points of the categories and 17.5 hours for the top open-ended category, the average number of hours spent studying was 4.7 for males and 6.4 for females. Among those with university aspirations, the number of hours spent studying went up to 5.5 and 7.1 hours, respectively.

Time spent on studies outside the classroom is one measure of effort. So, too, is time spent inside the classroom which, apparently, is a choice variable for many high school students. Over 21 percent of males reported skipping classes at least once a week, as compared to 15 percent of females. Those with university aspirations were somewhat less likely to skip class this frequently, but the practice was clearly not uncommon among both genders.

Table 5 reveals significant gender differences in respondents' self-assessment of their effort. While almost 60 percent of males stated that they had worked at less than full capacity at some point, only 40 percent of females reported behaving in this way.

By all three measures of or proxies for effort exerted in high school, females worked harder and longer than males. Had males worked as hard as females, would they have been able to generate similar grades or were there gender differences in the efficiency with which grades were produced? To examine this question, the next section estimates a grade production function.

The Grade Production Function

The Model

The general form of the grade production function is

$G = g(F, S, E, \varepsilon)$

Where:

- G is the measured final year school grade average,
- F is a vector of family inputs, both current and past,
- S is a vector of school inputs,
- E is a vector of current student effort,
- ε is a measure of the individual's exogenously determined innate academic ability.

As Hanushek (1986) has pointed out, the education production function literature derives its conceptual basis from the standard production function literature but without the emphasis on functional form. This paper follows the practice of most authors who use a linearized empirical specification which might be regarded as a reduced form or local approximation:[9]

$$G_i = \beta_E Effort_i + \beta X_i + \varepsilon_i$$

where X_i is a vector of non-effort variables.

The specific explanatory variables used are listed in the table of sample means, Table 6.[10] In terms of family inputs, the model in-

9 Although, see Figlio (1999) for a discussion of functional form in this context. Another specification issue that needs to be pointed out is the capacity of students to choose their courses of study. Males and females may well make selections that reflect their comparative advantages. Thus, in the language of production functions, the two genders may be producing different outputs. I am grateful to an anonymous reviewer for pointing this out. Unfortunately, the YITS data did not permit the estimation of grade production functions for individual courses or sets of courses.

10 Sample means for the effort variables have already been reported and are not repeated in Table 6.

cluded measures of the parents' capacity to provide support for the educational process, measures of indirect parental influence, and measures of parental activity. Capacity was measured using combined parental income in 1999 as reported in cycle one of the survey. All sources of income were accounted for, including government transfers. The educational attainment of parents or guardians was included to capture, separate from financial capacity, the indirect influence of parental education in terms of expectations, understanding of the PSE sector, etc. While income and education might have captured the environment in which the respondents grew up, they did not measure proactive involvement and encouragement on the part of parents. To proxy for active support of their children's education, the estimates use the PISA variable on the frequency with which the mother or the father worked with the student on school work (ranging from never to several times a week). Note that, being a PISA variable, this measure applied at the time of cycle one and was not contemporaneous with high school averages in the final year of high school.

School resources available to support student learning and grade achievement were captured in three variables from the PISA school survey. An index of the quality of school infrastructure was based on principals' reports concerning building conditions and instructional space. The index ranged from -1.12 to 3.38, with higher values implying better conditions. Similarly, the availability of educational resources (including computers, library resources, science equipment and so on) was captured by an index that ranged from -1.9 to 3.22. Teaching support was measured by the student-teaching staff ratio: the number of students in the school divided by the number of full-time equivalent teachers. Again, these measures have been made available only for cycle one.

Provincial dummies were used to pick up any differences in the way in which grading occurred, as well as any provincial variations in resources not captured in the school resource variables.

As discussed above, the student's own effort was measured using three proxies: hours of study per week; incidence of skipping classes; and the degree to which they agreed that they did as little work as possible.

Most of the variables measured in Table 6 should have produced means that were not significantly different for males and females, since gender played no role in their determination. There were, therefore, only two comparisons of interest. First, males and females received about the same amount of help with their school work from their parents, so there appeared to be no gender difference in the investment of time made by parents. Second, the mean family income for women was lower than it was for men, which may have been accounted for by the marginally lower levels of educational attainment among the parents of females. Why this occurred is not clear.

Effort and Causality

There is a strong possibility that effort levels, which are endogenous values chosen by students, are correlated with academic ability which, in turn, is likely to be a deter-

minant of high school grades. Without a measure of this ability, it would wind up in the error term and OLS estimates of the effects of included effort variables on grades would be biased, a problem akin to the standard ability bias issue in estimating the effects of education on earnings. If more able students devoted greater effort to earning grades, perhaps because learning activities were more enjoyable for them, an upward bias in the estimated effort effect in this analysis could be expected, as the higher grades of students exerting greater levels of effort could be attributed entirely to that effort (instead of, at least partly, to their higher ability levels).

As Stinebrickner and Stinebrickner (2004) pointed out, however, the bias story is unlikely to be that simple when the human capital model of the learning activity is taken seriously. High school averages may not be the ultimate goal of students' optimizing calculations. Instead, their decisions about effort may be based on the probability of entry into postsecondary education and the higher income resulting from that entry. It is plausible to suppose, as these authors pointed out, that high ability students with grade targets in mind exert less effort than those with lower ability as they aim only to achieve the minimum grades required for admission into PSE. In comparisons of the grades of higher effort/lower ability students to those of lower effort/higher ability students, estimates of the effect of effort appear to be downward biased.

Unlike the data used by Stinebrickner and Stinebrickner (2007), there was no natural experiment in the YITS that produced exogenous changes in effort. Neither were there suitable instruments available for the standard IV strategy applied in the context of endogenous regressors.[11] One might hope that, since the ultimate use of the grade production function in this analysis was to make a comparison between genders, differencing the functions might also difference out any biases. This would have occurred only under very limiting assumptions, however. Suppose the true models for males and females were:

$$G_m = \beta_E^m Effort + \beta_2^m Ability + u^m$$
$$G_f = \beta_E^f Effort + \beta_2^f Ability + u^f$$

Without a measure of ability, the initial estimation would be:

$$G_m = \beta_E^{m'} Effort + v^m, \quad where\ v^m = \beta_2^m Ability + u^m$$
$$G_f = \beta_E^{f'} Effort + v^f, \quad where\ v^f = \beta_2^f Ability + u^f$$

followed by

$$E(\beta_E^{f'} - \beta_E^{m'}) = \beta_E^f - \beta_E^m + (\beta_2^f \delta^f - \beta_2^m \delta^m)$$

with δ^j representing the slope coefficient from a regression of ability on effort for gender *j*. The estimated difference in the contribution of effort to grades would be unbiased only if the last term equalled zero, which would be unlikely.

The YITS data contained the results of standardized PISA scores, measured at age

11 David Johnson suggested the use of distance to a postsecondary education as a possible instrument, noting Frenette's (2002) finding that distance matters in decisions regarding post-secondary education attendance. With lower incentives to attend, students living farther away might exert lower effort levels for reasons unrelated to academic ability. Unfortunately, the postal code data required to construct a related instrument were not available.

Introducing a lagged measure of performance approximates the value added, or augmentations, to learning specifications used by some authors when estimating education production relationships. See, for example, Ehrenberg and Brewer (1994).

15, and these scores had some potential to act as proxies for ability. Unquestionably, PISA test scores were indeed correlated with innate ability, but they were also likely to have been correlated with effort. Note, however, that PISA performance would have been influenced by effort levels in the past, while the effort variables used in the grades production equation were measured in the last year of high school. If the correlation between past and current effort levels were less than perfect, using PISA reading scores as a plug-in solution to the omitted ability variable problem would have not eliminated the bias completely but might have reduced it.

Estimates

In the spirit of descriptive statistics, the present analysis first estimated the grade production function without the PISA reading score proxy for ability, without claiming a measure of causality. The production functions were then re-estimated after including the PISA reading score as the only feasible approach to resolving the omitted ability variable problem. The results are reported in Table 7.

Note that the YITS reported grade averages in the final year of high school as a categorical variable; these categories are presented in Tables 1 and 2. Since the differences in the categories were meaningful, employing a categorical method like ordered logit would not have been appropriate. Instead, students were assigned numerical values equal to the mid-points of the grade category and the grade production functions were estimated by OLS applied to each gender separately.

All three effort measures were strongly correlated with the level of high school average in the regressions that excluded the PISA score ability control.[12] Additional time spent studying had significant and large coefficients which tended to be smaller for males than for females, except for the highest category. Compared to those who claimed to always have worked hard, those who sometimes, often or always did as little work as was necessary to get by earned lower grades. There were no clear differences between the genders in the behaviour of these coefficients. The estimated impacts of skipping classes were negative and similar for males and females. An interesting outcome from the regression results is that the coefficients of the three different effort measures were similar for the two genders.

Compared to students whose mother had completed no more than a high school education, sons and daughters of college-educated mothers achieved higher grades and those with university-educated mothers earned even higher averages. The effect of mothers' education levels was similar for males and females. A similar pattern was seen in the impacts of fathers' income, although the estimated coefficient on the indicator for fathers' college education was insignificant. Having controlled for parental education, the effect of income was statistically significant only for females and was small in magnitude. As discussed above, the frequency with which parents helped their

12 Again, no claim for causality can be made since effort levels are endogenous.

children with their school work was used to capture parental involvement. As it turned out, high school performance was negatively related to parental help with school work except for females, where fathers' help was found to have no significant impact. The obvious interpretation would be that parents interceded when their children were having difficulty with school.

None of the three measures of school quality appear to have had an effect on high school performance. This observation is not entirely inconsistent with other findings in the literature on school quality, but might also be attributable in this case to the inclusion of provincial controls. If provincial funding schemes were uniform, in that school resources varied by province but not within provinces, there would be little independent variation in the quality measures. Turning to the estimates on these provincial controls, compared to Ontario, high school averages for both males and females were significantly lower in Newfoundland and Labrador, as well as in Alberta, especially for females in the latter province. Relative high school performance was higher in Prince Edward Island. It was also higher for females only in Nova Scotia and for males only in Quebec.

Turning to the model with PISA scores serving as proxies for ability, the impact on grades of spending time studying diminished for males and became statistically insignificant for females. This finding is consistent with the simpler ability bias story discussed above, where the data showed that effort and ability were positively correlated, leading to an upward bias in the estimated causal effect of effort when controls for ability were not included. The deleterious effects of shirking work and skipping classes, on the other hand, remained largely unaffected by the inclusion of the PISA reading score.

The PISA scores themselves were highly significant determinants of high school averages. One standard deviation increase in the PISA reading score was estimated to add 3.6 percentage points to that average for males and 3.8 percentage points for females. They were also clearly correlated with measures of family background and support, reducing the estimated impact of parental education, income and assistance. Provincial differences, however, appeared to be more pronounced with the inclusion of the PISA scores.

Decomposition Analysis

With the above estimates calculated, the question of the extent to which the gender gap in high school grades could be attributed to differences in effort levels was addressed. A standard Blinder-Oaxaca decomposition was used to answer this question by estimating the proportion of the grade gap attributable to different distributions of the effort variables. Normally, the choice of reference group to use in a decomposition is somewhat arbitrary; however, the rationale involved in the present analysis was to assume that males exerted the same levels of effort as females and then to determine how much of the overall gender gap remained. Therefore, the decomposition used was as follows:

$$G^{girls} - G^{boys} = \beta^{boys}(X^{girls} - X^{boys}) + (\beta^{girls} - \beta^{boys})X^{girls}$$

The first component on the right hand side represents the portion of the gender gap in mean high school averages accounted for by differences in the means of the explanatory variables. Essentially, the effort vari-

ables (as well as the remaining explanatory variables) were reset for males to those of females and observations were made as to how the grades of males changed. The second component captures differences in the efficiency with which males and females converted inputs into the grade production function into high school averages. Table 8 reports the decomposition, isolating the proportion of the first component attributable to differences in effort levels.[14]

Considering first the specification without the PISA score proxy for ability, differences in effort levels accounted for slightly over one half of the three percentage point gap in final high school grades and more than the entire portion of the gap "explained" by differences in the explanatory variables. The explanatory variables not related to effort levels, when taken together, actually worked in favour of males, although only marginally so. According to this specification, then, if males had worked as hard as females in high school, it could be assumed that the gender gap in averages would have been cut in half. It would not have been eliminated completely, however, as females appeared to have been able to convert inputs into the production of high school averages more effectively than males.

Introducing the PISA reading scores as a proxy for ability reduced the contribution of the effort variables to the gender gap, but only marginally (to approximately 44 percent of the gap). The PISA score, in this application, was considered part of the "endowment" of an individual and, not surprisingly, the total contribution of endowment differences to average grade differences increased to almost 80 percent of the overall gender difference. Viewed in this light, the reasonableness of using the PISA scores as a control for pure ability differences could be called into question. On the other hand, the continued finding of gender differences in the ability to convert inputs into grade averages strengthens the conclusion that females were better able to earn the high school grades required for entry into postsecondary education.

Math vs. Reading Grades[15]

Given that the primary goal of this paper was to investigate the ability of high school students to pass minimum entry requirements for universities, its focus so far has been on final high school averages. In order to delve deeper into the examination of gender differences, the differences in grades sorted by subject were analysed. The YITS asked students about the last mathematics, language, and science courses they had taken in high school and, for mathematics and language courses, their final grades were available in the data. Table 9 repeats the decomposition procedure used for overall high school averages to see if the difficulties among males were general or specific to the kind of subject matter studied.[16] The specifications used for the individual course grades results did not include PISA scores.

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14 In keeping with the jargon of this literature, the explanatory variables are termed "endowments". Complete results are reported in the Appendix.

15 I am grateful to Felice Martinello for suggesting separate estimates for language and mathematics grades.

16 The regression results were not reported here. They are available from the author upon request.

Clearly, subject matters. Almost no gender difference was observed in the grades obtained in mathematics courses, but there appeared to be a very substantial advantage for females in language courses. Interestingly, lower effort in high school produced a similar grade point penalty for males in both mathematics and language courses.[17] However, males appeared to be more efficient at translating effort into mathematics grades, with their mathematics grade production function lying higher at the mean of female endowments, and this partially offset the loss of grades through lower effort. In the case of language courses, however, the effect of their lower effort was compounded by a lower ability to convert their efforts into good grades. A male who was observationally equivalent to the average female in the sample was predicted to earn a language course grade that was more than 3.5 percent lower.

Caution should be exercised in interpreting these disaggregated results, however, as effort levels in the YITS data were not reported by course, so it would be impossible to determine or differentiate between how much effort was put into mathematics courses and how much into language courses. The two genders may have had different comparative advantages or "comparative interests" leading them to allocate their effort differently across these kinds of courses.[18] If, for example, males had taken a particular interest in mathematics courses and dedicated a disproportionately large share of their overall study time to those courses, effort levels in those courses would have been higher than those used to produce the decomposition in Table 9. This would, in turn, have produced over-estimates of their efficiency advantage in converting effort into mathematics grades. Without measures of effort disaggregated by course, the direction of biases could not be determined.

Conclusion

The gender gap in university participation is a remarkable sociological phenomenon. To the extent that it reflects differential access to universities, it is also an important economic problem that needs to be addressed. Undoubtedly, part of the explanation for lower participation rates by males lies in a lower desire on their part to pursue a university education, whether because they expect to earn lower returns for participation than women do or because their "taste" for education is somehow lower. Even if their desire for further education were the same, however, entrance standards set by Canadian universities might represent a greater barrier for males than for females, given the lower high school grades achieved by the former. Before coming to that conclusion, however, it is important to consider the possibility that those lower grades themselves represent an artefact of male high school students' lower desire to attend university and the consequent reduced effort put into generating the grades required for university entry.

The YITS data show that males in the sample did exert lower effort levels in high school than females, but that this lower ef-

17 The observed similarity of mathematics grades between the genders was consistent with the findings of national assessments through the School Achievement Indicators Program. See Lauzon (2001), p. 4.

18 I am indebted to Lorne Carmichael for making this point.

fort (and other personal attributes affecting grades) accounted for only 52 percent of the gap in the observed gender difference in mean grades. The remainder of the gap was attributable to differences between the genders in their ability to produce high school grades. Introducing PISA reading test scores into the estimating equations as controls for ability differences increased the proportion of the raw differential "explained" by effort and endowments, but these scores were poor proxies for pure ability as they also captured past histories of investment in producing academic achievement.

Had males in the sample worked as hard at producing high school grades as females, any gender gap in university participation attributable to rationing by entrance standards would have been lessened but would not have disappeared. Therefore, it is important to consider why the genders differed in the efficiency with which they produced grade outcomes. A preliminary examination of course grades by subject type indicated quite clearly that the difficulties for males lay not in mathematics but in language courses.

This paper raises a number of topics with policy implications. First, although there has been considerable interest in access issues, research to date has been almost exclusively focused on why some individuals have been unable to afford higher education or have not been interested in continuing education beyond high school. Almost no consideration has been given to supply constraints in the market for higher education.[19] Figure 1 suggests the role that such constraints might play. Similarly, postsecondary education policy makes much mention of underrepresented groups in postsecondary education, but that list of groups rarely, if ever, includes males. Yet, if male participation rates could be brought up to the level of female rates, there would be a significant increase in educational attainment in the Canadian labour force. Admittedly, this paper does not quantify the extent to which the rationing of university spaces by grades affects male participation. However, by introducing these two dimensions of the problem into the debate on university accessibility, this paper aims to make a contribution.

If the rationing of university spaces by high school grades is, in fact, contributing to the gender gap, then remedial action is required to eliminate the relative disadvantage in grades faced by males. The research in this paper suggests that such remedial action will require both measures to increase their motivation and measures to increase the efficiency with which males translate their efforts into grades, particularly in language courses.

19 Finnie (2004) is an important exception.

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Tables and Figures

Table 1. High school grade distributions

Grade	Males	Females
90% +	5.8%	8.7%
80-89%	26.4%	37.8%
70-79%	41.8%	39.1%
60-69%	21.4%	12.3%
55-59%	3.1%	1.5%
50-54%	0.9%	0.4%
< 50%	0.6%	0.3%

Source: YITS, Cohort A

Table 2. High school grade distributions, by gender and university aspirations

	All Respondents		With University Aspirations	
Grade	Male	Female	Male	Female
90% +	5.8%	8.7%	8.6%	11.1%
80-89%	26.4%	37.8%	35.3%	44.9%
70-79%	41.8%	39.1%	39.8%	34.7%
60-69%	21.4%	12.3%	13.7%	8.1%
55-59%	3.1%	1.5%	1.9%	1.0%
50-54%	0.9%	0.4%	0.5%	0.2%
< 50%	0.6%	0.3%	0.3%	0.2%

Source: YITS, Cohort A

Table 3. Weekly hours of study, by gender and university aspirations

	All Respondents		With University Aspirations	
Hours	Male	Female	Male	Female
0	6.7%	1.9%	3.4%	0.6%
< 1	9.3%	4.1%	7.3%	2.5%
1-3	36.3%	27.9%	32.6%	23.2%
4-7	29.7%	37.0%	32.8%	38.6%
8-14	13.8%	20.7%	17.7%	24.9%
15 +	4.3%	8.5%	6.2%	10.2%

Source: YITS, Cohort A

Table 4. Incidence of skipping classes: by gender and university aspirations

	All Respondents		With University Aspirations	
No. of Times	Male	Female	Male	Female
Never	31.4%	37.2%	34.7%	37.9%
Less than once a month	19.3%	22.4%	19.4%	23.8%
Once or twice a month	27.8%	25.6%	26.5%	25.5%
Once a week	11.3%	9.1%	10.7%	8.0%
More than once a week	10.2%	5.8%	8.8%	4.9%

Source: YITS, Cohort A

Table 5. Work effort, by gender and university aspirations

	All Respondents		With University Aspirations	
Response	Male	Female	Male	Female
Never	39.7%	56.8%	42.6%	59.1%
Rarely	23.2%	22.6%	24.4%	23.8%
Sometimes	22.0%	13.1%	20.3%	11.6%
Often	10.4%	5.3%	9.1%	3.8%
Always	4.7%	2.2%	3.6%	1.8%

Response to the question: "How often was the following statement true for you. 'I did as little work as possible. I just wanted to get by'?"

Source: YITS, Cohort A

Table 6. Sample means

Variable	Males	Females
Mother's Education		
High School or Less	0.523	0.539
Some Postsecondary: Incomplete	0.035	0.028
College	0.262	0.257
University	0.180	0.176
Father's Education		
High School or Less	0.541	0.568
Some Postsecondary: Incomplete	0.019	0.018
College	0.244	0.225
University	0.196	0.189
Parent's Combined Income	71.441	68.001
Frequency of Mother's Help (1 = never, 5 = several times/wk)	2.520	2.667
Frequency of Father's Help (")	2.319	2.361
School's Physical Infrastructure Index (SCMATBUI)	-0.358	-0.338
School's Educational Resources Index (SCMATEDU)	-0.243	-0.236
Student Teaching Staff Ratio	17.00	16.99
Nfld	0.018	0.021
PEI	0.004	0.004
NS	0.033	0.034
NB	0.026	0.027
QUE	0.228	0.220
ONT	0.382	0.390
MAN	0.036	0.036
SASK	0.043	0.042
ALTA	0.102	0.101
BC	0.129	0.125
No. of Observations	8131	8500

Source: YITS, Cohort A

Table 7. Regression results

	Male		Female	
Dependent Variable	**Without PISA score**	**With PISA score**	**Without PISA score**	**With PISA score**
Hours of study per Week (ref. group: 0 hrs.)				
Less than 1 hour	0.933	-0.050	2.027	0.680
1 – 3 hours	1.827**	0.661	2.046	0.190
4 – 7 hours	2.837**	1.223*	4.071*	1.268
8 – 14 hours	4.635**	2.437***	5.981**	2.678
15 + hours	6.879**	4.854***	5.875**	2.810
Did as Little Work as Possible (ref. group: never)				
Rarely	-1.208**	-1.572***	-0.402	-0.771***
Sometimes	-3.294**	-3.332***	-2.732**	-2.537***
Often	-4.060**	-4.130***	-4.426**	-3.936***
Always	-3.843**	-3.937***	-6.520**	-5.381***
Incidence of Skipping Classes (ref. group: never)				
Less than Once per Month	-1.329**	-0.987***	-1.558**	-1.591***
Once or Twice per Month	-2.749**	-1.946***	-2.397**	-2.272***
Once per Week	-3.842**	-3.114***	-3.465**	-3.512***
More than once per Week	-5.563**	-4.508***	-5.045**	-5.120***
PISA Reading Score		0.0358***		0.0388***
Mother's Education (ref. group: HS or less)				
Some Postsecondary: Incomplete	-0.270	0.135	0.202	-0.091
College	1.221**	0.654**	1.393**	0.604**
University	3.045**	1.649***	2.806**	1.401***
Father's Education (ref. group: HS or less)				
Some Postsecondary: Incomplete	-0.321	-0.773	0.289	-0.191
College	0.446	0.091	0.912**	0.342
University	3.013**	2.104***	3.397**	2.251***
Parent's Combined Income (,000's)	0.003	-0.002	0.006*	0.000
Frequency of Mother's Help (1 = never, 5 = several times/wk)	-0.395**	-0.092	-0.488**	-0.049
Frequency of Father's Help (")	-0.342**	-0.213	-0.120	-0.070
School's Physical Infrastructure Index (SCMATBUI)	-0.155	-0.292	0.242	0.161
School's Educational Resources Index (SCMATEDU)	-0.004	0.223	-0.060	0.014
Student Teaching Staff Ratio	-0.074	-0.169***	0.006	-0.067

Table 7 continued

Dependent Variable	Male		Female	
	Without PISA score	**With PISA score**	**Without PISA score**	**With PISA score**
Province (ref. group: Ontario)				
NFLD	-2.115**	-1.380**	-2.167**	-2.048***
PEI	1.402*	2.080***	1.284*	2.016***
NS	0.820	1.182***	1.405**	1.445***
NB	0.823	1.884***	0.598	1.191***
QUE	1.866**	1.478***	-0.128	-0.895**
MAN	0.021	-0.238	0.453	0.016
SASK	0.335	0.283	1.020*	0.634
ALTA	-1.077*	-1.737***	-3.996**	-4.753***
BC	0.491	0.503	-0.834	-0.925**
Constant	77.82**	61.85***	77.18**	59.82***
R^2	0.204	0.317	0.223	0.341
No. of Observations	8131	8118	8500	8493
Mean of Dependent Variable	75.92	75.92	78.95	78.95

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.
Source: YITS, Cohort A

Table 8. Decomposition of mean grade differences

	Without PISA score	**With PISA score**
Mean Prediction for Females	78.945	78.957
Mean Prediction for Males	75.922	75.930
Raw Difference	3.023	3.027
Due to Different Effort Levels	1.598	1.335
Due to Differences in Other Endowments	-0.153	1.052
Total Due to Endowments	1.445	2.387
Due to Differences in Coefficients (evaluated at Females' Means)	1.577	0.64

Source: YITS, Cohort A

Table 9. Decomposition of mean grade differences in math and language courses

	Mathematics	Language
Mean Prediction for Females	74.995	79.592
Mean Prediction for Males	74.536	74.892
Raw Difference	0.459	4.700
Due to Different Effort Levels	1.132	1.235
Due to Differences in Other Endowments	-0.128	-0.071
Total Due to Endowments	1.004	1.106
Due to Differences in Coefficients (evaluated at Females' Means)	-0.545	3.594

Source: YITS, Cohort A

Appendix

Full Decomposition Results

The following tables show the disaggregated decomposition results. Some care must be exercised in interpreting the disaggregation of the overall differences due to coefficients on individual factors that have no natural zero point.[20] Changes in the scale of any individual factor would change the allocation of the unexplained difference (i.e., that due to coefficients) to that factor. Thus, the seemingly large contribution of the student-staff teaching ratio (relative to other factors) in the right-most column reflects the magnitude of its scale.

20 This point was made by Jann (2008, 8-9).

Table 10. Decomposition results: specification without ability control

Dependent Variable	Due to Endowments	Due to Coefficients
Hours of study per Week (ref. group: 0 hrs.)		
Less than 1 hour	-0.047	0.042
1 – 3 hours	-0.164	0.061
4 – 7 hours	0.215	0.463
8 – 14 hours	0.317	0.281
15 + hours	0.283	-0.085
Did as Little Work as Possible (ref. group: never)		
Rarely	0.005	0.186
Sometimes	0.295	0.073
Often	0.220	-0.018
Always	0.095	-0.058
Incidence of Skipping Classes (ref. group: never)		
Less than Once per Month	-0.040	-0.052
Once or Twice per Month	0.052	0.090
Once per Week	-0.104	0.034
More than once per Week	0.263	0.028
Mother's Education (ref. group: HS or less)		
Some Postsecondary: Incomplete	0.002	0.013
College	-0.006	0.044
University	-0.012	-0.042
Father's Education (ref. group: HS or less)		
Some Postsecondary: Incomplete	0.001	0.011
College	-0.009	0.066
University	-0.022	0.072
Parent's Combined Income (,000's)	-0.010	0.199
Frequency of Mother's Help (1=never, 5=several times/wk)	-0.058	-0.142
Frequency of Father's Help (")	-0.015	0.534
School's Physical Infrastructure Index (SCMATBUI)	-0.003	-0.134
School's Educational Resources Index (SCMATEDU)	0.000	0.014
Student Teaching Staff Ratio	0.001	1.351
Province (ref. group: Ontario)		
NF	-0.008	-0.001
PEI	0.000	0.000
NS	0.000	0.020
NB	0.001	-0.006
PQ	-0.014	-0.439
MB	0.000	0.015
SK	0.000	0.028
AB	0.001	-0.293
BC	-0.002	-0.166
Constant		-0.637
Total	1.445	1.557

Table 11. Decomposition results: specification with ability control

Dependent Variable	Due to Endowments	Due to Coefficients
Hours of study per Week (ref. group: 0 hrs.)		
Less than 1 hour	0.003	0.102
1 – 3 hours	-0.059	-0.214
4 – 7 hours	0.093	0.010
8 – 14 hours	0.166	0.018
15 + hours	0.200	-0.006
Did as Little Work as Possible (ref. group: never)		
Rarely	0.006	0.191
Sometimes	0.299	0.245
Often	0.225	0.031
Always	0.095	-0.102
Incidence of Skipping Classes (ref. group: never)		
Less than Once per Month	-0.031	-0.099
Once or Twice per Month	0.038	-0.096
Once per Week	0.084	-0.057
More than once per Week	0.216	-0.091
Mother's Education (ref. group: HS or less)		
Some Postsecondary: Incomplete	0.001	0.002
College	-0.003	-0.013
University	-0.007	-0.046
Father's Education (ref. group: HS or less)		
Some Postsecondary: Incomplete	0.001	0.012
College	-0.002	0.066
University	-0.015	0.030
Parent's Combined Income (,000's)	-0.006	0.152
Frequency of Mother's Help (1=never, 5=several times/wk)	-0.014	0.104
Frequency of Father's Help (")	-0.009	0.325
School's Physical Infrastructure Index (SCMATBUI)	-0.006	-0.172
School's Educational Resources Index (SCMATEDU)	0.001	0.052
Student Teaching Staff Ratio	0.001	1.731
Province (ref. group: Ontario)		
NF	-0.005	-0.010
PEI	0.000	0.000
NS	0.001	0.009
NB	0.003	-0.017
PQ	-0.011	-0.558
MB	0.000	0.009
SK	0.000	0.016
AB	0.002	-0.311
BC	-0.002	0.190
PISA reading score	1.109	1.466
Constant		-2.071
Total	1.445	0.064