Present-biased preferences and academic achievements

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Abstract

This study measures students' degree of present-biased preferences, as captured by "the number of days delayed," or "delay." "Delay" is the difference between the day that a student indicated that he or she would start working on a homework assignment, and the day that he or she actually started working on that assignment.

Regression results demonstrate that "delay" is negatively associated with homework score, grade in principles of micro-and-macroeconomics, and cumulative GPA. In addition, students do not update their priors about their own behavior.

JEL classification: D90, I20

Keywords: Present-biased preferences; procrastination; time inconsistency; self-discipline; academic achievements.

1 Introduction

People have self-control issues. We tend to seek immediate gratification and postpone costly actions (O'Donoghue and Rabin, 2000). As such, self-control seems to be an asset: the ability to delay gratification and carry out costly action promptly has become a key to success, such as studying hard and getting good grades, meeting project deadlines, living within one's means, and staying on a diet (Laibson, 1997).

At school, self-control issues arise when students postpone studying until days or hours before a major exam, or wait until the last minute to start working on an assignment, such as homework or a term paper. The principle seems simple: given the same deadline, the longer one waits to start working on an assignment, the less time is permitted for that assignment. As a result,

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the later a student starts working on an assignment, the lower the quality of the completed (and sometimes unfinished) assignment.

Nevertheless, postponing working on an assignment does not necessarily suggest self-control issues. While some students are procrastinating, others take the time to study lecture notes and the textbook to better prepare themselves for the homework assignment. If so, delaying working on an assignment could possibly improve, rather than jeopardize, the quality of the assignment.

As such, the number of days that a student waits until starting working on an assignment is no longer a good measurement of (the lack of) self-control. Instead, an appropriate measurement of self-control should reveal whether a student has present-biased preferences, and if so, the degree of it.

O'Donoghue and Robin (1999) define present-biased preferences as follows:

> "When considering trade-offs between two future moments, present-biased preferences give stronger relative weight to the earlier moment as it gets closer."

For instance, when given a choice between accomplishing an unpleasant task (say, unpleasant yard work) for seven hours on May 1 versus eight hours on May 8, if asked on March 1, many would choose the former. However, if the same options are presented on May 1, the same individuals would choose the latter. Although the choices are the same, the same individual at a different time (March 1 versus May 1) would make a different choice (O'Donoghue and Robin, 1999).

Notice that the example above is in contrast to exponential discounting that economists typically assume. In other words, many economists assume that individuals are time-consistent —- that is, a person's preference of when to do something does not change regardless of the time that the options are presented (O'Donoghue and Robin, 1999).

This study measures students' present-biased preferences similar to O'Donoghue and Ra-

bin's (1999) example above. The author observes the behaviors of students in several principles of micro-and-macroeconomics classes, taught between spring 2015 and spring 2017 at the University of St. Thomas, Houston, TX. On a day when a homework assignment was given on Blackboard, the author, also the instructor of the classes, asked each student to indicate which day he or she planned to start working on that assignment. Unbeknownst to the students, the author also observed the day that each student actually started working on the assignment. Not surprisingly, the two days did not always coincide.

The difference between the day that a student planned to work on an assignment, and the day that the student actually started working on that assignment, is called "the number of days delayed," or "delay," in this paper. "Delay" is the measurement of the degree of a student's present-biased preferences, as well as his or her lack of self-control. The larger "delay," the more the student is biased to the present, and the more self-control issue the student has.

Of course, delay does not always suggest present-biased preferences, or self-control issues. For instance, sickness could cause delay. However, if a student consistently delays working on homework, that could suggest present-biased preferences and self-control issues.

This study finds that students with stronger present-biased preferences, as measured by relatively larger "delay," are more likely to 1. score lower in a homework assignment, 2. perform worse in principles of micro-and-macroeconomics, and 3. have lower GPAs.

The major finding of this study is that, self-control issue has a negative association with academic achievements. This finding is coherent with the literature: research shows that high school students with higher scores on self-control tend to have higher GPAs (Chamorro-Premuzic and Furnham, 2003; Duckworth and Seligman, 2006; Tangney, Baumeister, and Boone, 2004). Furthermore, studies also find that self-control outdoes IQ in predicting academic achievements of adolescents (Duckworth and Seligman, 2005).

Nevertheless, to the best of the author's knowledge, none of the literature measures students'

level of self-control by their degree of present-biased preferences, or students' behaviors in the field. Instead, the literature measures students' self-control with laboratory observations unrelated to their academic work. For instance, Duckworth and Seligman (2005) ask respondents to choose between a small immediate monetary reward ($1 now) and a large delayed reward ($2 later) to see if they had good impulse control. Tangney et al. (2004) and Duckworth and Seligman (2006) use hypothetical statements such as "Sometimes I feel like smashing things," or questions like "do you save regularly?" to estimate students' self-control ability. None of these measurements are directly related to students' academic work. In addition, none of the students' behaviors were observed in the field.

In contrast to the literature, this study captures students' self-control ability that is directly related to their academic work — delay — the difference between the day that a student indicated that he or she would start working on a homework assignment, and the day that the student actually worked on it. Furthermore, this study uses "delay" to measure students' degree of present-biased preferences. The same student was presented the same question —- when to attempt the assignment —- at different times. This study demonstrates that the same student's "current-self" and "future-self" made different choices, a phenomenon of time inconsistency.[1]

Finally, unlike most experimental studies that rely on laboratory results, this study captures individuals' behaviors outside of the laboratory, which better reflects the reality. To the best of the author's knowledge, this is the first paper studies students' present-biased preferences and behaviors in the field.

The rest of the paper will proceed as follows: Section (2) introduces the method of data collection. Section (3) describes the data collected in the field. Section (4) details regression models and expectations, and Section (5) presents regression results. Section (6) discusses policy implications, as well as whether students update the priors of their own behaviors. Section (7) concludes.

[1] O'Donoghue and Rabin (1999, p.103) indicated that an impatient but time-consistent agent's "relative preference for well-being at an earlier date over a later day is the same no matter when she is asked."

2 Data collection method

Subjects Students who took principles of microeconomics (ECON 1332) and principles of macroeconomics (ECON 1331) taught by the author from spring 2015 to spring 2017 at the University of St. Thomas (UST), Houston TX, were solicited for the study (see Table (1)). Each class had 20 to 30 students. The students were diversified in gender, as well as cultural and ethnic backgrounds.

(Table (1) here)

In the beginning of the study, the students were guaranteed confidentiality of their personally identifiable data, and signed the consent approved by the UST Human Subject Committee. Extra credits were offered as an incentive for participation. Due to the low marginal cost of participation (5 minutes of class time; details below), the initial participation rate was 100%. However, some students (typically poor performers) later dropped the class and their data were excluded. In addition, students who failed to hand in any assignment were also dropped from the data set.

Procedure In the beginning of each semester, the author, also the instructor, discussed this research project with all students in classes listed in Table (1). The students were told that the purpose of this project is to understand their study plan; in particular, the day that they plan to work on homework assignments. However, students were not aware that the instructor later checked the day that students actually started working on the homework assignments.

Students were assured that this research project would not affect their grade. Specifically, the instructor guaranteed that she would not look at students' study plan until the grades were submitted. This promise was honored.

Homework assignments In each class listed in Table (1), the instructor gave five graded open-book homework assignments on Blackboard, a web tool for higher education.[2] Each assignment contained 10 to 18 multiple choice questions.[3] In addition, each assignment became available on a Tuesday at 12:30 pm, and was due the following Sunday at 11:59 pm.

The due dates of the homework assignments were indicated on the syllabus. Moreover, on a Tuesday when an assignment became available, the instructor announced in class that a homework assignment "will become available today at 12:30pm.[4]" On the following Thursday during class time (after the assignment became available for two days), the instructor reminded students about the assignment.

Each student had two attempts for each assignment before the due date, and the higher score counted. The second attempt was optional. Each attempt was timed for 150 minutes, and all assignments comprised multiple choice questions only. Therefore, students could work on homework assignments without time pressure. Furthermore, the students were encouraged to work in groups.

After each attempt, Blackboard informed the student the number of mistakes he or she made, without indicating which answer was wrong. Once an assignment was due, students could no longer attempt the assignment, and Blackboard graded all students' assignments automatically. At the end of the semester, the worst assignment was dropped from each student's record.

Each homework assignment had the same weight and was normalized to 100 points. For instance, if an assignment had 15 questions, then each question counted 6.67 points. But in an assignment that had 10 questions, each question counted 10 points. At the end of the semester, after dropping the worst assignment, the average score of the assignments counted 20% of the

[2]The instructor also gave extra exercises, similar to homework assignments. However, exercises did not affect students' final grade, and the instructor did not track whether students attemped these exercises.

[3]There was one exception: Homework 4 in spring 2017 had only 7 multiple choice questions.

[4]ECON 1332 Section N was the only exception. The class met on Tuesdays and Thursdays at 3:35pm. Therefore, the assignments became available three hours before the class met. The instructor told the class "The homework assignment has been posted," rather than "The homework assignment will become available today."

students' final grade.

The weight of assignments, as well as assignment policy (no late assignments, two attempts allowed in each assignment, etc.) were indicated on the syllabus. In addition, the instructor announced the assignment policy in all classes at the beginning of each semester.

Study plan On a Tuesday when a new assignment became available, the instructor gave the students a short questionnaire during the class. The questionnaire asked students to indicate on which day they planned to start working on the assignment. Each student could choose among Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday (the due date), or "I do not plan to work on my assignment this week (I am out of town, etc)." Throughout the data collection period, no student ever chose the last option.

Each homework assignment contained material that was covered in the week before. This gives students more information to decide which day to attempt the homework.

Students were reassured that their grades will not be affected whether or not they worked on an assignment on a different day from his or her original plan as indicated on the questionnaire. In other words, students were not bond to "commit" to their plan. This promise was also honored.

As mentioned, the instructor also announced to the students that the instructor would not look at the students' study plan questionnaire until the semester was over and the grades were submitted. This eliminated instructor's bias, as well as students' incentive to "impress" the instructor by putting down an earlier date.

Procrastination Blackboard keeps a record as to exactly which day a student started working on an assignment. Let A_i be the day that the student actually started working on Homework i, $i = 1 \ldots 5$. This is how A_i is coded: Tuesday=2, Wednesday=3, Thursday=4, Friday=5, Saturday=6,

and Sunday=7.[5] For example, if a student actually attempted Homework 3 on Sunday, then $A_3 = 7$.

Let the day that a student planned to start working on Homework i be P_i, coded the same way as A_i. Then, if a student indicated on the questionnaire that he or she would start working on Homework 3 on Friday, then $P_3 = 5$.

Not surprisingly, P_i is not always equal to A_i. Very often, $A_i > P_i$. That is to say, students more or less procrastinated. Let the number of days delayed, or "delay" be D_i, where $D_i = A_i - P_i$. For instance, if a student indicated on the questionnaire that he or she would like to start working on Homework 3 on Friday, but actually started working on Homework 3 on Sunday, then $D_3 = A_3 - P_3 = 7 - 5 = 2$.

It is possible that $D_i < 0$. That is, occasionally, a student worked on an assignment earlier than he or she had planned. However, this happened less than 9% of the time. In contrast, $D_i > 0$ happened most of the time (see Table (2) for details).

(Table (2) here)

3 Data

Through spring 2015 to spring 2017 (5 semesters in all), the author was able to collect most students' plan to work on a homework assignment (P_i), as well as the actual day students worked on the assignment (A_i). Thus, the author was able to calculate the number of days delayed for most assignments.

Missing observations of D_i Because "delay" D_i is equal to $P_i - A_i$, a student does not have an observation of D_i if either P_i or A_i is missing. For instance, if a student missed the Tuesday class when Homework i became available, then he or she did not participate in the questionnaire

[5] One can also code Tuesday=1, Wednesday=2, and so on, but this does not affect the regression results.

to indicate as to which day he or she planned to start working on Homework i. Therefore, he or she has no record of P_i, and thus, no record of D_i.

Additionally, if a student missed Homework i, then he or she had no record of A_i, and as a result, no record of D_i.

Potential underestimation The drawback of variable D_i is that it underestimates students' degree of present-biased preferences due to missing assignments. For instance, if a student had indicated that he or she would start working on Homework i on Friday ($P_i = 5$) but ended up missing the deadline of the assignment, then there is no record of A_i or D_i. Thus, D_i fails to capture students' present-biased preferences when they missed assignments.

As mentioned in Section (2), poor performers dropped the class and their data were excluded. Moreover, students who failed to hand in any assignments had no data of A_i; consequently, their data were excluded also. These data exclusions could also cause the results to become biased downwards.

(Partial) remedy for underestimation due to missing assignments The due date for every assignment was a Sunday. Therefore, missing the assignment means that the student "would have" done the homework on the following Monday or later, or perhaps never. This means A_i "could have been" equal to 8, a number larger than 8, or $A_i = \infty$. Suppose $P_i = 5$, then this student's D_i was supposed to be a number greater than or equal to 3. Hence, one can partially alleviate the underestimation by recording missing assignment as $A_i = 8$.

Nevertheless, this remedy does not eradicate the issue of underestimation, for the student could have attempted the assignment later than Monday ($A_i > 8$), or never ($A_i = \infty$).

Demographic information In a separate on-line questionnaire approved by the UST Human Subject Committee, the author collected student's demographic information, including race, gen-

der, and major.

Summary of statistics The summary of statistics are displayed in Tables (3), (4), (5), and (6). Tables (3) and (5) record missing assignments as missing data, whereas Tables (4) and (6) record missing assignments as ones "having been completed on the following Monday."

(Tables (3), (4), (5), and (6) here)

4 Regression models and expectations

The purpose of this study is to find out whether procrastination — specifically, one's degree of present-biased preferences —- has an association with the quality of his or her work, as well as his or her academic achievements. Three variables capture students' present-biased preferences: A_i, the actual day that the student started working on Homework i; D_i, the number of days a student delayed before working on Homework i; and M, the number of missing assignments.

The definition of "procrastinate," according to the Merriam-Webster dictionary, is "to put off intentionally and habitually." If one takes this definition literally, then variable A_i —- the actual day that the student started working on Homework i —- might reflect how much each student tends to procrastinate. The larger A_i, the later a student started working on Homework i since it became available, and the more the student had procrastinated.

However, a student might start working on an assignment late because he or she took the time to study the textbook and lecture notes before attempting the assignment. In that case, variable A_i might not be a good indication of procrastination.

Assuming that, when filling out the questionnaire about their homework plan, the students had to consider the amount of time needed to study before attempting the assignment, then variable D_i would probably serve as a more accurate measurement of procrastination than variable A_i.

Variable D_i also measures a student's degree of "present-biased preferences," as defined by O'Donoghue and Rabin (1999). The larger D_i, the more the student has postponed working on the assignment, and the more the student is biased to the present.

4.1 Present-biased preferences and homework score

The regression model can be expressed as follows,

$$HomeworkScore = \alpha_0 + \alpha_1 A + \alpha_2 D + \boldsymbol{X}\boldsymbol{\alpha} + u, \tag{1}$$

where $HomeworkScore$ stands for the score earned for each homework assignment between spring 2015 and spring 2017. A is the actual day the assignment was first attempted, and D is the number of days delayed for that particular assignment. $\boldsymbol{X}$ is a vector of control variables, including the race, gender, major, years in college of the student who submitted the assignment, and the subject control variable $\big($whether data were collected from microeconomics classes (micro=1), or macroeconomics classes (micro=0)$\big)$. Furthermore, dummy variables are included to control for different assignments ($HW2$, $HW3$, $HW4$, or $HW5$).

As mentioned in Section (3), the major drawback of variables A and D is the underestimation of present-biased preferences, due to missing assignments. If a student missed Homework i, then A_i and D_i are both missing.

One remedy for this drawback is to run two separate sets of regressions for Equation (1). In the first set of regressions, missing Homework i will be recorded as missing A_i and D_i (that is, missing data). In the second set of regressions, however, missing Homework i will be recorded as $A_i = 8$, and $D_i = 8 - P_i$. That is, one can treat missing assignment as an assignment "having been completed" on Monday, one day after the due date. Although in reality, a missing assignment "could have been" completed in a later day ($A_i > 8$), or pernaps never ($A_i = \infty$).

Individual fixed effects Unobservable individual characteristics could be correlated with the decision on whether to procrastinate on homework assignments. This can be controlled for by the fixed effects model. As each student handed in more than one assignment each semester, one can run Regression (1) again with individual fixed effects.

4.2 Present-biased preferences and academic achievements

Academic achievements can also be captured by the grade received in principles of micro-or-macroeconomics. Therefore, the regression equation can be expressed as follows,

$$EconGrade = \beta_0 + \beta_1 A + \beta_2 D + \beta_3 M + \boldsymbol{X}\boldsymbol{\beta} + \epsilon; \tag{2}$$

where $EconGrade$ is the grade that the student received in principles of micro-or-macroeconomics. A stands for $\bar{A}_i$ or $MD(A_i)$; namely, the mean or median day that the student actually started working on an assignment. D stands for for $\bar{D}_i$ or $MD(D_i)$; that is, the mean or the median of the number of days the student delayed working on a homework assignment. M is the number of missing homework assignments, where $0 \leq M \leq 4$ (students who missed all five assignments were dropped from the data set). Finally, $\boldsymbol{X}$ is a vector of control variables, similar to that in Equation (1).

Equation (2) has a smaller sample size than that in Equation (1). The dependent variable of Equation (2) is the grade of micro-or-macroeconomics, and each student receives only one grade in either micro-or-macroeconomics class. The dependent variable in Equation (1), however, is the score of homework assignments submitted between spring 2015 and spring 2017. A typical student submitted several assignments in a semester. As a result, the sample size in Equation (2) is smaller than that in Equation (1).

Another measurement of academic achievements is the cumulative grade point average (GPA):

$$GPA = \gamma_0 + \gamma_1 A + \gamma_2 D + \gamma_3 M + \boldsymbol{X}\boldsymbol{\gamma} + \varepsilon. \tag{3}$$

Equation (3) is similar to Equation (2), although the dependent variable is now a student's cumulative GPA.

By regressing GPA on the measurements of procrastination obtained in economics classes, this study assumes that a student had similar, if not exactly the same, procrastination behaviors across different classes. In other words, if a student's preferences were biased to the present in economics assignments, then his or her preferences were probably also biased to the present in other classes.

4.3 Expected signs of the coefficients

Explanatory variables Variables A and D in Equation (1), and variables A, D, and M in Equations (2) and (3) are the measurements of procrastination. Therefore, one expects negative coefficients of variables A, D, and M in Equations (1), (2), and (3).

However, as mentioned, a student might choose to start working on a homework assignment late because he or she would like to study lecture notes and the textbook first. If most students attempting assignments late because they studied first, then the coefficient of A might be positive. As a result, the sign of variable A's coefficient is ambiguous.

Control variables $\boldsymbol{X}$ is a vector of control variables including gender, years in college $\big($whether students are juniors and seniors ($JS = 1$), or freshmen and sophomores ($JS = 0$)$\big)$, ethnicity, and majors.

The reference major is "major undecided." EMP stands for students majoring in engineering, math, or physics; these students typically have relatively high math aptitude and outperform their peers in economics classes (Butler, Finegan and Siegfried, 1998). Therefore, one expect EMP

to be positively associated with $HomeworkScore$ in Equation (1), and $EconGrade$ in Equation (2).

One would expect variable JS to be positively associated with work quality and academic achievements in Equations (1), (2), and (3). Other things being equal, juniors and seniors are probably more knowledgable and more serious about their studying than their freshmen and sophomore counterparts.

In race control variables, the reference race is "Other." The university is diversified in race and cultural background. Except for Asian, Black, Hispanic, and White, about 16% of the students identify their race as "Other." This includes mixed races and students from the Middle East, India, and Pakistan. The expected signs of race control variables, as well as gender control variable (variable "Male"), are unknown in Equations (1), (2), and (3).

"Micro" is a control variable that indicates where the data were collected from. "Micro"=1 if data were collected from microeconomics classes; "Micro=0" if the data were collected from macroeconomics classes. Anecdotal evidence from College Confidential,[6] an online student forum, suggests that students typically find microeconomics more challenging than macroeconomics, due probably to math and graphs involved in microeconomics. Therefore, the expected sign of "Micro" coefficient is negative in Equations (1) and (2), but unknown in Equation (3).

Note that some students took both micro-and-macroeconomics classes taught by the same instructor. However, they always did so in different semesters, as the instructor never taught both micro-and-macroeconomics in the same semester throughout the data collection period. Therefore, the same student who took both micro-and-macroeconomics from the same instructor was treated as two distinct students, as the student's year (freshman, sophomore, junior or senior), econ grade (micro or macro), and cumulative GPA have all changed.

[6]http://talk.collegeconfidential.com/ap-tests-preparation/537093-economics-micro-vs-macro.html, accessed March 2017.

Limitations One drawback of this data set is the lack of the SAT scores to control for students' IQ. The UST Human Subject Committee permitted the collection of the SAT scores directly from students only. Unfortunately, many students were transfer students who came to the university without the SAT scores. Other students took the ACT instead of the SAT. Still others took the SAT but forgot about their scores.

Eventually, less than half of the students reported their SAT scores from their memory. While these students reported their SAT scores, they indicated that they might not remember their scores correctly, as the test "was taken a long time ago." Since the reliability of these self-reported SAT scores is questionable, they are not included in the analysis. After all, research demonstrates that self-control outdoes IQ in predicting academic achievements (Duckworth and Seligman, 2005).

5 Regression results

5.1 Present-biased preferences and homework score

The author runs two sets of regressions for Equation (1). The first set of regressions (Table (7)) treats missing assignments as missing data (missing A_i and D_i). The second set of regressions (Table (8)) treats missing assignments as assignments that "had been submitted on Monday" ($A_i = 8$ and $D_i = 8 - P_i$).

Missing assignments as missing data (Table 7 here)

Regressions (1), (2), and (3) in Table (7) demonstrate a negative association between A, D, and the Homework Score. Regression (1) shows that, other things being equal, starting working on an assignment one day later is negatively associated with the homework score by almost one point. Similarly, Regression (2) indicates that one day of delay is negatively associated with homework score by almost one point. The results are statistically significant at the 1% level.

However, Regression (3) suggests that, the number of days delayed working on an assignment seems to matter more than the actual day that a student started working on an assignment. Regression (3) reveals a negative association between "Delay" and Homework score, and the result is statistically significant at the 5% level.

Missing assignments as "submitted on Monday" As mentioned in Section (3), α_1 and α_2 in Equation (1) suffer underestimation issue due to missing assignments. One remedy is to run another set of regressions, recording missing assignments as "having been submitted on Monday," a day after the due date $\big($results in Table (8)$\big)$.

Regressions (1), (2), and (3) in Table (8) demonstrate similar results as those in Table (7), although the estimation of α_1 and α_2 are now much larger in the absolute value. Regression (1) shows that, starting working on an assignment one day later is negatively associated with the homework score by 5.7 points. Regression (2) reveals that, a day of delay is negatively associated with almost 5 points in homework score. Finally, Regression (3) demonstrate that, starting working on homework one day later is negatively associated with homework score by almost 3 points, and a day of delay is also negatively associated with homework score by more than 3 points. All results are statistically significant at the 0.1% level.

Note that as the estimation of α_1 is negative, students probably did not attempt the assignment late "because they were studying."

(Table 8 here)

Control variables Tables (7) and (8) reveal similar results in the control variables. As expected, students who major in engineering, math, and physics (EMP) scored higher in these econ homework assignments than their non-EMP counterparts. For instance, Regressions (1), (2), and (3) in Table (7) indicate that, all else equal, EMP students scored almost 10 points higher than students who have not yet declared their major, and the results are statistically significant at the 5%

level. This is due probably to EMP students' relatively high math aptitude — perhaps these students with good math foundation selected themselves into economics classes, or perhaps good math foundation helped these EMP students to excel in economics.

Some race control variables are significant. All regressions from Tables (7) and (8) seem to suggest that Asian, Black, Hispanic and White students are scoring higher than students of "other races." Recall that many foreign students, including those from India, Pakistan, and Middle East countries, indicate their race as "other races." Some of these students have to learn economics the first time with a second language in a foreign country, which could be challenging. This might explain why their homework scores are lower than their counterparts.

The reference category for assignment dummy variables is Homework 1, which covers introduction and the circular flow diagram (Chapters 1 and 2). Homework 2 covers the concept of demand and supply (Chapter 3). Typically, students find questions from Chapter 3 more difficult than those from Chapters 1 and 2. Perhaps that's why the scores of Homework 2 are lower than those of Homework 1.

Homework 5 covers different market structures and perfect competition in microeconomics, and aggregate demand/aggregate supply model in macroeconomics. Questions in Homework 5 are arguably more challenging than those in Homework 1, which covers the introduction and the circular flow diagram. Perhaps that was why scores in Homework 5 were lower than those in Homework 1.

Note that Table (8) has more observations than those in Table (7), because missing assignments are treated as missing data in Table (7), but recorded as assignments having been submitted on Monday in Table (8).

Individual fixed effects As mentioned, unobservable individual characteristics can be correlated with the decision on procrastination. One can control for this with a fixed effects model.

Regressions with individual fixed effects are displayed in Tables (9) and (10). Comparing Table (7) with Table (9), and Table (8) with (10), one can observe that the major results are similar. For instance, Regression (3) in Tables (8) and (10) both indicate that a day of delay is negatively associated with Homework Score by about 2-3 points, and the results are both statistically significant at the 0.1% level.

(Tables (9) and (10) here)

5.2 Present-biased preferences and grades in economics

Tables (11) and (12) display regression results of Equation (2). Table (11) records missing assignments as missing data, whereas Table (12) records missing assignments as "submitted on Monday."

(Table (11) here)

Missing assignments recorded as missing data In Table (11), Regressions (1), (2), and (3) measure A_i (the day that the student actually started working on the assignment) and D_i (the number of days delayed) in the mean. Regressions (4), (5), and (6) measure A_i and D_i in the median $\big(MD(A_i)$ and $MD(D_i)\big)$.

Regressions (1), (3), (4), and (6) suggest that the actual day a student started working on a homework assignment does not matter to his or her grade in economics. That is to say, as long as students did not attempt the assignment later than they had planned, attempting the assignment in a later day has no association with grade in micro-or-macroeconomics.

Regressions (2) and (3) in Table (11) demonstrate a negative association between "delay" measured in the mean ($\bar{D}_i$), and the grade in principles of micro-and-macroeconomics. One day of delay measured in the mean is negatively associated with EconGrade by about one-tenth of a letter grade. The results are statistically significant at the 5% level.

Similarly, Regressions (5) and (6) demonstrate a negative association between "delay" mea-

sured in the median $\big(MD(D_i)\big)$ and EconGrade. A day of delay measured in the median is negatively associated with EconGrade by about 0.08 to 0.09 points — almost one-tenth of a letter grade —- and the results are statistically significant at the 5% level.

Due to missing assignments, the coefficient of "D," whether measured in mean or the median $\big(\beta_2$ in Equation (2)$\big)$, can be underestimated.

Missing homework assignments If a student procrastinated to the point that the deadline was passed, then $M \geq 1$. Recall that no student ever indicated that he or she intended to miss an assignment. Therefore, all missing assignments were unintentional. Table (11) shows a negative association between the number of missing assignments and EconGrade. One missing assignment is negatively associated with the EconGrade by about 0.4 point (almost half a letter grade), all else equal. The results are statistically significant at the 0.1 % level.

Underestimation of variable D As mentioned, the coefficeint of variable D (whether measured in the mean or median) suffers underestimation. One remedy is to record missing assignments as ones "sunmitted on Monday," and re-run Equation (2). The regression results are displayed in Table (12). Note that there is no "missing assignment" variable, as missing assignments are now recorded as "submitted on the following Monday."

Comparing Tables (11) and (12), one can observe that the coefficients of variable "Delay," whether measured in the mean of median, are now larger in the absolute value and more statistically significant. For example, regression (3) in Table (12) reveals that, one day of delay measured in the mean is negatively associated with more than one-tenth of a letter grade (-0.13 points) in economics, and the result is statistically significant at the 1% level. By contrast, in Table (11), the coefficient of "delay" in the corresponding regression $\big($regression (3)$\big)$ is smaller in the absolute value and less statistically significant. Similar results can be observed by comparing corresponding regressions (2), (5), and (6) in Tables (11) and (12). These results demonstrate that recording

missing assignments as "submitted on Monday" mitigates the issue of underestimation.

Note that recording missing assignment as "submitted on Monday" ($A_i = 8$) could alleviate, but not eradicate, the underestimation problem. The reason is that, students who missed the assignment might not have handed it in on Monday ($A_i = 8$). Instead, they could have turned in the assignment even later ($A_i > 8$), or perhaps never ($A_i = \infty$).

In Table (12), regressions (1) and (4) seem to suggest that starting a homework assignment one day later (a Large A_i) is negatively associated with grade in economics. However, once variable D_i is added to the model, then variable A_i does not seem to matter $\big($see Regressions (3) and (6)$\big)$. (Table 12 here)

Control variables Students who major in engineering, math, and physics (EMP) excelled in economics classes. EMP students outperformed their non-EMP counterparts by about one letter grade, and the results are statistically significant at the 5% level $\big($Tables (11) and (12)$\big)$. It is not surprising: EMP students typically take more calculus classes than non-EMP students. Research has proven that calculus improves students learning in economics, even after controlling for self-selection bias (Butler, Finegan and Siegfried, 1998).

Regressions also suggest that business majors did worse in econ classes compared to their non-business counterparts $\big($Tables (11) and (12)$\big)$. Other things being equal, business majors scored 0.2 points (one fifth of a letter grade) lower than those who have not declared their majors, and the results are mostly statistically significant at the 10% level.

The results are due probably to self-selection bias. The University of St. Thomas is a liberal arts college that requires all students to take six credit hours of social and behavioral science. Students can choose from economics, geography, international studies, political science, psychology, and sociology.

While non-business majors are free to choose any two courses from the six fields listed above,

business majors are required to take principles of micro-and-macroeconomics to graduate. Non-majors who chose to take economics to satisfy social and behavioral science requirement were probably more comfortable with numbers and graphs than business majors, who had no choice but to take economics classes. Clearly, students forced to take a course are likely to do worse than their counterparts who elect to take the same course. Hence, business majors did worse in principles of micro-and-macroeconomics than those who had not yet declared their majors.

Grades in microeconomics were lower than those in macroeconomics (Tables (11) and (12)). For instance, all regressions in these two tables show that grade in microeconomics is almost one third of a letter grade lower than that in macroeconomics, and the results are statistically significant at the 1% level.

It is interesting, and perhaps bizarre, that students scored higher in microeconomics homework than macroeconomics homework (Tables (7) and (8)), but received worse grades in microeconomics than in macroeconomics (Tables (11) and (12)). On average, students scored about 2 to 3 points (out of 100) higher in microeconomics homework than in macroeconomics homework. Yet, the students' received almost one-third a letter grade lower in microeconomics than in macroeconomics.

As mentioned, anecdotal evidence collected from College Confidential suggests that students typically find microeconomics more challenging than macroeconomics, due probably to math and graphs involved in microeconomics. Students were allowed and even encouraged to do their homework assignments together. Nevertheless, collaboration is not permitted in the exams. Homework assignments comprise only 20% of the final grade, and the final grade depends largely upon two midterm exams and one final exam. Although students find microeconomics more challenging than macroeconomics, and perhaps as a result worked together in their homework assignments, they could not collaborate in the exams. Maybe this is why students scored slightly higher in microeconomic homework than macroeconomic homework, but received lower

grades in microeconomics than in macroeconomics.

Note that gender, race, and years in school do not play a role in students' grades in principles of micro-and-macroeconomics classes.

5.3 Present-biased preferences and GPA

(Table 13 here)

Missing assignments as missing data Table (13) displays the regression results of Equation (3). Recall that by running such regressions, this study assumes that the same student will carry his or her habit of procrastination (or no procrastination) across different classes. As a result, one might find some kind of association between the student's study habit and his/her GPA.

Regressions (2), (3), (5), and (6) demonstrate a negative association between "delay" and GPA. One day of delay is negatively associated with GPA by 0.07 - 0.08 point, and the results are statistically significant at the 5% level.

In contrast, regressions (1), (3), (4), and (6) do not show an association between GPA and the day a student actually started to work on an assignment.

As expected, "missing assignments" (M) is negatively associated with GPA in all regressions in Table (13). One missing assignment is negatively associated with the GPA by 0.25-0.27 points, and the results are significant at the 0.1% level. Missing assignments is an indication of the lack of time management and self-control. Therefore, it is not surprising that missing assignment is negatively associated with GPA.

Control Variables Regressions (1) through (6) in Table (13) demonstrate that, other things being equal, female students outperform their male cohorts in the GPA by approximately 0.12-0.14 points, and the results are statistically significant at the 10% level. Research shows that, typically, eighth-grader girls are more self-disciplined than their boy counterparts (Duckworth

and Seligman, 2006). Perhaps this self-discipline gives female students an edge, whether they are in middle school or college.

Moreover, African American students seem to have lower GPAs than the reference race (other races). There exists a vast literature about why African Americans typically have lower academic achievements than others. The causes include, but are not limited to, poverty, sociological and historical forces (Gabriel, 2010), quality of education in early school years (Allen, 1992), and stereotype threat (Steele and Aronson, 1995). However, it is beyond the scope of this study.

Missing assignments as "submitted on Monday" To mitigate the issue of underestimation of "delay", one can record missing assignment as "submitted on Monday," and re-run Equation (3). The regression results are displayed in Table (14).

(Table (14) here)

Regressions (2), (3), (5), and (6) in Table (14) demonstrates a negative association between delay and cumulative GPA. A day of delay is negatively associated with GPA by 0.10 to 0.14 points, and the results are statistically significant at the 1% and 0.1% level.

Regressions (1) and (4) seem to suggest a negative association between GPA and the actual day a student started working on the homework (variable A) matters. However, once "delay" is added in the regression $\big($Regressions (3) and (6)$\big)$, variable A does not matter anymore.

By comparing corresponding regressions (2), (3), (5), and (6) in Tables (13) and (14), one can observe that the coefficients of "delay" in Table (14) are larger in the absolute value, and more statistically significant, than their counterparts in Table (13). This comparison once again demonstrates the underestimation of the coefficient of "delay" $\big(\gamma_2$ in Equation (3)$\big)$ due to missing assignments.

6 Discussion

Prior update? Bayesian statistics assumes that one has a prior distribution over the events. Upon observing the data, a rational individual would update the prior. Yet, do students really update their priors? The quick answer is, probably not.

As mentioned in Section (2), students were asked to indicate when they would start working on a homework assignment on five different dates throughout the semester; namely, the dates when Homework 1, Homework 2, Homework 3, Homework 4, and Homework 5 became available, respectively.

That is to say, each student had several opportunities to observe his/her own behavior to see whether he or she tended to delay working on an assignment. Did these observations help the student to become a better predictor of the behavior of his/her future-self?

The short answer is no. If students did update their priors, then variable $Delay$ would have a downward trend. Yet the data indicate otherwise $\big($see Table (15)$\big)$. In fact, according to the ANOVA results, $Delay$ actually has an upward trend. Using Homework 1 as the baseline, Column (1) in Table (15) demonstrates that, other things equal, Homework 5 was delayed for half a day more than Homework 1. The result is statistically significant at the 1% level.

(Table(15) here)

Furthermore, if missing assignments are recorded as "submitted on Monday," $\big($Column (2)$\big)$, then $Delay$ not only has an upward trend but the results are also more statistically significant. Other things being equal, Homework 3 was delayed 0.34 days more than Homework 1; Homework 4, 0.43 days more; and Homework 5, 0.65 days more. The results are significant at the 5%, 1%, and 0.1% level, respectively.

Why did students delay more and more? The later into the semester, the busier the students became, due probably to term papers, projects, and presentations assigned in other classes. In

addition, Homework 5 was due in the end of the semester, when students were the most overwhelmed cramming for their final exams.

If students were fully forward-looking, or behave liken "Econs," [7] then they would have calculated the time needed for all assignments in other classes and planned accordingly. This is especially true because all professors at the University of St. Thomas are required to give a course syllabus with schedule clearly planned at the beginning of each semester. However, the ANOVA results demonstrate otherwise; in particular, students did not update their priors about how many days they tended to delay working on a homework assignment.

Limitations Although this study finds a negative association between present-biased preferences and academic achievements, the direction of causality is ambiguous. Procrastination could lead to poor performance. However, poor performers might tend to procrastinate.

Ideally, to identify the causal relationship, one would have to randomly assign some students to study early, and some to procrastinate, and then compare the results. However, such an experiment would not be ethical as most, if not all, students care about their grades. Such a design of the experiment would also fail to pass any Human Subject Committee.

Application to education For professors who would like to help students to excel, the results of this study have two implications. If procrastination causes poor academic performance, then the professor can give incentives, such as extra credit, for early submission of homework assignments. This could motivate students to do their homework earlier, achieving a better learning result.

On the other hand, if poor performers tend of procrastinate and hence the negative correlation, then the professor can assign exercises in class or during lab sessions. Frequent practices help students to become knowledgable about the subject; as a result, students are less likely to

[7] Thaler (2015) calls rational and highly intelligent beings "Econs."

procrastinate.

7 Conclusion

This study collects first-hand data from the field to measure students' degree of present-biased preferences. Students' present-biased preferences are measured in "delay" — namely, the number of days a student had delayed working on an assignment relative to his or her original plan.

Furthermore, this study demonstrates a negative association between present-biased preferences and academic achievements. Regression results reveal that "delay" is negatively associated with academic achievements. After controlling for underestimation issue, one day of delay is negatively associated with homework score by three to five points. The results are statistically significant at the 0.1% level, with and without controlling for individual fixed effects.

In addition, "delay" and the number of missing assignments are negatively associated with grade in micro-or-macroeconomics, as well as cumulative GPA. One day of delay in homework is negatively associated with one-tenth of a letter grade in economics, while one missing homework assignment is negatively associated with almost half of a letter grade in economics. Similar negative associations are observed between delay and GPA, and between the number missing assignments and GPA.

In this study, homework assignments were relatively small assignments. Each assignment comprised 10 to 18 multiple choice questions. If the assignment were larger and requires longer time to complete, such as a term paper, then one might observe a bigger negative association between delay and the score received for the assignment.

The main results of this study — the negative association between present-biased preferences and academic achievements — applies to workplace as well. Assuming that students who procrastinate at school are also likely to do so at workplace after graduation, then firms are doing the right thing in checking transcripts before hiring new employees. Since regressions demonstrate

a negative association between "delay" and GPA, firms might be able to find potential employees with good self-control and discipline by looking at their GPAs, and perhaps their grades in micro-and-macroeconomics.

Table 1: Classes included in the study

Semester	Class Title	Section	Meeting Days and Time
Spring 2015	Principles of Microeconomics	ECON 1332 Section B	TTH 9:35-10:50am
Spring 2015	Principles of Microeconomics	ECON 1332 Section C	TTH 11:00am-12:15pm
Fall 2015	Principles of Macroeconomics	ECON 1331 Section A	TTH 9:35-10:50am
Fall 2015	Principles of Macroeconomics	ECON 1331 Section B	TTH 11:00am-12:15pm
Spring 2016	Principles of Microeconomics	ECON 1332 Section B	TTH 9:35-10:50am
Spring 2016	Principles of Microeconomics	ECON 1332 Section C	TTH 11:00am-12:15pm
Spring 2016	Principles of Microeconomics	ECON 1332 Section N	TTH 3:35-4:50pm
Fall 2016	Principles of Macroeconomics	ECON 1331 Section A	TTH 9:35-10:50am
Fall 2016	Principles of Macroeconomics	ECON 1331 Section B	TTH 11:00am-12:15pm
Spring 2017	Principles of Microeconomics	ECON 1332 Section B	TTH 9:35-10:50am
Spring 2017	Principles of Microeconomics	ECON 1332 Section C	TTH 11:00am-12:15pm

The textbook the university uses is "Economics" by McConnell, Brue and Flynn. The first four chapters in micro-and macroeconomics are the same. Material starts to differ after the first midterm exam.

Table 2: Delay

	$Delay < 0$	$Delay = 0$	$Delay > 0$	Total
Count	115	366	872	1349
Percentage	8.23%	27.13%	64.64%	100.00%

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Table 3: Summary statistics: Missing assignments recorded as missing data

Variable	Mean	Std. Dev.	N
Homework Score	78.668	28.247	1349
Actual	5.266	1.791	1275
Delay	1.172	1.705	1154
Male	0.434	0.496	1349
Junior/Senior	0.279	0.449	1349
Asian	0.123	0.329	1349
Black	0.058	0.233	1349
Hispanic	0.405	0.491	1349
White	0.244	0.43	1349
EMP	0.011	0.105	1349
Business major	0.235	0.424	1349
Other majors	0.148	0.355	1349
Micro	0.678	0.467	1349

Table 4: Summary statistics: Missing assignments recorded as "submitted on Monday"

Variable	Mean	Std. Dev.	N
Homework Score	78.668	28.247	1349
Actual	5.491	1.884	1349
Delay	1.338	1.815	1196
Male	0.434	0.496	1349
Junior/Senior	0.279	0.449	1349
Asian	0.123	0.329	1349
Black	0.058	0.233	1349
Hispanic	0.405	0.491	1349
White	0.244	0.43	1349
EMP	0.011	0.105	1349
Business major	0.235	0.424	1349
Other majors	0.148	0.355	1349
Micro	0.678	0.467	1349

Table 5: Summary statistics: Missing assignments recorded as missing data

Variable	Mean	Std. Dev.	N
EconGrade	3.081	0.812	255
GPA	3.059	0.602	255
Actual (mean)	5.274	1.284	255
Actual (median)	5.361	1.622	255
Delay (mean)	1.178	1.077	255
Delay (median)	1.133	1.277	255
Missing assignment	0.404	0.719	255
Male	0.412	0.493	255
Junior/Senior	0.282	0.451	255
Asian	0.125	0.332	255
Black	0.063	0.243	255
Hispanic	0.435	0.497	255
White	0.239	0.427	255
EMP	0.012	0.108	255
Business major	0.227	0.42	255
Other majors	0.141	0.349	255
Micro	0.663	0.474	255

Table 6: Summary statistics: Missing assignments recorded as "submitted on Monday"

Variable	Mean	Std. Dev.	N
EconGrade	3.081	0.812	255
GPA	3.059	0.602	255
Actual (mean)	5.439	1.308	255
Actual (median)	5.486	1.66	255
Delay (mean)	1.327	1.15	255
Delay (median)	1.263	1.37	255
Male	0.412	0.493	255
Junior/Senior	0.282	0.451	255
Asian	0.125	0.332	255
Black	0.063	0.243	255
Hispanic	0.435	0.497	255
White	0.239	0.427	255
EMP	0.012	0.108	255
Business major	0.227	0.42	255
Other majors	0.141	0.349	255
Micro	0.663	0.474	255

Table 7: Homework score: Missing assignments recorded as missing data

	(1) Homework	(2) Homework	(3) Homework
Actual	-0.761**		-0.196
	(-2.99)		(-0.58)
Delay		-0.850**	-0.706*
		(-3.05)	(-1.99)
Male	-0.795	-1.326	-1.204
	(-0.84)	(-1.33)	(-1.24)
Junior/Senior	0.231	-0.179	-0.0160
	(0.21)	(-0.15)	(-0.01)
Asian	3.862*	3.533*	4.084*
	(2.28)	(1.99)	(2.35)
Black	3.533	4.595*	4.676*
	(1.66)	(2.00)	(2.08)
Hispanic	2.943*	3.608*	3.552*
	(2.20)	(2.56)	(2.58)
White	1.831	0.997	1.204
	(1.27)	(0.66)	(0.81)
EMP	9.506*	9.683*	9.792*
	(2.23)	(2.19)	(2.27)
Business major	-0.397	-0.382	-0.101
	(-0.33)	(-0.30)	(-0.08)
Other major	1.778	2.134	2.014
	(1.27)	(1.45)	(1.41)
Microeconomics	2.158*	2.539*	2.093*
	(2.20)	(2.49)	(2.09)
Homework 2	-2.817*	-3.170*	-3.108*
	(-2.11)	(-2.28)	(-2.29)
Homework 3	1.377	0.177	1.031
	(1.01)	(0.12)	(0.74)
Homework 4	0.611	0.0260	0.130
	(0.44)	(0.02)	(0.09)
Homework 5	-2.678	-2.751	-2.610
	(-1.83)	(-1.80)	(-1.73)
_cons	86.79***	84.33***	85.16***
	(42.90)	(49.46)	(39.66)
N	1230	1115	1113

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Homework score: Missing assignments recorded as "submitted on Monday"

	(1) Homework	(2) Homework	(3) Homework
Actual	-5.667***		-2.594***
	(-14.48)		(-5.05)
Delay		-4.921***	-3.160***
		(-12.49)	(-6.04)
Male	-1.378	-2.392	-1.761
	(-0.91)	(-1.60)	(-1.19)
Junior/Senior	-0.185	-1.132	-1.238
	(-0.11)	(-0.64)	(-0.71)
Asian	6.828*	7.068**	6.179*
	(2.53)	(2.65)	(2.33)
Black	11.55***	9.382**	10.17**
	(3.39)	(2.70)	(2.95)
Hispanic	4.667*	5.487**	4.695*
	(2.23)	(2.62)	(2.26)
White	4.460*	4.569*	3.503
	(1.97)	(2.02)	(1.55)
EMP	6.210	3.699	3.545
	(0.91)	(0.56)	(0.54)
Business major	-1.070	-0.615	-0.723
	(-0.56)	(-0.33)	(-0.39)
Other majors	4.699*	4.276	4.262
	(2.07)	(1.91)	(1.93)
Microeconomics	3.297*	2.226	2.933
	(2.11)	(1.45)	(1.92)
Homework 2	-2.118	-5.350*	-4.486*
	(-0.97)	(-2.51)	(-2.12)
Homework 3	-0.943	-4.911*	-3.580
	(-0.43)	(-2.26)	(-1.65)
Homework 4	-2.920	-5.853**	-4.064
	(-1.31)	(-2.71)	(-1.87)
Homework 5	-5.089*	-6.589**	-4.820*
	(-2.17)	(-2.85)	(-2.08)
_cons	105.3***	86.11***	96.58***
	(32.57)	(33.25)	(29.29)
N	1349	1196	1196

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Homework score with individual fixed effects: Missing assignments recorded as missing data

	(1) Homework	(2) Homework	(3) Homework
Actual	-0.162		0.820
	(-0.51)		(1.84)
Delay		-0.572	-1.191**
		(-1.87)	(-2.89)
Male	-0.276	-0.465	-0.675
	(-0.12)	(-0.19)	(-0.28)
Junior/Senior	5.730*	6.215*	6.174*
	(2.08)	(2.16)	(2.22)
Asian	13.15**	12.22*	12.71**
	(2.75)	(2.45)	(2.63)
Black	7.526	8.484	9.154
	(1.18)	(1.27)	(1.41)
Hispanic	8.808*	8.729*	8.575*
	(2.49)	(2.32)	(2.36)
White	7.876	6.436	6.530
	(1.95)	(1.50)	(1.58)
EMP	7.913	4.726	5.011
	(0.92)	(0.53)	(0.58)
Business major	-1.522	-0.781	-0.687
	(-0.50)	(-0.25)	(-0.22)
Other majors	-0.663	-0.0572	0.0492
	(-0.20)	(-0.02)	(0.01)
Microeconomics	3.971*	3.018	2.949
	(2.14)	(1.58)	(1.59)
Homework 2	-2.891*	-2.743*	-2.981*
	(-2.45)	(-2.21)	(-2.47)
Homework 3	0.790	0.143	0.416
	(0.65)	(0.11)	(0.33)
Homework 4	0.00262	-0.170	-0.745
	(0.00)	(-0.13)	(-0.58)
Homework 5	-3.137*	-2.551	-3.260*
	(-2.33)	(-1.79)	(-2.31)
_cons	56.65***	58.92***	55.18***
	(6.27)	(6.50)	(6.12)
N	1230	1115	1113

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Homework score with individual fixed effects: Missing assignments recorded as "submitted on Monday"

	(1) Homework	(2) Homework	(3) Homework
Actual	-5.620***		-2.469***
	(-11.46)		(-3.49)
Delay		-4.254***	-2.657***
		(-9.39)	(-4.14)
Male	0.686	1.036	1.300
	(0.19)	(0.27)	(0.35)
Junior/Senior	7.267	3.777	3.599
	(1.71)	(0.87)	(0.84)
Asian	33.35***	31.05***	29.49***
	(4.36)	(4.04)	(3.85)
Black	12.93	9.801	8.766
	(1.36)	(0.97)	(0.87)
Hispanic	17.02**	12.97*	13.21*
	(2.99)	(2.21)	(2.27)
White	21.01***	18.67**	18.36**
	(3.35)	(2.92)	(2.89)
EMP	9.934	13.84	11.95
	(0.68)	(0.98)	(0.85)
Business major	-8.622	-4.818	-4.394
	(-1.74)	(-0.99)	(-0.91)
Other majors	4.701	6.506	6.239
	(0.86)	(1.17)	(1.13)
Microeconomics	3.293	1.579	2.019
	(1.11)	(0.54)	(0.70)
Homework 2	-2.129	-4.742*	-4.004*
	(-1.06)	(-2.39)	(-2.02)
Homework 3	-0.977	-4.771*	-3.434
	(-0.48)	(-2.35)	(-1.67)
Homework 4	-2.964	-6.668**	-4.864*
	(-1.44)	(-3.30)	(-2.34)
Homework 5	-4.981*	-7.287**	-5.531*
	(-2.25)	(-3.28)	(-2.44)
_cons	79.97***	60.79***	72.73***
	(5.45)	(4.30)	(5.03)
N	1349	1196	1196

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Econ grade: Missing assignments recorded as missing data

	(1) EconGrade	(2) EconGrade	(3) EconGrade	(4) EconGrade	(5) EconGrade	(6) EconGrade
Actual_mean	-0.0565		-0.0138			
	(-1.52)		(-0.32)			
Delay_mean		-0.107*	-0.0990*			
		(-2.48)	(-1.97)			
Actual_median				-0.0342		0.00463
				(-1.17)		(0.13)
Delay_median					-0.0837*	-0.0870*
					(-2.31)	(-1.99)
Missing assignment	-0.420***	-0.407***	-0.405***	-0.426***	-0.414***	-0.415***
	(-6.41)	(-6.29)	(-6.18)	(-6.53)	(-6.42)	(-6.38)
Male	-0.0133	-0.0326	-0.0290	-0.0151	-0.0355	-0.0374
	(-0.14)	(-0.35)	(-0.31)	(-0.16)	(-0.38)	(-0.39)
Juior/Senior	0.0263	0.0257	0.0260	0.0283	0.0212	0.0206
	(0.25)	(0.24)	(0.24)	(0.26)	(0.20)	(0.19)
Asian	0.0150	0.0277	0.0232	0.0214	0.0396	0.0417
	(0.08)	(0.15)	(0.13)	(0.12)	(0.22)	(0.23)
Black	-0.295	-0.265	-0.259	-0.307	-0.272	-0.274
	(-1.34)	(-1.21)	(-1.18)	(-1.39)	(-1.24)	(-1.25)
Hispanic	0.179	0.201	0.198	0.180	0.200	0.201
	(1.24)	(1.40)	(1.37)	(1.24)	(1.39)	(1.39)
White	0.140	0.166	0.162	0.148	0.171	0.172
	(0.88)	(1.06)	(1.03)	(0.93)	(1.09)	(1.09)
EMP	1.069*	0.984*	0.981*	1.092*	0.994*	0.994*
	(2.51)	(2.32)	(2.30)	(2.56)	(2.33)	(2.33)
Business major	-0.212	-0.209	-0.211	-0.209	-0.204	-0.203
	(-1.79)	(-1.78)	(-1.79)	(-1.76)	(-1.73)	(-1.72)
Other majors	0.0683	0.0578	0.0599	0.0694	0.0572	0.0559
	(0.49)	(0.42)	(0.43)	(0.50)	(0.41)	(0.40)
Microeconomics	-0.267**	-0.286**	-0.281**	-0.276**	-0.287**	-0.288**
	(-2.70)	(-2.93)	(-2.85)	(-2.80)	(-2.94)	(-2.93)
_cons	3.655***	3.482***	3.541***	3.546***	3.453***	3.433***
	(15.26)	(21.85)	(14.45)	(16.80)	(21.93)	(15.79)
N	255	255	255	255	255	255

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Econ grade: Missing assignments recorded as "submitted on Monday"

	(1) EconGrade	(2) EconGrade	(3) EconGrade	(4) EconGrade	(5) EconGrade	(6) EconGrade
Actual _mean	-0.155***		-0.0886			
	(-4.10)		(-1.95)			
Delay _mean		-0.187***	-0.131**			
		(-4.46)	(-2.60)			
Actual _median				-0.102***		-0.0519
				(-3.41)		(-1.42)
Delay _median					-0.138***	-0.102*
					(-3.90)	(-2.33)
Male	0.00941	-0.0444	-0.0165	-0.00878	-0.0512	-0.0338
	(0.09)	(-0.44)	(-0.16)	(-0.08)	(-0.50)	(-0.33)
Junior/Senior	0.0236	0.0179	0.0188	0.0319	0.0223	0.0262
	(0.20)	(0.15)	(0.16)	(0.27)	(0.19)	(0.22)
Asian	0.0465	0.0951	0.0537	0.0671	0.140	0.101
	(0.24)	(0.50)	(0.28)	(0.35)	(0.73)	(0.53)
Black	-0.159	-0.152	-0.131	-0.174	-0.150	-0.140
	(-0.69)	(-0.66)	(-0.57)	(-0.75)	(-0.65)	(-0.60)
Hispanic	0.187	0.230	0.209	0.196	0.246	0.227
	(1.23)	(1.52)	(1.39)	(1.27)	(1.61)	(1.49)
White	0.200	0.266	0.229	0.236	0.298	0.275
	(1.22)	(1.63)	(1.40)	(1.42)	(1.81)	(1.66)
EMP	1.030*	0.938*	0.924*	1.078*	0.941*	0.952*
	(2.28)	(2.08)	(2.06)	(2.37)	(2.06)	(2.09)
Business major	-0.220	-0.212	-0.216	-0.213	-0.206	-0.207
	(-1.68)	(-1.63)	(-1.67)	(-1.61)	(-1.57)	(-1.58)
Other majors	0.179	0.141	0.154	0.177	0.146	0.156
	(1.14)	(0.90)	(0.99)	(1.12)	(0.92)	(0.99)
Microeconomics	-0.278**	-0.324**	-0.296**	-0.298**	-0.324**	-0.308**
	(-2.66)	(-3.13)	(-2.85)	(-2.82)	(-3.10)	(-2.95)
_cons	3.987***	3.409***	3.807***	3.703***	3.314***	3.551***
	(15.52)	(20.41)	(14.46)	(16.38)	(20.25)	(15.22)
N	255	255	255	255	255	255

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: GPA: Missing assignments recorded as missing data

	(1) GPA	(2) GPA	(3) GPA	(4) GPA	(5) GPA	(6) GPA
Actual_mean	-0.0413		-0.00775			
	(-1.45)		(-0.24)			
Delay_mean		-0.0823*	-0.0777*			
		(-2.49)	(-2.03)			
Actual_median				-0.0222		0.0120
				(-1.00)		(0.45)
Delay_median					-0.0683*	-0.0767*
					(-2.47)	(-2.30)
Missing_Assignment	-0.266***	-0.256***	-0.255***	-0.272***	-0.260***	-0.263***
	(-5.33)	(-5.18)	(-5.09)	(-5.46)	(-5.29)	(-5.30)
Male	-0.121	-0.136	-0.134	-0.123	-0.138	-0.143
	(-1.66)	(-1.88)	(-1.84)	(-1.69)	(-1.92)	(-1.96)
Junior/Senior	-0.0202	-0.0206	-0.0204	-0.0190	-0.0242	-0.0258
	(-0.25)	(-0.25)	(-0.25)	(-0.23)	(-0.30)	(-0.32)
Asian	-0.0457	-0.0367	-0.0393	-0.0398	-0.0275	-0.0219
	(-0.33)	(-0.27)	(-0.28)	(-0.29)	(-0.20)	(-0.16)
Black	-0.471**	-0.445**	-0.443**	-0.482**	-0.448**	-0.452**
	(-2.80)	(-2.67)	(-2.64)	(-2.86)	(-2.68)	(-2.70)
Hispanic	-0.0968	-0.0807	-0.0821	-0.0959	-0.0805	-0.0775
	(-0.88)	(-0.74)	(-0.75)	(-0.87)	(-0.73)	(-0.70)
White	0.0966	0.116	0.114	0.103	0.122	0.124
	(0.80)	(0.97)	(0.95)	(0.85)	(1.02)	(1.03)
EMP	0.481	0.414	0.412	0.500	0.415	0.414
	(1.48)	(1.28)	(1.27)	(1.54)	(1.28)	(1.27)
Business major	-0.0628	-0.0609	-0.0618	-0.0601	-0.0566	-0.0550
	(-0.69)	(-0.68)	(-0.69)	(-0.66)	(-0.63)	(-0.61)
Other majors	0.132	0.124	0.125	0.132	0.123	0.120
	(1.23)	(1.17)	(1.18)	(1.23)	(1.17)	(1.13)
Microeconomics	-0.0130	-0.0263	-0.0237	-0.0203	-0.0269	-0.0304
	(-0.17)	(-0.35)	(-0.31)	(-0.27)	(-0.36)	(-0.41)
_cons	3.493***	3.370***	3.404***	3.400***	3.351***	3.300***
	(19.08)	(27.69)	(18.19)	(21.07)	(27.92)	(19.92)
N	255	255	255	255	255	255

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: GPA: Missing assignments recorded as "submitted on Monday"

	(1) GPA	(2) GPA	(3) GPA	(4) GPA	(5) GPA	(6) GPA
Actual_mean	-0.105***		-0.0504			
	(-3.72)		(-1.49)			
Delay_mean		-0.140***	-0.108**			
		(-4.49)	(-2.88)			
Actual_median				-0.0635**		-0.0130
				(-2.84)		(-0.48)
Delay_median					-0.112***	-0.103**
					(-4.28)	(-3.18)
Male	-0.0968	-0.134	-0.118	-0.111	-0.140	-0.136
	(-1.26)	(-1.78)	(-1.55)	(-1.43)	(-1.85)	(-1.78)
Junior/Senior	-0.0415	-0.0460	-0.0455	-0.0362	-0.0429	-0.0420
	(-0.47)	(-0.52)	(-0.52)	(-0.40)	(-0.49)	(-0.48)
Asian	-0.0334	-0.00388	-0.0274	-0.0152	0.0291	0.0195
	(-0.23)	(-0.03)	(-0.19)	(-0.10)	(0.21)	(0.14)
Black	-0.389*	-0.377*	-0.366*	-0.403*	-0.371*	-0.368*
	(-2.25)	(-2.21)	(-2.14)	(-2.30)	(-2.16)	(-2.14)
Hispanic	-0.0994	-0.0697	-0.0816	-0.0923	-0.0562	-0.0608
	(-0.87)	(-0.62)	(-0.73)	(-0.80)	(-0.50)	(-0.54)
White	0.130	0.175	0.154	0.156	0.201	0.195
	(1.06)	(1.44)	(1.26)	(1.26)	(1.65)	(1.59)
EMP	0.463	0.384	0.376	0.502	0.371	0.373
	(1.37)	(1.15)	(1.12)	(1.47)	(1.10)	(1.11)
Business major	-0.0466	-0.0412	-0.0433	-0.0419	-0.0359	-0.0362
	(-0.48)	(-0.43)	(-0.45)	(-0.42)	(-0.37)	(-0.37)
Other majors	0.240*	0.212	0.220	0.239*	0.214	0.217
	(2.04)	(1.83)	(1.90)	(2.01)	(1.84)	(1.86)
Microeconomics	-0.0223	-0.0527	-0.0366	-0.0374	-0.0520	-0.0482
	(-0.28)	(-0.69)	(-0.47)	(-0.47)	(-0.67)	(-0.62)
_cons	3.710***	3.336***	3.562***	3.488***	3.275***	3.334***
	(19.32)	(26.89)	(18.16)	(20.62)	(27.08)	(19.27)
N	255	255	255	255	255	255

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: (No) prior update

	(1)	(2)
	Missing asgmt. as missing data	Missing asgmt. as submitted on Mon.
	Delay	Delay
Homework 1	0	0
	(.)	(.)
Homework 2	-0.0728	-0.00755
	(-0.48)	(-0.05)
Homework 3	0.158	0.340*
	(1.02)	(2.12)
Homework 4	0.172	0.426**
	(1.11)	(2.67)
Homework 5	0.468**	0.653***
	(2.85)	(3.85)
_cons	1.024***	1.066***
	(9.72)	(9.56)
N	1115	1196

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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