# THE IMPACT OF ASSIGNMENTS ON ACADEMIC PERFORMANCE

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#### ABSTRACT

We study the factors affecting the academic performance of economics students at a small Canadian university using the Ordered Probit method, with Ordinary Least Squares and the Propensity Score Matching method used in robustness checks. Graded homework, shown to have ambiguous effects in previous work, here had a positive effect. A major contribution of the study is its analysis for various subgroups: Graded assignments had their strongest effects among male students and those with foreign (non-Canadian) backgrounds. GPA and higher levels of teacher experience also positively affected performance.

## **INTRODUCTION**

In this paper, we examine the impact of graded homework on the test performance of students taking economics courses. Recently, researchers have done extensive amounts of work on how to improve performance of economics students (Anderson, Benjamin & Fuss, 1994; Arias & Walker, 2004; Borg & Shapiro, 1996; Greene, 1997; Jensen & Owen, 2001). These studies focused on factors such as class size, personality type, verbal abilities, gender, and interest in economics. One of the least researched issues is the impact of graded assignments on student performance, even though assigning problem sets is now an important part of teaching strategies employed in economics courses (Geide-Stevenson, 2009). Assignments that are graded, with the score used as part of the final course grade, are expected to improve test performance. The logic is that students will be motivated to work on the graded assignment and will learn from it; consequently, test scores will improve. Graded assignments, however, do impose costs on both instructors and students. Instructors spend time grading the assignments and providing adequate feedback. As for students, they may need to forgo other, more productive learning processes and methods to make the time to work on graded assignments (Geide-Stevenson, 2009). Thus, it is necessary to examine whether and to what extent graded assignments benefit students.

Although many studies have examined the impact of homework assignments on student performance at the elementary and secondary education levels, only a few studies have investigated this important issue in a university-level setting. Cooper (1989) provides an excellent review of the studies on the impact of homework on student performance in elementary and secondary schools. Grove and Wasserman (2006), using data from economics students in a

U.S. university, compared exam performance of students for whom assignments counted toward the final grade with the performance of a control group. Using Ordinary Least Squares regression analysis, the study found that a grade incentive to complete assignments boosted the exam performance of academically average freshman students but not those who were academically above or below average, or of any other class standing. Geide-Stevenson (2009) used data from economics students at another U.S. university and found from Ordinary Least Squares regression analysis that graded assignments had no impact on academic performance.

Thus, not only is there a paucity of studies on the impact of assignment on academic performance of university students, but the results so far also are conflicting. In the present study, we aim to fill the gap in the literature and extend the earlier studies in a number of ways: to the best of our knowledge, this study is the first of its kind using Canadian data; this study uses the Ordered Probit method as well as Ordinary Least Squares and Propensity Score Matching methods; and unlike previous studies, which used data from either lower-level or upper-level economics courses, this study uses data from both levels of economics courses.

A major contribution of this paper is that it examines the impact of assignments on academic performance of various student subgroups: male vs. female and domestic vs. international. International students have been enrolling in Canadian universities in increasing numbers, so it is important to identify factors that influence their academic performance. In this respect also, this study aims to make an important contribution.

The paper has the following format: section 2 deals with data and methodology, section 3 presents results of the study, and section 4 offers conclusions.

## DATA AND METHODOLOGY

## Data

Data for this study come from 387 students who were taking various levels of economics courses at Thompson Rivers University, a small Canadian primarily undergraduate institution, during the winter term (January-April) of the 2009-2010 academic year. The authors personally collected data from 18 different sections of various courses during the 10th and 11th weeks of the 12-week term. Students appeared to be enthusiastic about the survey administered as part of the study, and the authors encountered virtually no difficulty in data collection. Before administering the survey, the authors explained its purpose to students, and during the survey process, the authors answered queries from students to make sure they understood the survey questions. As shown in the descriptive statistics in Table 1, 60% of the sampled students are male and 40% are female; 61% of the students are of domestic (Canadian) origin, and the rest (39%) are international students. The authors obtained Institutional Ethics Committee approval before conducting the survey.

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## **Model Specification**

We focus on the impact of graded homework assignments on the probability of a student receiving a specific grade, from A to F, in an economics course. The model is written in following form:

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\begin{aligned} &Grade = \beta_0 + \beta_1 \ Assignment + \beta_2 \ Student \ Gender + \beta_3 \ International + \beta_4 \ GPA + \\ &\beta_5 \ Second \ Year + \beta_6 \ Third \ Year + \beta_7 \ Fourth \ Year + \beta_8 \ Experience + \beta_9 \ Faculty \end{aligned} \tag{1}
Gender + \varepsilon
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The dependent variable Grade is an index of average grade (F to C-- = 0, C to C+ = 1, B- to B+ = 2, and A- to A+ = 3) that students received in their midterm examinations for a course. In the above formulation, student characteristics are represented by gender, cultural background (whether international or domestic), and cumulative GPA. Course characteristics are represented

	Descr	Tab iptive Statistics (M	le 1 ean Values of V	ariables)	
Variables	Overall	Female Student	Male Student	Domestic Student	International Student
Mala Student	.60			.57	.67
Male Student	(.025)			(.032)	(.038)
Female Student	.40			.43	.33
remaie Student	(.025)			(.032)	(.038)
Domestic Student	.61	.43	.57		
Domestic Student	(.024)	(.032)	(.032)		
International Student	.39	.33	.67		
International Student	(.024)	(.038)	(.038)		
Average Midterm Marks	71.390	72.701	70.542	73.117	68.662
Average whiterin warks	(.704)	(1.084)	(.922)	(.895)	(1.109)
Cumulative GPA	3.062	3.16	2.996	3.129	2.956
Cumulative Of A	(.030)	(.049)	(.038)	(.037)	(.050)
Experience (Years)	9.832	11.382	8.830	10.473	8.82
Experience (Tears)	(.582)	(1.012)	(.694)	(.782)	(.850)
Study Hours	2.867	3.316	2.577	2.566	3.343
Study Hours	(.907)	(.158)	(.118)	(.108)	(.176)
First Year Level	.271	.237	.294	.257	.293
riist real Level	(.023)	(.035)	(.030)	(.028)	(.037)
Second Year Level	.338	.375	.315	.338	.34
Second Teal Level	(.024)	(.039)	(.030)	(.031)	(.039)
Third Year Level	.235	.25	.226	.283	.16
	(.022)	(.035)	(.027)	(.029)	(.030)
Fourth Year Level	.085	.092	.081	.114	.04
routur rear Level	(.014)	(.024)	(.018)	(.021)	(.016)
Sample Size	387	237	150	237	150
Note: Standard errors are	e shown in th	e parentheses.		•	

by the level of the course, whether first, second, third, or fourth year. Faculty characteristics are represented by teaching experience and gender of the faculty member teaching a particular course.

If graded assignments are a course requirement, students will be motivated to study and work on the assignments, and consequently their grades are expected to improve. Furthermore, if assignments are closely related to test questions, then students who do the assignments are more likely to do well on the test. Finally, students may be more interested in participating in classes if they believe that participation will help them to do well on the assignments, and such class participation may also have a positive independent effect on course grade. In summary, it is expected that graded assignments will positively influence students' course grade. The independent variable Assignment is a dummy variable representing whether the student has a graded assignment as part of the course requirements.

Cumulative GPA serves as a proxy for a student's ability, and it is expected that those with higher cumulative GPAs will have better class performance. GPA is a continuous variable measuring the cumulative GPA attained by the student. Gender may also have an impact on grade. Meit, Borges, Cubic, and Seibel (2007) argued that female students tend, more than males, to have various positive learning attitudes and behaviors; among these, they are self-directed, dutiful, and persevering in their studies and are more disciplined. Learning success has been found to depend on student strategies. Simsek and Balaban (2010) found that appropriate study strategies, including rehearsal, organization, and self-motivation, were more effectively used by females. Thus, it is expected that females would do better than males. The independent variable Student Gender is a dummy variable with male as the base category.

International and domestic students differ with respect to academic background and preparation, and differences in student status may have an impact on the course grade. The School of Business at Thompson Rivers University has many international students enrolled whose first language is not English. They face language barriers, given that courses are conducted in English. Consequently, it is hypothesized that international students would do worse than domestic students, whose first language is English. The variable International also is a dummy variable, with domestic status as the base category.

Course content and difficulty differ among the various levels of courses, and the level of a course is expected to have an impact on grades attained. The course levels are represented by three dummy variables: Second Year, Third Year, and Fourth Year; the base category is First Year.

As for faculty characteristics, more years of experience are likely to make teachers more efficient and productive, and consequently students are expected to do better in classes taught by more experienced teachers. The independent variable Experience is a continuous variable representing the number of years a faculty member has been teaching. It is hypothesized that students would do better in the courses taught by more experienced faculty.

Studies suggest that instructor gender also has an impact on student outcomes in higher education (Rask and Bailey, 2002; Ashworth and Evans, 2001). Faculty members become role models for students of their own gender; thus, students are hypothesized to do better in courses taught by instructors who share their gender. It is difficult to hypothesize the overall impact of faculty gender in a particular class, as this depends on the gender composition of the students. Thus, the impact of gender on academic performance is an empirical question. In this study, faculty Gender is a dummy variable, with male as the base category.

Because the dependent variable, Grade, is ordinal in natural, the study will use an Ordered Probit method to estimate the model shown in Equation (1). The ordered probit model is useful to determine a student's probability of receiving a specific grade in an economics course. The model can be expressed in the following form:

$$y_i^* = x_i \beta + \varepsilon_i \tag{2}$$

where  $y_i^*$  is the predicted grade as a function of the independent variables in the model. The  $x_i$ 's are the independent variables, and the  $\beta$ s are the estimated coefficients. The observed ordinal grades are given by  $y_i$ , which takes one of the values 0, 1, 2, or 3. The observed y is of the following forms:

$y = 0$ (or grade F to C–) if $\mu_{-1} < y^* < \mu_0$	(3a)
$y = 1$ (or grade C to C+) if $\mu_0 < y^* < \mu_1$	(3b)
$y = 2$ (or grade B- to B+) if $\mu_1 < y^* < \mu_2$	(3c)
$y = 3$ (or grade A- to A+) if $\mu_2 < y^* < \mu_3$	(3d)

where  $\mu_0$ ,  $\mu_1$ ,  $\mu_2$ , and  $\mu_3$  are threshold variables to be estimated in the ordered probit model using maximum likelihood procedure. The probabilities of receiving particular letter grades based on the slope and threshold estimates are shown in the following equations:

$P[y=0] = \Phi(\mu_0 - x_i\beta) - \Phi(\mu_1 - x_i\beta)$	(4a)
$P[y=1] = \Phi(\mu_1 - x_i\beta) - \Phi(\mu_0 - x_i\beta)$	(4b)
$P[y=2] = \Phi(\mu_2 - x_i\beta) - \Phi(\mu_1 - x_i\beta)$	(4c)
$P[y=3] = \Phi(\mu_3 - x_i\beta) - \Phi(\mu_2 - x_i\beta)$	(4d)

where  $\Phi$  is the standard normal cumulative distribution.

## RESULTS

Results of the regressions appear in Tables 2 through 5. The results show that, as expected, the a graded assignment in a course is associated with higher letter grades for students in that course. To check for a possible multicollinearity problem, the study used the step-wise

regression method and did not find any presence of problems. To deal with the possible heteroskedasticity, the study used heteroskedasticity robust standard errors in all of the regressions.

		r	Table 2		
		Average 1	Midterm Marks		
	Overall	Male Student	Female Student	Domestic Student	International Student
With Assignment	74.30* (1.09)	74.09* (1.36)	74.59* (1.83)	74.77* (1.38)	73.10* (1.66)
Without Assignment	69.77 (.895)	68.63 (1.18)	71.59 (1.33)	71.93 (1.16)	67.10 (1.35)
Note: Standard errors a	are shown in the	parentheses; * inc	licates that the mea	an difference between	"with assignment" and
"without assignment" is	s significant at the	e 1% level.			

Table 2 compares mean midterm grades of students who had, or did not have, assignments included as part of their final grade. The results suggest that students with assignments have significantly higher mean marks than those without assignments. This result holds true for all categories; the difference is most pronounced for male and international students. These mean comparisons do not imply, however, that students with assignments got higher marks because of the assignments. Other confounding factors might lead to such results. In particular, meritorious and hardworking students, who otherwise would be expected to earn high course grades, might also be expected to self-select into courses that are known to have graded assignments. This effect is explored below. A regression method that includes confounding factors is needed to examine whether the graded assignments actually caused the improvements in grade.

		Table	3		
Resu	lts of Ordered Pi	obit Estimations: D	ependent Variable-Mi	dterm Grade	
Variables	Overall	Domestic Student	International Student	Female Student	Male Student
Male Student	032 (.117)	044(.157)	.086(.181)		
International Student	223**(.113)			375(.185)	140(.146)
GPA	.636*(.135)	.966*(.207)	.220(.161)	.715*(.251)	.574*(.165)
Second Year	.034(.146)	.244(.217)	328(.219)	.008(.253)	.012(.187)
Third Year	076(.164)	013(.234)	133(.246)	078(.312)	084(.189)
Fourth Year	250(.222)	153(.297)	123(.379)	357(.379)	204(.282)
Homework Assignment	.350*(.137)	.224(.186)	.508*(.212)	.384(.236)	.350**(.169)
Experience	.010*(.004)	.011**(.006)	.004(.008)	.015*(.006)	.005(.006)
Female Faculty	291***(.157)	434**(.227)	.025(.195)	454(.265)	157(.190)
/cut1	.408(.513)	1.60(.676)	294(.602)	.578(.885)	.308(.513)
/cut2	1.20(.517)	2.46(.688)	.475(.600)	1.20(.864)	1.199(.526)
/cut3	2.37(.535)	3.63(.716)	1.728(.602)	2.46(.882)	2.33(.536)
Notes: Standard errors ar	e shown in parent	heses. Significance le	evels: * 1%, ** 5%, ***	10%.	L

Table 3 provides the results of Ordered Probit regression. The first column shows the results of regression using the overall sample. It suggests that the graded assignments had significant positive effects on grade. The model also shows that students with higher GPA earned higher grades, international students earned significantly lower grades than domestic ones, and the teacher's experience had a significant positive effect on grades. Table 4 provides the marginal effects of this regression. The results suggest that having a graded assignment decreased the probability of getting a grade between F and C– and the probability of getting a grade of C to C+ by 5.3 % and 6.3%, respectively, and it increased the probability of getting a grade of A– to A+ by 11.7%.

Ν	Iarginal Effects of Or	Table 4 dered Probit Estimat	ion (Overall Sample)	
Variables	Grade (F to C-)	Grade (C, C+)	Grade (B-, B, B+)	Grade (A-, A, A+)
Male Student	.005 (.020)	.005 (.021)	0006 (.002)	010 (.039)
International Student	.036** (.018)	.040** (.022)	004 (.005)	073** (.038)
GPA	104* (.023)	115* (.029)	.011 (.015)	.207* (.044)
Second Year	005 (.024)	006 (.027)	.0005 (.002)	.011 (.048)
Third Year	.013 (.028)	.012 (.030)	001 (.005)	022 (.052)
Fourth Year	.046 (.045)	.043 (.038)	014 (.022)	075 (.063)
Homework Assignment	053* (.019)	063* (.025)	0004 (.008)	.117* (.047)
Experience	002** (.0008)	002** (.0008)	.0002 (.0002)	.003** (.0015)
Female Faculty	.054 (.033)	(.026)	016 (.016)	088** (.045)
Notes: Standard errors are sh	nown in parentheses. Si	gnificance levels: * 19	%, ** 5%, *** 10%.	

Regressions using subgroup samples determined whether the impact of assignment on grade varies among different subgroups of students. Table 3 shows the results of Ordered Probit regressions for different subgroups: male, female, domestic, and international. For the male group, Assignment and GPA had significant positive effects on grade. For the female group, Assignment had a positive but nonsignificant impact, whereas GPA and teacher experience had significant positive effects on student grade. For the domestic subgroup, again Assignment was not a significant variable; however, for this group, GPA and teacher's experience had a significant positive effect. For the international student group, Assignment, with a positive influence on grade was the only variable with a significant effect on grade. The marginal effects of Assignment in these regressions are shown in Table 5. The estimations show that for international students, Assignment reduced the probability of getting a grade from A to A+ by 14.9%. For the male group, Assignment reduced the probability of getting a grade from F to C-- by 5.4%, and from C to C+ by 6.9%, and it increased the probability of getting a grade from F to getting a grade from F to C-- by 5.4%, and from C to C+ by 9.9%, and it increased the probability of getting a grade from F to C-- by 5.4%, and from C to C+ by 6.9%, and it increased the probability of getting a grade from F to C-- by 5.4%, and from C to C+ by 6.9%, and it increased the probability of getting a grade from F to C-- by 5.4%, and from C to C+ by 6.9%, and it increased the probability of getting a grade from F to C-- by 5.4%.

		Table 5		
	Marg	inal Effects for Subgr	oups	
Variables	Grade (F to C-)	Grade (C, C+)	Grade (B-, B, B+)	Grade (A-, A, A+)
Domestic Student	026 (.021)	043 (.037)	010 (.013)	.080 (.067)
International Student	093* (.037)	085** (.039)	.030 (.019)	.149** (.067)
Female Student	057*** (.032)	055 (.036)	022 (.025)	.135 (.085)
Male Student	054** (.025)	069** (.036)	.010 (.010)	.112** (.057)
Notes: Standard errors	are shown in parenthe	eses. Significance level	s: * 1%, ** 5%, *** 10	)%.

grade from A– to A+ by 11.2%. In sum, the positive impact of Assignment on grade is most pronounced for the international group, followed by the male group.

## **ROBUSTNESS CHECK**

Two forms of statistical analysis verified the robustness of the results. These were Ordinary Least Squares Regression and the Propensity Score Matching Approach.

## **Ordinary Least Squares Regression (OLS)**

To check the robustness of the results, we used midterm marks as a continuous dependent variable and ran an estimation using the OLS regression method. The results, shown in Table 6, are very similar to those found with the Ordered Probit method. The results suggest that for the overall sample, Assignment, GPA, and teacher's experience had significant positive effects on grades, whereas being an international student had a significant negative effect on grade. The average effects on course marks of presence of a graded assignment, a difference of one point in GPA, and a difference of one year in the instructor's experience were 3.53, 7.13, and 0.11 points, respectively. International students received marks that were on average 2.64 points lower than those of domestic students. The subgroup analyses suggest that Assignment positively influences grade for international and male students but has no impact on the grades of domestic and female students by 3.53 and 4.17 points, respectively. In sum, the OLS analyses confirm the findings of the Ordered Probit method.

## **Propensity Score Matching Approach (PSM)**

It is possible that meritorious and hardworking students self-select to the courses that have graded assignments. If this is the case, these students do well on the midterms not because of the graded assignments but because of their merit. If that is the case, the results of a study such as this one would be more meaningful if it were possible to have each student take two courses, one with a graded assignment and another without, and then compare relative performances. The current project, however, did not allow for such an experiment. Instead, we use a propensity score matching (PSM) approach to tackle this kind of problem. The PSM approach answers the counterfactual question as to what would have happened to those students who, in fact, attended classes with a graded assignment, if they had not attended classes with an assignment (or the converse). The PSM approach employs a predicted probability of group membership (e.g., students with assignment vs. those without assignment), based on observed predictors and usually obtained from logistic regression, to create a counterfactual group.

Variables	Overall	Domestic Student	International Student	Female Student	Male Student
Male Student	484 (1.367)	310 (1.70)	.192 (2.22)		
International Student	-2.64** (1.43)			-3.64** (2.11)	-2.01 (1.83)
GPA	7.13* (1.48)	9.89* (1.72)	3.35 (2.57)	7.86* (2.62)	6.53* (1.78)
Second Year	1.98 (1.78)	4.20 (2.62)	-1.93 (2.65)	1.54 (2.83)	1.79 (2.37)
Third Year	1.24 (1.86)	2.44 (2.69)	456 (2.57)	1.40 (3.35)	1.11 (2.29)
Fourth Year	-1.04 (2.42)	.583 (3.25)	1.73 (3.36)	-2.35 (4.43)	276 (2.84)
Homework Assignment	3.53* (1.42)	1.37 (1.89)	6.58* (2.14)	2.60 (2.29)	4.17** (1.88
Experience	.113* (.045)	.110*** (.061)	.065 (.078)	.124** (.060)	.085 (.069)
Female Faculty	-4.04* (1.59)	-5.94* (2.14)	1.33 (2.20)	-5.87** (2.84)	-2.41 (1.83)
constant	51.44* (6.304)	39.92* (6.43)	56.62* (9.96)	50.81* (9.71)	51.16* (6.17

To examine the impact of Assignment on grade, we use three different PSM methods: Nearest Neighborhood Matching, Radius Caliper Matching, and Kernel Matching. The results of the PSM analyses are shown in Table 7. The results suggest that for the overall sample, the impact of Assignment on midterm grade was significantly positive for all three PSM methods. The results further show that Assignment had a significant positive effect on grade for international and male students. These findings confirm the earlier results from the Ordered Probit and OLS approaches.

Kernel 3.55** (1.81) 1.30 (2.41)	Radius Caliper (.05)           3.57**         (1.82)           1.32         (2.44)
1.30 (2.41)	1.32 (2.44)
. ,	· · · ·
5 49** (2 70)	
5.48** (2.70)	5.24** (2.66)
4.59*** (2.88)	4.93*** (2.88)
1.92 (2.53)	2.30 (2.52)

## CONCLUSION

Using data from economics students at a small, primarily undergraduate university in Canada, we examined the impact of graded assignments on academic performance, as measured by average midterm grades. We used the Ordered Probit method; as a robustness check, we also utilized Ordinary Least Squares and the Propensity Score Matching method. We found that for the overall sample, Assignment had a significant positive impact on grade. We examined the impact of Assignment for different subgroups of students and found that it positively influenced the grades of male and international students. Other results suggest that GPA had a significant positive effect on grade and that students with more experienced teachers earned higher grades. The results further suggest that domestic students do better than international ones.

The results clearly suggest that graded assignments can be used to improve academic performance, especially that of males and international students. Descriptive statistics suggest that compared to other subgroups, male students on average study less (see the row titled "Study Hours" in Table 1). It appears that graded assignments motivate male students to study and thus have a beneficial impact on their grades. Descriptive statistics further suggest that international students, on average, study relatively more than other groups. However, international students have a different educational background as well as possibly a different language from domestic ones, and consequently they may face barriers in pursuing studies in Canada. It seems that graded assignments and subsequent feedback may give international students an opportunity to improve their understanding of the course material and that this enables them to do better on exams.

The major policy recommendation of the study is to include one or more graded assignments as integral components of university courses. It is also recommended that more emphasis be given to improving language proficiency of international students.

Like other studies related to education, this study suffers from selection bias, in that meritorious and hardworking students may gravitate to the courses with more graded coursework, such as assignments. To control for this bias, we employed two strategies: first, we included as many relevant independent variables as possible, and second, we used the Propensity Score Matching approach as a robustness check. The Propensity Score Matching approach can solve the problem of selection bias if the bias arises from differences in the observable factors, but not if the bias is due to unobservable factors such as ability or interest in the subject. Thus, the strategies adopted in this study may have reduced selection bias but could not fully eliminate it.

Future studies on the relationship between graded assignments and academic performance could employ panel data to utilize fixed effect regression methods that can control for unobserved individual-specific fixed effects.

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Page 12