

Grades in Economics and Other Undergraduate Courses

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Grades are a mysterious metric across all undergraduate courses that students complete each year and for each major and academic degree awarded. Instructors who teach courses assign letter grades to students who complete the courses and do not withdraw from them. Educational institutions then convert the letter grades to a numerical scale, generally zero to four points, and then average the scale across all courses taken to produce a grade point average (GPA). If different educational institutions use the same GPA scale, or their GPAs convert to the same scale, then users of GPAs have a comparable measure across students at different educational institutions.

This averaging and scaling for the GPA masks the heterogeneous conditions in course taking and grading that affects the average. Students take a mix of courses, introductory and advanced with different assessment practices (e.g., Watts and Schaur 2011). They take courses in a major and unrelated to a major. They take courses as requirements and electives. Some courses large enrollment courses have an impersonal learning

environment whereas smaller courses offer a personalized learning experience. Courses can be easy or challenging for students depending on the difficulty of the subject matter, the grading practices of instructors, and the effort expended by students (Allgood, Walstad, and Siegfried 2015; Walstad and Miller 2016). Grading standards too change over time because of evaluations of teaching or department practices that contribute to grade inflation (Butcher, McEwan, and Weerapana 2016). These course, classroom, department, and institutional factors that affect grading make the GPA this mysterious metric.

In spite of the aggregation problems with the GPA, different entities widely use and accept it as a measure of academic achievement. Educational institutions regularly report the academic performance of students with it. Employers evaluate candidates for internships and jobs based on this numerical score. Academic committees include the GPA as part of the transcript or record file to review for awards, scholarships, or program admissions. Researchers rely on GPA data to investigate educational inputs and outputs. Although researchers recognize that the GPA is a “noisy

signal,” they contend that it contains valuable information on the relative ranking of students when academic norms are fairly stable (Achen and Courant, 2009). The reason for the appeal of the GPA is obvious: it offers a summary of achievement from academic coursework that is easy to interpret for students, instructors, administrators, employers, and researchers.

This study accepts the GPA as a useful metric while acknowledging its limitations as an aggregate measure. The study describes how overall GPAs differ across various undergraduate majors and by demographic and other characteristics. It uses GPA in various academic subjects as an outcome variable to investigate the effects of demographic, preparation, and institutional factors on this aggregate measure. The analysis focuses on the economics major, but includes the study of GPAs from other undergraduate majors to provide context for interpreting the economics findings. The study concludes by examining the role of gender in influencing GPAs in various subjects.

I. Data and Sample

This GPA analysis uses restricted-use data from the Baccalaureate and Beyond (B&B) project of the National Center for Education Statistics (NCES) at the U.S. Department of Education (nces.ed.gov/surveys/b&b/). It is a

large, nationally representative sample of U.S. college graduates in the 2007–8 academic year, the latest year for available data. For our analysis the primary goal is to examine grade point *averages*, so we used the entire sample of approximately 15,960 students. Although some transcripts records were less complete, our sensitivity analysis with smaller samples (and more complete transcripts) showed no significant change in the results. The B&B survey design also required weighting choices for the estimation. Our sample uses both transcripts and data from student interviews, so balanced repeated replicate weights were used for the variance estimation.

The perspective for interpreting the GPAs includes two other points. First, the conversion of the the numerous grading systems used across institutions to 0 to 4 numerical values was done by NCES. Second, the B&B sample contains only students who graduated, which will raise the overall GPA compared with a broader sample of all undergraduates (many of whom may dropout before graduation).

II. Overall GPAs Across Majors

Table 1 lists the eleven broad B&B categories for majors (NCES variable *rtmaj11*), but with economics added for this study by separating it from the social sciences. The labels for most majors are self-explanatory, but a few require

more detail. Industry studies is a catchall for job-related majors such as criminal justice, exercise science, auto tech, and culinary arts. Other applied majors include architecture, design, communications, applied arts, media studies, public administration, human services, law and legal studies, and public relations. General studies covers such studies as liberal, interdisciplinary, university, and general.

TABLE 1— OVERALL GPAS BY MAJOR AND OTHER VARIABLES

Majors [Percent]	GPA (s.e.)	Other Var. [Percent]	GPA (s.e.)
Overall	3.24		
[100]	(0.01)		
Economics	3.16	Female	3.29
[2.3]	(0.04)	[57.6]	(0.01)
Engineering	3.18	Male	3.17
[5.4]	(0.03)	[42.4]	(0.01)
Math, Phy. Science, Bio.	3.26	Hispanic	3.15
[7.5]	(0.02)	[9.4]	(0.02)
Comp. & Info. Science	3.28	Asian	3.23
[2.3]	(0.05)	[7.0]	(0.02)
Business	3.20	Black	3.03
[23.4]	(0.02)	[10.7]	(0.02)
Accounting	3.27	White	3.27
[3.6]	(0.04)	[80.9]	(0.01)
Finance	3.19	Age <22	3.36
[2.8]	(0.04)	[27.3]	(0.01)
Management	3.22	Age 22-23	3.19
[14.5]	(0.02)	[39.9]	(0.01)
Marketing	3.13	Age 24-25	3.02
[3.3]	(0.04)	[10.5]	(0.02)
Social Science (no econ)	3.22	Age ≥26	3.29
[15.8]	(0.02)	[22.3]	(0.01)
Health care	3.38	HSgpa > 3.5	3.37
[7.8]	(0.02)	[51.3]	(0.01)
Humanities	3.32	Verbal >540	3.37
[14.7]	(0.02)	[45.5]	(0.01)
Education	3.43	Math >540	3.35
[6.7]	(0.02)	[47.9]	(0.01)
Industry studies	3.13	Baccalaureate	3.30
[5.0]	(0.03)	[17.6]	(0.02)
Other Applied	3.20	Masters	3.22
[12.0]	(0.02)	[36.8]	(0.01)
General Studies	3.10	Doctoral	3.23
[3.3]	(0.03)	[45.6]	(0.01)

The overall undergraduate GPA for all majors is 3.24, or between a B and B+ letter grade. The GPA for economics majors is only slightly below the average at 3.16. GPAs for all majors

are in a compressed range of 3.10 to 3.43, but eliminating the outliers of general studies (3.10) and education (3.43), reduces it to 3.13 to 3.38. The low GPA for general studies was expected because it attracts undergraduates who do not concentrate in any one academic discipline and often lack direction in academic studies. The high GPAs for education majors, however, is likely the consequence of “soft” grading rather than superior achievement.

Table 1 also reports GPA averages, for other variables. Females have a slightly higher GPA than males. The range by race is almost a quarter of a letter grade, between blacks as compared with whites or Asians. GPA by age at the mid-point of the last academic year has a nonlinear effect: highest among the youngest college graduates (under 22), falls from ages 22 to 25, and then rises at age 26 or older. Those college graduates who report the highest GPAs (>3.5) in high school or had higher than the average SAT/ACT verbal and math score also have high GPAs.

Although not reported in a table, we also calculated an economics GPA for college graduates who completed a course or courses in economics. This economics GPA average is 2.9, or a B to B- grade. Although this economics GPA for all majors appears high for an academic subject that is quantitative and analytical, consider the context. First, the

sample is composed of only graduates, and not any college dropouts, which is a factor that increases the average. Second, only about 39 percent of college graduates who are not economics or business majors complete an economics course. Among this group the average is 1.2 courses, most likely principles (Bosshardt and Walstad 2017). Third, the economics GPA ranges from a low of 2.40 (about C+) for general studies majors to a high of 3.18 (about a B or B+) for engineering majors. Where majors fall on the range depends on whether students' majors are quantitative or qualitative (e.g., 3.13 for math, science, and biology majors and 2.79 for humanities majors). Fourth, business majors complete an average of two to three economics courses, most likely a principles sequence and one other economics course. The economics GPA for business majors (2.96) is higher than most other majors, but it too differs by how quantitative or analytical it is: higher for accounting (3.21) and finance (3.09), but lower for management (2.92) and marketing (2.86).

As might be expected, GPAs in economics are lower than overall GPAs for all majors because economics is a more difficult subject and it may only be taken as a requirement. GPAs in economics across all other variables also are lower than for overall GPAs, but show similar patterns to overall GPA.

III. GPA Model and Results

The further study of the overall GPA and GPAs in different subjects was conducted with survey regression analysis using the demographic variables in Table 1. Our dependent variable is the student's GPA overall or in a particular subject. The specification for each equation is: $GPA_i = f(D_i, A_i, I_i)$, where i is the individual graduate, D_i represents demographics (gender, race and ethnicity, age), A_i is prior achievement before attending a college or university (HSgpa, SAT/ACT verbal and math scores), and I_i is the undergraduate institution attended based on the highest degree offered (baccalaureate, masters, or doctorate). Tobit analysis is used for the estimation.

GPAs for numerous academic subjects are available as dependent variables. For brevity, Table 2 only reports the results from the overall GPA and seven subjects. The most striking finding is that prior achievement or measured ability in high school is highly associated with success in the undergraduate coursework. College graduates who reported earning a GPA greater than 3.5 in high school have a significantly higher GPA overall and for all the above subjects in which we ran separate regressions. Although most colleges and universities enroll high school graduates who vary in academic achievement, they seek

TABLE 2—REGRESSIONS FOR GPA IN SELECTED SUBJECTS

	Overall	Biology	Business	Calculus	Economics	Engineering	Foreign Languages	Psychology
Female	0.14 (0.01)	0.08 (0.04)	0.05 (0.03)	0.13 (0.06)	-0.04 (0.04)	-0.04 (0.07)	0.19 (0.04)	0.23 (0.04)
Hispanic	-0.05 (0.02)	-0.15 (0.07)	-0.09 (0.07)	-0.40 (0.11)	0.07 (0.08)	0.06 (0.12)	0.19 (0.05)	-0.15 (0.06)
Asian	-0.04 (0.02)	-0.21 (0.07)	-0.05 (0.07)	0.11 (0.09)	0.06 (0.07)	0.13 (0.11)	0.15 (0.05)	-0.21 (0.08)
Black	-0.16 (0.02)	-0.21 (0.06)	-0.16 (0.06)	-0.16 (0.10)	-0.09 (0.07)	0.07 (0.13)	-0.15 (0.06)	-0.05 (0.06)
Age22-23	-0.08 (0.01)	-0.06 (0.04)	-0.13 (0.03)	-0.10 (0.06)	-0.05 (0.05)	-0.12 (0.07)	-0.05 (0.04)	-0.05 (0.04)
Age24-25	-0.19 (0.02)	-0.09 (0.06)	-0.33 (0.06)	-0.27 (0.11)	-0.22 (0.07)	-0.24 (0.12)	-0.15 (0.07)	-0.13 (0.07)
Age \geq 26	-0.02 (0.03)	0.09 (0.09)	-0.13 (0.07)	-0.22 (0.15)	0.07 (0.10)	-0.30 (0.14)	-0.13 (0.13)	-0.04 (0.08)
Hsgpa>3.5	0.19 (0.01)	0.29 (0.04)	0.25 (0.04)	0.30 (0.06)	0.24 (0.05)	0.19 (0.08)	0.27 (0.04)	0.34 (0.04)
Verbal	0.09 (0.01)	0.12 (0.03)	0.11 (0.03)	0.01 (0.04)	0.10 (0.03)	0.16 (0.04)	0.08 (0.02)	0.15 (0.02)
Math	0.03 (0.01)	0.013 (0.03)	0.05 (0.02)	0.21 (0.04)	0.19 (0.03)	-0.04 (0.04)	0.13 (0.02)	0.06 (0.03)
Baccalaureate	0.08 (0.02)	0.06 (0.05)	0.22 (0.04)	0.04 (0.08)	0.22 (0.06)	0.11 (0.14)	-0.01 (0.05)	0.08 (0.05)
Masters	0.05 (0.01)	0.03 (0.04)	0.14 (0.04)	0.12 (0.08)	0.16 (0.05)	0.17 (0.10)	0.09 (0.04)	0.08 (0.04)
constant	2.44 (0.04)	1.53 (0.14)	2.23 (0.13)	1.45 (0.21)	1.23 (0.17)	2.45 (0.25)	1.95 (0.13)	1.81 (0.14)

and compete to enroll high school graduates with the highest achievement and ability. The regression results indicate that this recruitment strategy pays off because such students continue to perform well in the different undergraduate academic subjects they complete for their undergraduate degrees.

SAT/ACT scores provide insight into what results in success in coursework. Verbal and math scores are significant overall and for seven of eight subjects, but not with the verbal score for calculus and not with the math score for engineering. The calculus result is expected because it is a math course. For engineering, students already have good math scores so verbal scores are the differentiating factor.

The only other variable that appears to be a fairly consistent predictor of GPAs is age. The age effect is non-linear, with the youngest college graduates having the highest GPA, but it declines with age and then eventually increases. Most likely this age effect is due to some combination of motivation and maturity. The younger college graduates may have been more mature and motivated to undertake academic work for their age when they started their undergraduate studies than the typical undergraduate students who are a year or two older. Older college graduates also may be more mature than the typical undergraduates perhaps because they have useful work experiences or now have clear academic goals.

The effects of the other variables on academic GPAs are mixed. Females earned significantly higher overall GPAs than males and in four subjects (biology, calculus, foreign languages, and psychology), but no significant difference is evident in three subjects (economics, business, engineering). Blacks have a significantly lower overall GPA and in three subjects (biology, business, and foreign languages), but not in four subjects (calculus, economics, engineering, and psychology). For Asian students, the overall GPA difference is insignificant and the results vary by subject. For Hispanics, the overall GPA is significant, but no systemic differences are shown by subject. Students who attended baccalaureate or masters institutions had higher GPAs overall, but the results differ by discipline.

Finally, the gender differences merit further investigation given the on-going discussion of the topic among economists. We conducted two lines of inquiry. One purpose was to obtain the marginal effects among females for having a GPA in the subject (i.e. completed a course or courses with a grade). This probability was calculated with a probit regression that includes all variables from the previous regression plus an income measure to account for preferences and a transfer-status variable for students less likely to have a GPA in a subject. Second, we study the relationship of gender to the

percentage of the highest grades received in the first course students take in a subject (or the average grade if two courses are taken at the same time). The grade earned in the first course in a subject can encourage or discourage students from taking subsequent courses.

The results in the first column of Table 3 show that females are significantly more likely than males by 11 to 15 percentage points to have completed a course and have earned a grade in biology, foreign languages, and psychology. In the four other subjects that are more mathematical or quantitative they are 11 to 16 percentage points less likely to have taken and completed such a course.

TABLE 3— GENDER EFFECTS

Subject:	Probability of Having a GPA	Higher Percent of "A" Grades in First Course
Biology	0.11	F by 3.5
Foreign. Languages	0.12	F by 6.0
Psychology	0.15	F by 6.3
Calculus	-0.11	F by 4.9
Engineering	-0.12	M by 7.9
Business	-0.15	F by 1.1
Economics	-0.16	M by 3.1

The percentage of A grades earned in the first course in a subject, in column 2, show that once female students enroll in and complete one of the above courses, they are more likely to have earned a higher percentage of the A grades in five of them. These results are significant for all five subjects but business. The findings for economics and engineering courses, however, less positive because female students who take and complete these courses are significantly less likely than males to earn the top grades.

IV. Conclusion

GPA's for college graduates average 3.24 on a 0 to 4 point scale, or a grade equivalent of B to B+. The average GPA for all majors is in a compressed range from 3.10 (general studies) to 3.43 (education). The average GPA for economics majors (3.16) is below the overall average, as it is for business majors (3.20), but majors in math, physical sciences, and biology (3.26), computer science (3.28), and health care (3.38) are above the overall average.

The regression analysis shows that multiple demographic factors appear to influence overall GPA (gender, race and ethnicity, age, prior achievement or ability, and type of institution attended all matter). The regression analysis of GPA's across subjects, however, shows no clear demographic patterns, except for the positive effects of prior achievement (high school GPA > 3.5), and to a less extent, verbal or math ability (SAT and ACT scores).

The gender effects show that females earn significantly higher overall GPA's and earn significantly higher GPA's in most subjects, but not in economics or engineering. Some females are less likely to take quantitative or analytical courses, except biology, but when they do enroll and complete such courses they often earn a significantly higher percentage of A grades in those first courses, except in economics and engineering.

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