# GROUP DIFFERENCES IN PERFORMANCE: THE EFFECTS OF TEACHING ASSISTANTS ON COLLEGIATE GRADES

Sarah Hastedt*

University of Virginia

November 2008

*Department of Economics, University of Virginia. Mail: P.O. BOX 400182, Charlottesville, VA 22904.
Email : sh2qt@virginia.edu Fax : 434-982-2904

Acknowledgments:
The author is a Fellow in the University of Virginia Interdisciplinary Doctoral Training Program in the Education Sciences. Special thanks to Kenneth Elzinga and Daniel Melaugh for helpful comments and assistance with the data. Thanks to George Stovall and the Office for Institutional Analysis as well as Patty Futrell and Debby Stanford for providing invaluable help with the data. This paper benefited greatly from participants at the Center for Advanced Study of Teaching and Learning Work-in-Progress Meeting at the University of Virginia. Thanks to Sarah Turner and Maria Fitzpatrick for valuable comments.

*I. Introduction*

Teaching assistants are widely used at universities in the United States to teach courses and aide full time professors in grading and administrative tasks. Nearly fifty percent of graduate students in the U.S. were responsible for teaching a college course in 2000 and more than seventy percent of graduate students had some teaching responsibility (NCES 2000). Public research institutions rely most heavily on graduate student instructors with 14 percent of undergraduate credit hours assigned to teaching assistants (NCES 2001). Despite the widespread use of teaching assistants at the college level, relatively little research attention has been paid to the effect of teaching assistants on student performance. In this paper I utilize data from students enrolled in the Principles of Microeconomics course at the University of Virginia to examine the effect of teaching assistants on a variety of student outcomes. Specifically, I address three questions in this paper: (1) How do teaching assistants and teaching assistant characteristics affect student performance and the likelihood of further study in economics?, (2)To what extent can gender-specific effects at the discussion section level explain differences in performance between male and female students? and (3) How do student evaluations of teaching assistant performance relate to student performance and predict estimated teaching assistant fixed effects?

The investigation of gender-specific effects at the discussion section level is motivated by the fact that male students consistently outperform female students in introductory economics courses (Dynan and Rouse, 1997; Anderson, Benjamin, and Fuss, 1994; Heath, 1989; Lumsden and Scott, 1987; Siegfried and Strand, 1977). A recent study of undergraduate students in an introductory economics class at the University of Virginia echoes this finding (Elzinga and Melaugh, 2007). In the Principles of

Microeconomics course Elzinga and Melaugh examine, the average grade of female students is two-tenths of a GPA point lower than that of males. Even conditional on observable student characteristics, the average female grade is approximately one-tenth of a GPA point lower than that of males in the class. The male-female grade disparity is particularly evident in the right-tail of the grade distribution. This right tail phenomenon has been the subject of much inquiry and controversy in recent years.[1] Examining the reasons underlying this performance differential, particularly at top levels of the achievement distribution, can provide insight into the under-representation of women in the economics profession and at high levels of science more generally.

The persistence of the male grade premium in economics and the under-representation of women as economics majors and economics faculty members is especially troubling in light of the fact that the gender gap in college enrollment and graduation has reversed in recent years (Goldin, Katz, and Kuziemko, 2006). It is imperative to examine why the gender gap remains in economics even as women catch up to men in test score measures and surpass them in overall educational attainment. It is also important to examine the sources of this gender gap because the labor market values skills associated with degrees in economics and business. According to the 2004 National Association of Colleges and Employers Summer Salary Survey, Economics/Finance majors have an average starting salary of $41,000 closely followed by Business Administration/Management majors at $38,000 compared to English and Psychology majors earning $31,000 and $28,000, respectively.[2] If women fail to excel in

[1] Larry Summers' remarks at the 2005 conference "Diversifying the Science and Engineering Workforce: Women, Underrepresented Minorities, and their Science & Engineering Careers" raising the possibility that women may have less "natural" or "innate" mathematical ability sparked controversy within the academic community and the public at large.

[2] Information from: http://encarta.msn.com/college_article_startingsalaries/starting_salaries_for_popular_majors.htm

these fields due to reasons related to the structure of courses that can be influenced by policy, this is critical to know and address.

To examine how student evaluations of teaching assistant performance relate to student performance and predict estimated teaching assistant fixed effects I utilize data from the University of Virginia course evaluation system on teaching assistant performance. Use of student evaluations of teaching assistant performance allows an examination whether student subjective evaluations of teaching assistant performance are related to both current course performance and future course-taking behavior. It also allows analysis of how closely student evaluations of teaching assistant performance relate to estimated teaching assistant fixed effects on student course grades. This will provide valuable information regarding the ability of students to accurately rate teaching ability and suggest whether evaluation data should be used in teaching assistant development and incentive programs.

The remainder of the paper is laid out as follows. Section II provides background information on the role of teaching assistants and discusses the theory and motivation underlying the role model analysis. Section III discusses how the structure of the Principles of Microeconomics (Economics 201) course under study facilitates this analysis. Section IV describes the data and Section V discusses the methodology. Section VI presents results and Section VII concludes.

*II. Background*

Given the widespread use of teaching assistants at large universities it is important to have a better understanding of the effect of TAs on student performance. One group of studies focused on teaching assistants examines the effect of foreign teaching assistants on undergraduate performance in economics. Norris (1991) examines the impact of non-

native, English-speaking teaching assistants on student performance at the University of Wisconsin-Madison. He finds slightly better student performance in sections led by foreign TAs. Borjas (2000) examines the effect of having a foreign-born teaching assistant on student performance in the Economics Principles sequence at Harvard. In contrast to Norris, Borjas finds that foreign-born teaching assistants do appear to have a negative impact on the grades of American undergraduates. In a related literature, Bettinger and Long (2004) examine the effect of adjunct and graduate student instructors on the likelihood of student enrollment and success in future courses. Their results indicate that relative to full-time professors, adjunct and graduate student instructors generally diminish future interest in a subject but that these effects are small and vary by discipline.

One way TAs may influence students is by serving as role models. Students may be more responsive to TAs of the same gender or nationality. This may be especially important for groups that are traditionally underrepresented in economics such as females. It may also be the case that students are more likely to seek help from or ask questions in a class led by a TA of the same gender. If this is the case, having a female TA could improve women's performance by providing a learning environment that is more conducive to women's learning style.

The psychology literature defines a role model as a person considered worthy of emulation (Pleiss and Feldhusen, 1995; Alquist and Angrist, 1971). Numerous theories have been advanced to explain the relevance of role models in career development. Albert Bandura's social learning theory is often cited as a primary explanation for the relevance of role models. This social learning theory posits that an individual can "learn new skills or behavior by observing and coding relevant role model behaviors,

reproducing them, and continuing to reproduce them if reinforced" (Nauta and Kokaly, 2001). According to psychological theories of identification, people are more likely to emulate individuals that seem similar to themselves on the basis of physical appearance, personally background, and personality (Erkut and Mokros, 1984). Taken together these theories indicate that individuals may be more responsive to same-gender instructors. Social cognitive career theory (Lent et al., 1994) suggests that contextual factors can have an indirect effect on career outcomes by shaping interests, self-efficacy, and outcome expectations. These "contextual factors" include the existence of supports and barriers to career development such as the presence or absence of a relevant career model. Another channel that role model influence may operate through is by broadening the range of careers viewed as attainable by setting norms and beliefs (Almquist and Angrist, 1971).

Role model effects are difficult to measure empirically. One potential measurement problem involves selection issues. If female students who feel they would benefit from a same-gender instructor select into female-led classes, then estimates of the role model effect will be biased. Another issue is that it may be difficult to discern role model effects from teacher bias effects. For example, if women receive higher grades in classes taught by females it could be due to role model effects or positive teacher bias. The structure of the course examined in this paper helps mitigate potential effects of both of these issues. Students have little control over the identity of the teaching assistant leading their discussion section which minimizes self-selection problems (section enrollment procedures are discussed further in section IIIa). Individual teaching assistants do not have discretion in setting the final course grades of students in their sections so it is unlikely that teacher-bias could explain student grades in this setting.

Previous work has examined the influence of instructor gender at the secondary and post-secondary levels. Ehrenberg, Goldhaber, and Brewer (1995) use the National Education Longitudinal Survey of 1988 (NELS 88) and find that having a white female instructor improves subjective teacher evaluations of white female students but does not have an impact on objective measures of white female performance. In contrast, Dee (2007) uses data from NELS 88 and finds that having a same-gender instructor has positive, statistically significant effects on eighth grade students for a range of outcomes including test scores, teacher perceptions of student performance, and student engagement in other academic subjects. Nixon and Robinson (1999) use the National Longitudinal Study of Youth 1979 (NSLY 79) and find that exposure to female faculty and professional staff in high school positively effects women's educational attainment but does not impact that of men. They interpret this as evidence of a female role model effect.

At the college level, Dynan and Rouse (1997) use data from an introductory economics course at Harvard and find that classroom environment and gender role models do not affect the probability that a woman majors in economics, conditional on having taken the introductory course. Their results do indicate that women perform less well in economics relative to their other courses and that this relative performance differential significantly reduces the estimated gender gap in the probability of majoring in economics. Canes and Rosen (1995) do not find an association between faculty gender composition at the time when students select their major and the gender composition of undergraduate majors in science and engineering. Robb and Robb (1999) find no evidence that instructor gender influences a student's likelihood of continuing the study of economics or on performance in an introductory economics course. In contrast,

Rothstein (1995) uses the National Longitudinal Study of 1972 (NLSY 72) and finds that the probability that a female student earns an advanced degree is positively related to the percentage of female faculty at her undergraduate institution. Hoffman and Oreopoulos (2007) find small positive effects of having a same-sex instructor on the likelihood of completing a course and course grades but no effects on selection of future courses. Looking at the graduate level, Neumark and Gardecki (1998) examine whether a mentoring relationship between female Ph.D. students in economics and female faculty members improve outcomes for these students. They do not find evidence of improved job placement outcomes and limited evidence of benefits in terms of time to degree completion and completion rates.

The overall conclusion on the effect of instructor gender is mixed, with same-gender instructors either having a small positive effect or no effect on female performance and continuation in economics. Limited research exists regarding the role of teaching assistants on student performance despite their prevalence in courses at the college level. This paper seeks to address this gap in the literature by examining the question of how teaching assistants influence performance in introductory economics through both teaching quality and role model effects.

*III. Structure of Principles of Economics*

The structure of the large lecture sections of Principles of Microeconomics (Economics 201) at the University of Virginia offers an ideal setting to examine the effects of TA characteristics on student performance for several reasons. First, the course was taught by the same professor and had the same format over the entire study period.[3]

[3] The course is always taught during the fall semester of a two-semester academic year and is always offered on Tuesday and Thursday mornings at 11 am and 12:30 pm. Professor Elzinga lectures for 50 minutes and uses an overhead projector to display slides. Students are not permitted to ask questions during

Students enroll in one of two large lecture sections of approximately 500 students in addition to a 15 to 25 student discussion section led by a graduate teaching assistant. Students attend two fifty minute lectures each week led by the professor and one 50 minute discussion section led by their teaching assistant. Discussion sections are the primary forum for students to ask questions. New material is generally covered in lecture first and then reviewed by TAs during discussion section. Importantly for this study, TA-student matching is essentially random because students do not know the identity of their teaching assistant prior to enrolling in a particular section. Each student chooses the available discussion section that best fits his or her schedule.[4] Also important for this study is that grading is uniform across sections within a year as well as across years so all final grades are comparable (grading procedures are discussed in section III.b.).

*III.a. TA Assignment*

The student discussion section enrollment process allows students little control over the identity of their teaching assistant. Students enroll in discussion sections in the spring (or summer for first year students) prior to the fall when the course is taught. At the time when students sign up for sections they do not know who their TA will be. The Economics Department does not select teaching assistants until the summer and specific section assignments are not made until right before the semester begins.[5]

There are 18 teaching assistants each semester leading a total of 52 discussion sections. There is one Head Teaching Assistant who teaches a single discussion section

---

the large lecture sections, this is reserved for office hours and discussion sections. The microeconomics half of a comprehensive introductory economics textbooks has always been used.

[4] Discussion sections are offered throughout the day on Monday, Tuesday morning, Thursday afternoon and evening, and Friday morning and afternoon. No sections are held between lectures (i.e. Tuesday afternoon through Thursday morning) or on weekends.

[5] There is an add/drop period at the beginning of the semester when students may switch discussion sections but this is difficult to do because of class size constraints.

and is in charge of overall discussion section administration. The remaining 17 teaching assistants teach three discussion sections each. The Head TA is generally third or fourth year graduate student with previous experience as a 201 TA. The other teaching assistants are generally first and second year Economics graduate students. Over the period 1997-2006 an average of 70% (about 13 out of 18) of Econ 201 teaching assistants were first year graduate students. Table 1 lists student characteristics by teaching assistant gender. Teaching assistant gender does not appear to be systematically associated with student gender or other observable student characteristics. This suggests that students can expect a similar classroom environment in terms of observable characteristics regardless of teaching assistant gender.

*III.b. Grading*

The grading criteria and test format remain constant over the study period making course grades comparable across years. Final course grades are determined primarily by performance on tests. Students take two short answer midterm exams and a multiple choice final exam. All students take the same exams regardless of which discussion section they are enrolled in; however, TAs are responsible for grading the tests of students enrolled in their sections. Several measures are taken to ensure the greatest degree of grading consistency across TAs as possible on the short answer midterm exams. All teaching assistants grade simultaneously according to the same strict key which specifies acceptable answers and point values. Teaching assistants do not have discretion to award partial credit unless it is specifically detailed in the key. Teaching assistants meet with the Head TA as a group immediately following administration of the test to discuss the key and grade a sample of student exams together and are required to

submit their graded exams to the Head TA who randomly checks tests to make sure they are graded according to the key.

Students also receive points for discussion section performance which account for a very small percentage of total course points. TAs have discretion regarding the method used to assign points but the most common assessment tools are quizzes and homework assignments. It is unlikely that differences in TA points are driving differences in grades. In 2006, the average TA point value was 20.7 points out of 25 discussion section points (which are part of the 400 total course points) and did not differ across male and female students. The average TA point value (out of 25) for students with a female teaching assistant was 20.8 versus 20.6 students with a male teaching assistant, a statistically insignificant difference. For some students, TA points are not a component of their final grade at all for reasons detailed in the following paragraph. The small percentage of overall total points, the limited variance of TA points across TAs, and the fact that these points are not a factor in some student grades suggest that overall TA points themselves represent a trivial component of final grades.

Final grades are calculated using two methods. The first method is based on a 400 point scale which includes the student's grades on midterm exams, the final exam, and discussion section performance. The final accounts for 50% of the course grade, the midterms for approximately 44% of the grade, and discussion section performance accounts for the remaining 6% of the grade. The second method uses only the final exam to determine the letter grade so that midterm exam grades and discussion section points play no role in the final grade.[6] Students are assigned the higher of the two grades.

[6] In 2006, approximately 10.6% of Economics 201 students used the "Dutch Knockout" option (using only the final exam for their course grade). Among students with a female teaching assistant, 9.7% used the Dutch knockout compared to 11% of among students with a male teaching assistant. A t-test indicates that

*IV. Data and Descriptive Statistics*

The data used in this study include students enrolled in Professor Kenneth Elzinga's Principles of Microeconomics course at the University of Virginia from 1992-2006.[7] This data set contains information on student and TA characteristics as well as information on student academic performance while at UVA. Table 2 presents summary statistics for the variables included in the analysis. The first column reports overall sample means while the second and third columns report means for male and female students separately. Overall the males and females taking Econ 201 appear to be quite similar on observable characteristics with a few notable exceptions. The two primary differences are in the school within UVA that males and females are enrolled in and math SAT scores. Men are more likely to be enrolled in the Engineering School and women are more likely to be enrolled in the College of Arts and Sciences. A similar proportion of men and women are enrolled in the Architecture School. Men in Economics 201 score approximately 20 points higher on average on the math SAT than their female counterparts and are much more likely to have scored a 700 or above on the math SAT.

Over the study period, 40% of students were in sections led by a female teaching assistant and 60% of students were in sections led by an American teaching assistant. The percent of TAs that are American trends downward over the study period while there is no clear pattern to the percent of female TAs over time (see Figure 1). The number of female teaching assistants ranges from 5 to 11 while the number of American TAs ranges from 7 to 15 in a given year (see Table 3).

---

the difference is not statistically significant. There was a statistically significant difference in the proportion of male and female students relying on the final exam to determine their final course grade. Approximately 8% of female students utilized the Dutch knockout compared to about 13% of male students.

[7] Elzinga did not teach the course in 1993 so data is not available for that year. Due to missing TA section information 1998 is not included in the analysis although the course was taught by Elzinga that year.

*V. Estimation Strategy*

To address the first research question, how do teaching assistants and teaching assistant characteristics affect student performance and the likelihood of further study in economics, I estimate the following equation:

$$(1)\quad Grade_{ist} = \alpha + X_{ist}'\beta + \theta FemTA_{ist} + \gamma USTA_{ist} + \tau_t + \varepsilon_{ist}$$

Here the subscript *i* indexes students, *s* indexes sections and *t* indexes year. The dependent variable is the final grade a student received in Econ 201 expressed in GPA points.[8] For specifications that examine continuation in economics course work, the dependent variable is an indicator variable equal to one if the student pursues further course work in economics and 0 otherwise. The vector *X* includes student demographic traits such as gender, SAT math and verbal scores, in-state status, legacy status, and year of study. The variable *FemTA* is an indicator variable equal to one if the student is enrolled in a discussion section taught by a female and equal to zero otherwise. The variable *USTA* is an indicator variable equal to one if the student is enrolled in a discussion section led by an American TA and equal to zero otherwise. The variable $\tau_t$ is a year fixed effect. The error term captures unobserved student traits that influence a student's grade. Standard errors are clustered at the section level to address the concern that residuals are not independent within a particular section.

To test for the presence of gender-specific effects of teaching assistants on performance in introductory economics, an interaction between *FemTA* and a student's gender (*Fem* which equals 1 if a student is female and 0 if a student is male) is added to the specification shown in equation (1). The coefficient on the interaction term will pick up the differential impact a female TA may have on female undergraduates relative to

[8] Course letter grades are converted to GPA points on a 4 point scale. For example, an A- is worth 3.7 GPA points while a B+ is worth 3.3 GPA points.

male students. Even in the absence of role model effects, it is possible that there are systematic differences across TAs in how well class presentations meet the needs of specific student groups, notably women and minorities. To explore these questions further I pursue the estimation of models with TA-specific fixed effects with the specification:

(2) $Grade_{ist} = \alpha + X_{ist}'\beta + \theta FemTA_{ist} + \gamma FemTA_{ist} * Fem_{ist} + \tau_t + TA_s + \varepsilon_{ist}$

$TA_s$ indicates an effect specific to each TA. For a TA that teaches in multiple years, a single fixed effect is included for all years taught. Figure 2, Panel I depicts a scatter plot of TA fixed effects for male and female students when no controls are included. The upward slope of the plot suggests that strong TAs have a positive influence on both male and female students. Panel II of Figure 2 shows a scatter plot of TA fixed effects when a full set of controls is included. When controls for student demographic traits and ability are included the magnitude of the TA fixed effects falls. Even with controls there is a slight positive slope to the plot, again suggesting that strong TAs improve the performance of both male and female students.

*VI. Results*

*VI.a. Teaching Assistant Characteristics and Performance in Economics 201*

Table 4 reports ordinary least squares regression results where the dependent variable is a student's grade in Econ 201 based on a 4 point scale. Column one reports results when only race, gender and year controls are included in the regression. Echoing the finding of Elzinga and Melaugh 2007, the raw gender gap in performance is large (.2 GPA points). The addition of student demographic and ability controls shrinks the gap to one tenth of a GPA point but does not eliminate gap (as shown in Table 4, column 2). The second column of Table 4 also reports results for the effect of having a female

teaching assistant or American teaching assistant on student performance. Neither has a statistically significant effect on performance and each is small in magnitude. Student ability and demographic characteristics are much stronger predictors of performance in Economics 201. Particularly important are Math SAT scores, with students who score in the 600-699 range receiving an Economics 201 grade nearly .4 of a GPA point lower than students scoring a 700 or above. Column three reports results from the specification which adds an interaction between female students and female teaching assistants. The coefficient on this interaction term is positive but statistically insignificant, suggesting that there is not a role model for female students effect operating through female teaching assistants. TA fixed effects are included in the specification reported in column 4. The addition of TA fixed effects does not substantially alter either the size or significance of the main results. An F-test indicates that the null that TA fixed effects are jointly equal to zero can be rejected indicating.

Table 5 reports marginal effects from an ordered probit regression. The marginal effects are evaluated at the mean. The results are similar in sign and significance to the OLS results. Females are less likely to receive any form of A or B in the course than males and are more likely to receive a C, D, or F in some form.[9] For females, having a female TA has a small positive but statistically insignificant effect on the probability of receiving an A or a B. Having an American TA has a small positive but statistically insignificant effect on the probability of receiving an A or a B.

Figure 3, panels (I)-(VI), depicts the distribution of grades in Econ 201 by gender for selected years. These figures indicate that the male-female grade gap is largely driven by grade differences in the upper tail of the distribution (A+, A, A-). Table 6 reports

[9] To reduce the number of categories grades sharing a common letter are grouped together (e.g. a B+, B, and B- are all grouped together in the "B" category).

marginal effects from a probit regression where the dependent variable is equal to one if a student received an A+, A, or A- and equal to zero otherwise. The marginal effects are evaluated at the mean. The results show a similar pattern to those presented previously where there females are less likely to earn the highest grades in Econ 201 but gender grade gap shrinks when observable student characteristics are controlled for. Column 3 of Table 6 reports results when TA characteristics are included. Neither having a female TA nor having an American TA has a statistically significant effect on the probability of receiving an A in the course. The interaction between being a female student and having a female teaching assistant is positive and statistically significant at the 10% level. The .03 coefficient indicates that on average, for a female student having a female TA rather than a male TA increases the probability that she receives an A in Economics 201 by .03 percentage points. While the effect is small in practical terms, it is suggestive that a subset of female students benefit from having a same-gender instructor.

While having a female teaching assistant or an American teaching assistant may not lead to improved performance in Economics 201, it may be the case that teaching assistant characteristics or role model effects influence student course-taking behavior after completing Economics 201. To test for gender-specific effects and more general effects of teaching assistant characteristics on continuation in economics, I use completion of either Intermediate Microeconomics or Intermediate Macroeconomics as the outcome variable and re-estimate the specifications reported in Columns (1)-(3) of Table 4. These results are reported in Table 7. Females are less likely to continue on to study Intermediate Microeconomics or Macroeconomics, even after conditioning on student demographic and ability characteristics. Again, neither teaching assistant nationality nor gender influences the likelihood or continued study in economics (as the

estimates in column 2 show in column 2). One of the most important predictors is performance in Economics 201. Students with higher grades in Economics 201 are more likely to take intermediate level coursework in economics. I do not find evidence of a gender role model effect, as female students matched with female TAs in Economics 201 are not more likely to take Intermediate Microeconomics or Macroeconomics than those matched with male TAs.

## VII. Conclusion

This paper examines the effect of teaching assistants on student performance in an introductory economics course. I find that TA characteristics explain little of the gender gap in performance between male and female students in Economics 201. I also find little evidence of a gender role model effect for female students with female teaching assistants. Female teaching assistants do appear to have a small positive effect on the probability that a female student receives a very high grade in the course. This finding suggests that same-gender teaching assistants could matter for a higher-achieving subset of females. The general finding that having a same-gender teaching assistant does not influence female student performance is consistent with previous literature examining the impact of instructor gender on performance which finds little evidence of role model effects. Teaching assistant nationality also seems to have no influence on student performance in contrast to widely held student beliefs regarding the relative effectiveness of foreign- versus American-born teaching assistants. The ability to reject null that TA effects are jointly equal to zero suggests that TAs do matter for course grades but their observable characteristics (in terms of race and gender) are not predictive of their impact on students or specific student groups. The finding that TA characteristics do not have an

appreciable impact on closing the gender-gap in performance in Economics 201 suggests that differences in the preferences of male and female students for the study of economics may be an important factor underlying the performance differential.

References

Almquist, Elizabeth M. and Shirley S. Angrist, 1971. "Role Model Influence on College Women's Career Aspirations." *Merrill-Palmer Quarterly*. Vol. 17, pp. 263-279.

Anderson, Gordon, Dwayne Benjamin, and Melvyn A. Fuss, 1994. "The Determinants of Success in University of Economics Courses." The *Journal of Economic Education*, Vol. 25, No. 2., pp. 99-119.

Bettinger, Eric P. and Bridget Terry Long. "Do Faculty Serve as Role Models? The Impact of Instructor Gender on Female Students." 2005. *American Economic Review*, vol. 95, No. 2.

Bettinger, Eric P. and Bridget Terry Long. "Do College Instructors Matter? The Effects of Adjuncts and Graduate Assistants on Student's Interests and Success." NBER Working Paper No. 10370, March 2004.

Borjas, George J., 2000. "Foreign Born Teaching Assistants and the Academic Performance of Undergraduates." *American Economic Review*, pp. 355-359.

Canes, Brandice and Harvey S. Rosen, 1995. "Following in Her Footsteps? Faculty Gender Composition and Women's Choices of College Major." *Industrial and Labor Relations Review*, Vol. 48, No. 3. , pp. 486-504.

Dee, Thomas S. "Teachers and Gender Gaps in Student Achievement." *Journal of Human Resources*, Summer 2007, 42(3), pp. 528-554.

Dynan, Karen E. and Cecilia Elana Rouse. "*The Under-Representation of Women in Economics: A Study of Undergraduate Economics Students*." The Journal of Economic Education., Vol. 28 No. 4 (Fall 1997): 350-368.

Ehrenberg, Ronald G., Daniel D. Goldhaber, and Dominic J. Brewer. "Do Teachers' Race, Gender and Ethnicity Matter?: Evidence From NELS88", *Industrial and Labor Relations Review* 48 (April 1995).

Elzinga, Kenneth G. and Daniel O. Melaugh. 2007. "30,000 Principles Students: Some Lessons Learned," Working Paper.

Erkut, Sumru and Janice R. Mokros. 1984. "Professors as Models and Mentors for College Students." *American Educational Research Journal*, Vol. 21, No. 2, pp. 399-417.

Goldin, Claudia, Lawrence F. Katz, and Ilyana Kuziemko. "The Homecoming of American College Women: The Reversal of the College Gender Gap. NBER Working Paper No. 12139, March 2006.

Heath, Julia A., 1989. "An Econometric Model of the Role of Gender in Economic Education," *American Economic Review*, Vol. 79, No. 2, pp. 226-230.

Hoffman, Florian and Phillip Oreopoulos. “A Professor Like Me: The Influence of Instructor Gender of College Achievement” NBER Working Paper No. 13182, June 2007.

Karunanayake, Danesh and Margaret M. Nauta. 2004. “The Relationship Between Race and Students’ Identified Career Role Models and Perceived Role Model Influence.” *Career Development Quarterly*, Vol. 52, pp. 225-234.

Lent, Robert W., Steven D. Brown, and Gail Hackett, 1994. “Toward a Unifying Theory of Career and Academic Interest, Choice, and Performance.” *Journal of Vocational Behavior,* Volume 45, pp. 79-122.

Lumsden, Keith G. and Alex Scott, 1987. “The Economics Student Reexamined: Male-Female Differences in Comprehension.” *The Journal of Economic Education*, Vol. 18, No. 4, pp. 365-375.

National Center for Education Statistics. 2001. *Institutional Policies and Practices: Results from the 1999 National Study of Postsecondary Faculty, Institutional Survey.*

National Center for Education Statistics. 2000. *1999-2000 National Postsecondary Student Aid Study*

Nauta, Margaret M. and Michelle L. Kokaly. 2001. “Assessing Role Model Influences on Students’ Academic and Vocational Decisions.” *Journal of Career Assessment*, Vol. 9, No.1, pp. 81-99.

Neumark, David and Rosella Gardecki, 1998. “Women Helping Women? Role-Model and Mentoring Effects on Female Ph.D. Students in Economics.” *Journal of Human Resources*, pp. 220-46.

Nixon, Lucia A. and Michael D. Robinson. “The educational attainment of young women: Role model effects of female high school faculty,” *Demography* 36(2): May 1999, pp. 185-194.

Norris, Timothy. “Non-native English-Speaking Teaching Assistants and Student Performance.” *Research in Higher Education*, Vol. 32, No. 4, 1991.

Robb, Roberta Edgecombe and A. Leslie Robb. “Gender and the Study of Economics.” *The Journal of Economic Education*. Vol. 30, No. 1 (Winter 1999), pp. 3-19.

Rothstein, Donna S. 1995. “Do Female Faculty Influence Female Students’ Educational and Labor Market Attainments?” Industrial and Labor Relations Review, Vol. 48, No. 3, pp. 515 – 530.

Pleiss, M.K. and Feldhusen J.F. 1995. “Mentors, Role Models, and Heroes in the Lives of Gifted Children.” *Educational Psychologist*, Vol. 30, pp. 159-169.

Siegfried, John J. and Stephen H. Strand, 1977. “Sex and the Economics Student.” The Review of Economics and Statistics, Vol. 59, No. 2, pp. 247-249.

Xie, Yu and Kimberlee A. Shauman. Women in Science: Career Processes and Outcomes. Cambridge, MA: 2003.

Figure 1
Trends in TA Characteristics

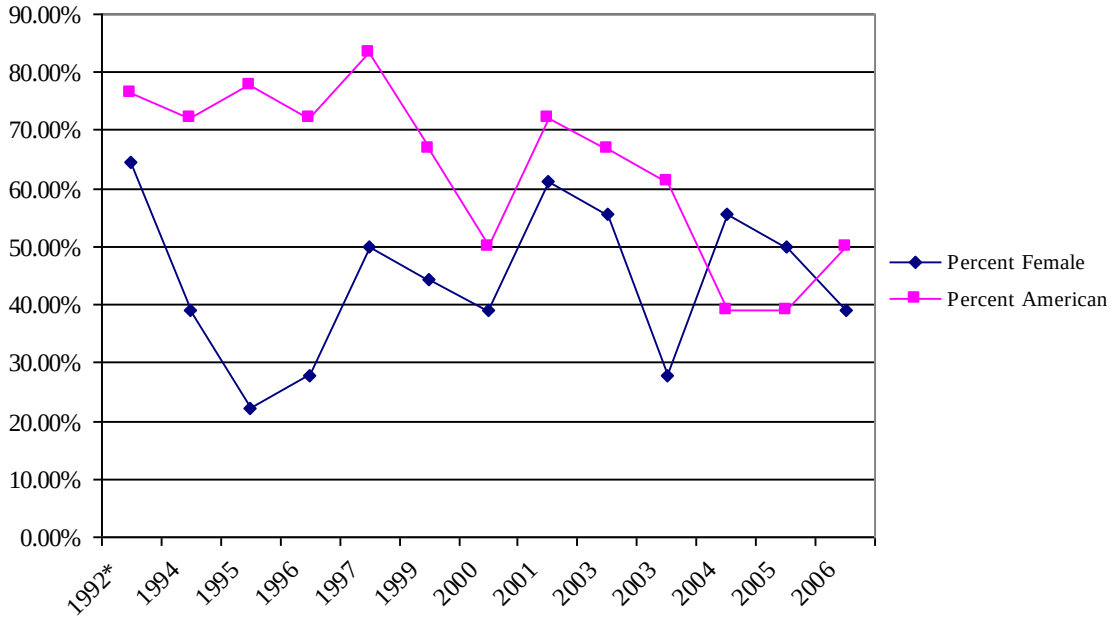
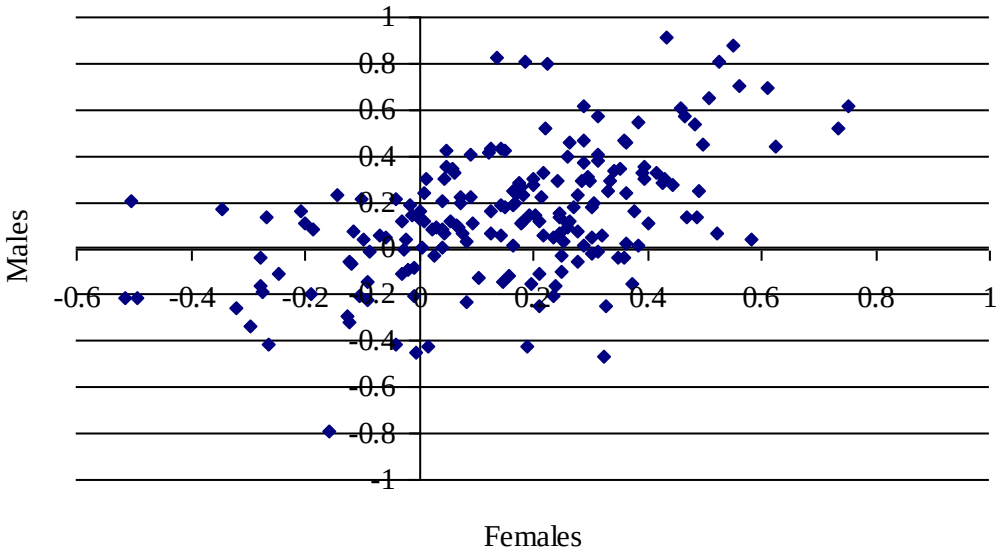


Figure 2

Panel I
TA Fixed Effects by Student Gender with No Controls




Panel II
TA Fixed Effects by Student Gender with Controls

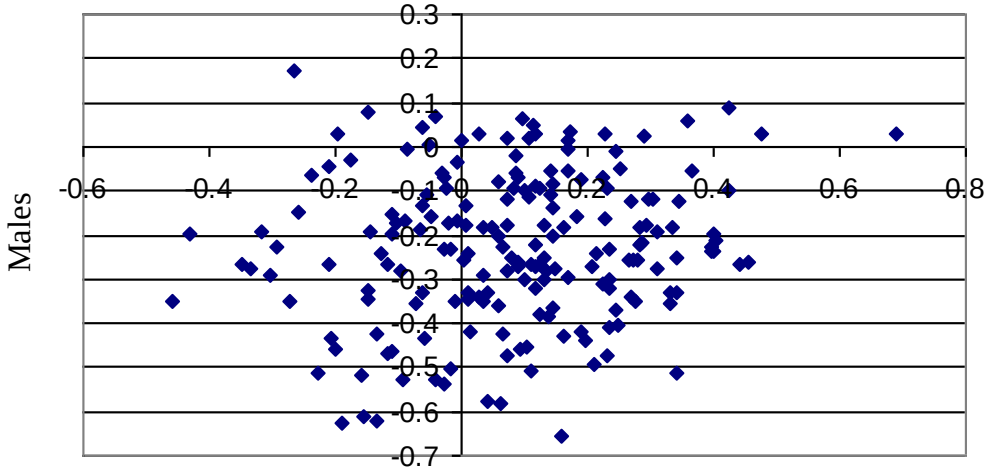
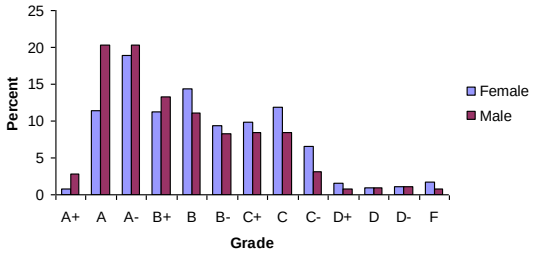
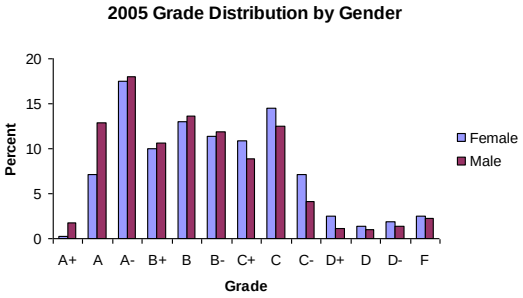


Figure 3

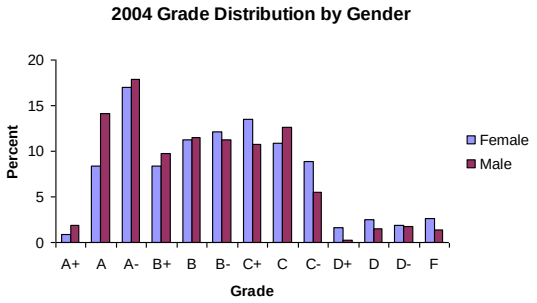
Panel I



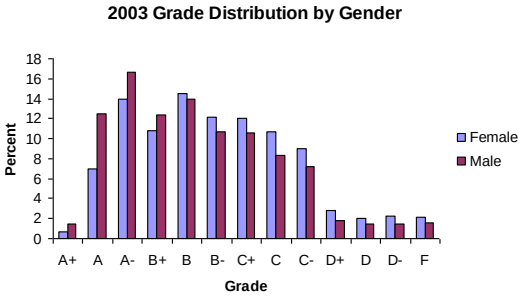

Panel II



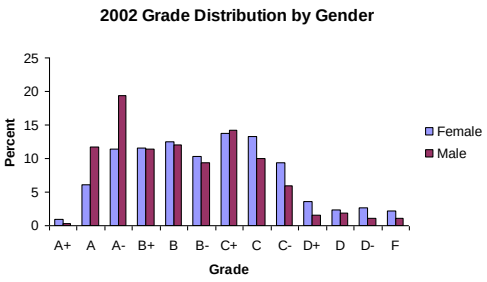

Panel III



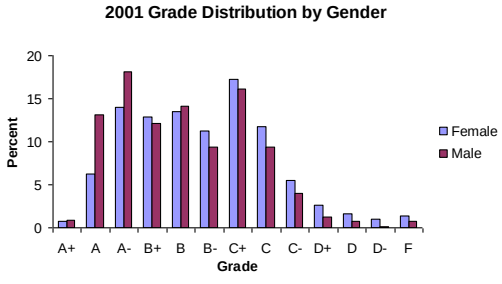

Panel IV




Panel V




Panel VI




Notes: Based on author's calculations using data from the University of Virginia Office of Institutional Analysis.

Table 1. Student Characteristics by TA Gender

| | Female TA | Male TA |
|---|---|---|
| Section size | 19.6 | 20.2 |
| Female | 0.490 | 0.486 |
| First year | 0.212 | 0.200 |
| Second year | 0.494 | 0.482 |
| Third year | 0.211 | 0.244 |
| Fourth year | 0.081 | 0.075 |
| Math SAT score | 674 | 676.5 |
| Verbal SAT score | 659 | 659.8 |
| White | 0.739 | 0.741 |
| Black | 0.054 | 0.050 |
| Other race | 0.207 | 0.209 |
| Legacy | 0.159 | 0.148 |
| VA resident | 0.645 | 0.649 |

Notes: Based on authors calculation using data from the University of Virginia Office of Institutional Analysis from 1992, 1994-1997, and 1999-2006.

Table 2. Summary Statistics

| | All | Female | Male |
|---|---|---|---|
| *Student characteristics* | | | |
| Female | 0.488 | | |
| White | 0.740 | 0.722 | 0.757 |
| Black | 0.051 | 0.058 | 0.045 |
| Other Race | 0.208 | 0.220 | 0.197 |
| First year | 0.205 | 0.202 | 0.209 |
| Second year | 0.486 | 0.488 | 0.485 |
| Third year | 0.231 | 0.234 | 0.228 |
| Fourth year | 0.077 | 0.076 | 0.078 |
| College of Arts & Sciences | 0.871 | 0.932 | 0.812 |
| Engineering School | 0.109 | 0.046 | 0.169 |
| Architecture School | 0.016 | 0.014 | 0.017 |
| VA Resident | 0.646 | 0.663 | 0.629 |
| UVA legacy | 0.152 | 0.143 | 0.159 |
| *Student Ability Measures* | | | |
| Verbal SAT | 659.5 | 657.6 | 661.3 |
| Verbal SAT <500 | 0.020 | 0.020 | 0.021 |
| Verbal SAT in 500s | 0.155 | 0.162 | 0.147 |
| Verbal SAT in 600s | 0.501 | 0.505 | 0.497 |
| Verbal SAT in 700s | 0.324 | 0.313 | 0.335 |
| Math SAT | 675.5 | 659.2 | 691.0 |
| Math SAT <500 | 0.008 | 0.010 | 0.006 |
| Math SAT in 500s | 0.117 | 0.156 | 0.080 |
| Math SAT in 600s | 0.469 | 0.529 | 0.412 |
| Math SAT in 700s | 0.406 | 0.305 | 0.502 |
| *Discussion Section Characteristics* | | | |
| Female TA | 0.390 | 0.391 | 0.388 |
| American TA | 0.597 | 0.606 | 0.588 |
| Section Size | 20.007 | 20.007 | 20.008 |
| Number of females | 9.759 | 10.463 | 9.089 |
| Number of females (excluding student) | | 9.463 | 9.089 |
| *Course outcome measure* | | | |
| Econ 201 Grade | 2.761 | 2.647 | 2.871 |
| N | 12,768 | 6,228 | 6,540 |

Notes: Based on authors calculation using data from the University of Virginia Office of Institutional Analysis from 1992, 1994-1997, and 1999-2006.

Table 3. Teaching Assistant Characteristics by Year

| **Year** | Female TAs | | American TAs | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| 2006 | 7 | 38.9 | 9 | 50.0 |
| 2005 | 9 | 50.0 | 7 | 38.9 |
| 2004 | 10 | 55.6 | 7 | 38.9 |
| 2003 | 10 | 55.6 | 11 | 61.1 |
| 2003 | 5 | 27.8 | 12 | 66.7 |
| 2001 | 11 | 61.1 | 13 | 72.2 |
| 2000 | 7 | 38.9 | 9 | 50.0 |
| 1999 | 8 | 44.4 | 12 | 66.7 |
| 1997 | 9 | 50.0 | 15 | 83.3 |
| 1996 | 5 | 27.8 | 13 | 72.2 |
| 1995 | 4 | 22.2 | 14 | 77.8 |
| 1994 | 7 | 38.9 | 13 | 72.2 |
| 1992 | 11 | 64.5 | 13 | 76.5 |

Note: Based on author's calculation using data from University of Virginia Office of Institutional Analysis. Each year there are 18 total teaching assistants with the exception of 1992 where there are only observations for 17 TAs due to missing records.

Table 4. Ordinary Least Squares Estimates of the Effect of Student and Teaching Assistant Characteristics on Student Final Grade in Economics 201

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Female | **-0.213** | **-0.110** | -0.122 | **-0.111** |
| | (0.016) | (0.014) | (0.053) | (0.014) |
| Black | **-0.889** | **-0.350** | -0.350 | **-0.345** |
| | (0.043) | (0.048) | (0.042) | (0.042) |
| Other race | **-0.056** | -0.022 | -0.022 | -0.019 |
| | (0.019) | (0.016) | (0.017) | (0.018) |
| Female TA | | -0.010 | -0.022 | |
| | | (0.016) | (0.022) | |
| Female*Female TA | | | 0.025 | |
| | | | (0.030) | |
| American TA | | 0.019 | 0.017 | |
| | | (0.016) | (0.016) | |
| First year | | **-0.330** | **-0.328** | **-0.312** |
| | | (0.031) | (0.031) | (0.031) |
| Second year | | **-0.162** | **-0.160** | **-0.150** |
| | | (0.027) | (0.027) | (0.027) |
| Third year | | **-0.086** | **-0.086** | **-0.077** |
| | | (0.027) | (0.027) | (0.027) |
| Engineering school | | **-0.058** | **-0.057** | **-0.059** |
| | | (0.023) | (0.023) | (0.023) |
| Architecture School | | **-0.417** | **-0.416** | **-0.413** |
| | | (0.057) | (0.057) | (0.058) |
| VA Resident | | **-0.092** | **-0.092** | **-0.093** |
| | | (0.015) | (0.016) | (0.015) |
| UVA legacy | | **-0.103** | **-0.103** | **-0.102** |
| | | (0.020) | (0.020) | (0.020) |
| Verbal SAT <500 | | **-0.608** | **-0.608** | **-0.622** |
| | | (0.064) | (0.064) | (0.063) |
| Verbal SAT in 500s | | **-0.570** | **-0.570** | **-0.575** |
| | | (0.025) | (0.025) | (0.025) |
| Verbal SAT in 600s | | **-0.266** | **-0.266** | **-0.269** |
| | | (0.016) | (0.016) | (0.016) |
| Math SAT <500 | | **-1.220** | **-1.221** | **-1.210** |
| | | (0.109) | (0.109) | (0.110) |
| Math SAT in 500s | | **-0.834** | **-0.835** | **-0.840** |
| | | (0.028) | (0.028) | (0.028) |
| Math SAT in 600s | | **-0.387** | **-0.387** | **-0.386** |
| | | (0.015) | (0.015) | (0.015) |
| Constant | 2.996 | 3.698 | 3.687 | 3.845 |
| | (0.031) | (0.039) | (0.070) | (0.169) |
| N | | 12,768 | | |
| Year FE | Yes | Yes | Yes | Yes |
| TA FE | No | No | No | Yes |

Notes: Based on author's calculations using data from the University of Virginia Office of Institutional Analysis. Robust standard errors are clustered at the section-year level and are reported in parentheses. Bold indicates significance at the 5% level. The omitted category for year in school is fourth year (senior), the omitted category for race is white, the omitted category for school is College of Arts and Sciences, and the omitted category for verbal and math SAT scores is a score below 500.

Table 5. Ordered Probit Estimates of the Effect of Student and Teaching Assistant Characteristics on Student Final Grade in Economics 201

| | A | B | C | D | F |
|---|---|---|---|---|---|
| Female | **-0.044** | **-0.011** | **0.042** | **0.011** | **0.002** |
| | (0.007) | (0.002) | (0.007) | (0.002) | (0.0004) |
| Female TA | -0.006 | -0.001 | 0.006 | 0.001 | 0.0002 |
| | (0.009) | (0.002) | (0.009) | (0.002) | (0.0005) |
| Female*Female TA | 0.005 | 0.001 | -0.005 | -0.001 | -0.0002 |
| | (0.012) | (0.003) | (0.012) | (0.003) | (0.001) |
| American TA | 0.008 | 0.002 | -0.008 | -0.002 | -0.0004 |
| | (0.007) | (0.002) | (0.006) | (0.002) | (0.0003) |
| Black | **-0.104** | **-0.057** | **0.110** | **0.040** | **0.010** |
| | (0.011) | (0.010) | (0.013) | (0.006) | (0.002) |
| Other race | -0.010 | -0.003 | 0.009 | 0.002 | 0.0005 |
| | (0.007) | (0.002) | (0.007) | (0.002) | (0.0003) |
| First year | **-0.120** | **-0.055** | **0.124** | **0.041** | **0.010** |
| | (0.010) | (0.007) | (0.011) | (0.005) | (0.002) |
| Second year | **-0.068** | **-0.017** | **0.065** | **0.017** | **0.004** |
| | (0.012) | (0.003) | (0.011) | (0.003) | (0.001) |
| Third year | **-0.038** | **-0.012** | **0.037** | **0.010** | **0.002** |
| | (0.012) | (0.004) | (0.011) | (0.003) | (0.001) |
| Engineering school | **-0.028** | **-0.009** | **0.027** | **0.008** | **0.002** |
| | (0.009) | (0.003) | (0.009) | (0.003) | (0.001) |
| Architecture School | **-0.130** | **-0.090** | **0.142** | **0.061** | **0.017** |
| | (0.013) | (0.017) | (0.015) | (0.011) | (0.004) |
| VA Resident | **-0.040** | **-0.009** | **0.037** | **0.009** | **0.002** |
| | (0.006) | (0.001) | (0.006) | (0.001) | (0.0003) |
| UVA legacy | **-0.039** | **-0.013** | **0.038** | **0.011** | **0.002** |
| | (0.008) | (0.003) | (0.008) | (0.002) | (0.001) |
| Verbal SAT <500 | **-0.165** | **-0.147** | **0.180** | **0.098** | **0.033** |
| | (0.010) | (0.021) | (0.010) | (0.014) | (0.007) |
| Verbal SAT in 500s | **-0.175** | **-0.114** | **0.186** | **0.080** | **0.023** |
| | (0.006) | (0.008) | (0.007) | (0.005) | (0.002) |
| Verbal SAT in 600s | **-0.116** | **-0.029** | **0.109** | **0.029** | **0.006** |
| | (0.007) | (0.002) | (0.007) | (0.002) | (0.001) |
| Math SAT <500 | **-0.213** | **-0.321** | **0.144** | **0.236** | **0.154** |
| | (0.005) | (0.023) | (0.026) | (0.022) | (0.032) |
| Math SAT in 500s | **-0.218** | **-0.198** | **0.226** | **0.138** | **0.052** |
| | (0.005) | (0.009) | (0.006) | (0.007) | (0.005) |
| Math SAT in 600s | **-0.163** | **-0.044** | **0.154** | **0.043** | **0.010** |
| | (0.006) | (0.003) | (0.006) | (0.002) | (0.001) |
| N | | | 12,768 | | |
| Year FE | | | Yes | | |
| TA FE | | | No | | |

Notes: Based on author's calculations using data from the University of Virginia Office of Institutional Analysis. Marginal effects evaluated at the means are reported. Robust standard errors are clustered at the section-year level and are reported in parentheses. Bold indicates significance at the 5% level or below. The omitted category for year in school is fourth year (senior), the omitted category for race is white, the omitted category for school is College of Arts and Sciences, and the omitted category for verbal and math SAT scores is a score below 500.

Table 6. Probit Regression Estimates of the Effect of Student and Teaching Assistant Characteristics on the of Probability of Receiving an A in Economics 201

| | (1) | (2) | (3) |
|---|---|---|---|
| Female | **-0.096** | **-0.070** | **-0.060** |
| | (0.008) | (0.010) | (0.008) |
| Black | **-0.206** | **-0.099** | **-0.098** |
| | (0.011) | (0.020) | (0.020) |
| Other race | -0.014 | -0.007 | -0.006 |
| | (0.009) | (0.009) | (0.009) |
| Female TA | | -0.009 | |
| | | (0.011) | |
| Female*Female TA | | *0.031* | |
| | | (0.017) | |
| American TA | | 0.012 | |
| | | (0.008) | |
| First year | | **-0.116** | **-0.116** |
| | | (0.013) | (0.013) |
| Second year | | **-0.055** | **-0.054** |
| | | (0.015) | (0.015) |
| Third year | | **-0.031** | **-0.030** |
| | | (0.015) | (0.015) |
| Engineering school | | **-0.029** | **-0.029** |
| | | (0.012) | (0.012) |
| Architecture School | | **-0.134** | **-0.136** |
| | | (0.020) | (0.019) |
| VA Resident | | **-0.047** | **-0.050** |
| | | (0.008) | (0.008) |
| UVA legacy | | **-0.031** | **-0.030** |
| | | (0.010) | (0.010) |
| Verbal SAT <500 | | **-0.127** | **-0.127** |
| | | (0.020) | (0.019) |
| Verbal SAT in 500s | | **-0.168** | **-0.171** |
| | | (0.009) | (0.009) |
| Verbal SAT in 600s | | **-0.124** | **-0.126** |
| | | (0.009) | (0.009) |
| Math SAT <500 | | **-0.211** | **-0.207** |
| | | (0.012) | (0.011) |
| Math SAT in 500s | | **-0.221** | **-0.220** |
| | | (0.007) | (0.007) |
| Math SAT in 600s | | **-0.166** | **-0.164** |
| | | (0.008) | (0.008) |
| N | | 12,768 | |
| Year FE | Yes | Yes | Yes |
| TA FE | No | No | Yes |

Notes: Based on author's calculations using data from the University of Virginia Office of Institutional Analysis. Marginal effects evaluated at the mean are reported. Robust standard errors are clustered at the section-year level and are reported in parentheses. Bold indicates significance at the 5% level or below. The omitted category for year in school is fourth year (senior), the omitted category for race is white, the omitted category for school is College of Arts and Sciences, and the omitted category for verbal and math SAT scores is a score below 500.

Table 7. Linear Probability Estimates of Continued Coursework in Economics

| | (1) | (2) | (3) |
|---|---|---|---|
| Female | **-0.129** | **-0.107** | **-0.102** |
| | (0.008) | (0.008) | (0.010) |
| Black | -0.021 | **0.047** | **0.048** |
| | (0.018) | (0.019) | (0.019) |
| Other race | **0.067** | **0.054** | **0.054** |
| | (0.010) | (0.010) | (0.010) |
| Female TA | | -0.002 | 0.004 |
| | | (0.011) | (0.014) |
| Female*Female TA | | | -0.013 |
| | | | (0.016) |
| Economics 201 Grade | | **0.108** | **0.108** |
| | | (0.005) | (0.005) |
| American TA | | -0.002 | -0.002 |
| | | (0.010) | (0.010) |
| First year | | **0.267** | **0.267** |
| | | (0.015) | (0.015) |
| Second year | | **0.261** | **0.261** |
| | | (0.012) | (0.012) |
| Third year | | **0.172** | **0.172** |
| | | (0.013) | (0.013) |
| Engineering school | | **-0.098** | **-0.098** |
| | | (0.013) | (0.013) |
| Architecture School | | **-0.11468** | **-0.11467** |
| | | (0.025) | (0.025) |
| VA Resident | | 0.004 | 0.004 |
| | | (0.008) | (0.008) |
| UVA legacy | | **-0.027** | **-0.027** |
| | | (0.011) | (0.011) |
| Verbal SAT <500 | | **0.148** | **0.147** |
| | | (0.030) | (0.030) |
| Verbal SAT in 500s | | **0.083** | **0.083** |
| | | (0.013) | (0.013) |
| Verbal SAT in 600s | | **0.038** | **0.038** |
| | | (0.010) | (0.010) |
| Math SAT <500 | | **-0.118** | **-0.117** |
| | | (0.035) | (0.035) |
| Math SAT in 500s | | **-0.083** | **-0.083** |
| | | (0.015) | (0.015) |
| Math SAT in 600s | | **-0.041** | **-0.041** |
| | | (0.010) | (0.010) |
| Constant | 1.046 | 0.486 | 0.484 |
| | (0.006) | (0.025) | (0.026) |
| N | | 11,770 | |
| Year FE | | Yes | |

Notes: Based on author's calculations using data from the University of Virginia Office of Institutional Analysis. Robust standard errors are clustered at the section-year level and are reported in parentheses. Bold indicates significance at the 5% level. The dependent variable is equal to 1 if a student completed either Intermediate Microeconomics or Intermediate Macroeconomics. The omitted category for year in school is fourth year (senior), the omitted category for race is white, the omitted category for school is College of Arts and Sciences, and the omitted category for verbal and math SAT scores is a score below 500.