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Introduction

Human capital is one's ability to perform labor to produce value (Goldin 2014). As marketable skills increase, human capital increases. Post-secondary education is a valuable component in human capital, because it increases the skill set that enables a person to work and make a living. In the last few decades, through post-secondary education, U.S. women increasingly have obtained more human capital (Executive Office of the President of the United States 2014).

Women's college attendance has increased substantially over time, and women in the U.S. now graduate from college at higher rates than men do. Ishitani's study shows that women are 56 percent more likely to graduate in four years than men (2006), and Astin points out that women also tend to have better grades in college even when controlling for high school grades (1997). Although once barred from higher education completely, women now make up the majority of college students in the U.S. (about 11.5 million females in 2017, compared with 8.9 million males, according to the National Center for Education Statistics). Women also graduate at higher rates than men do (about 1.8 million females in 2015, compared with about .8 million males). Women surpassing men in both college attendance and graduation rates is evidence of underlying differences in the factors that contribute to a person's college education. We further investigate these differences by analyzing how financial resources help members of each gender graduate from college.

We analyze how being a federal financial aid recipient contributes to a person's likelihood of graduation. We theorize that women who receive financial aid will be more likely to graduate than men who receive financial aid. This hypothesis can be viewed as a test of whether or not the economic development literature, which

is primarily tested in Third World countries, may apply to First World settings. We also theorize that females who receive financial aid are more likely to graduate than both females and males who do not receive financial aid.

Literature Review and Theoretical Framework

The existing research on women with financial aid versus men with financial aid is limited while comprehensive data on students' academic performance and financial aid statuses is essentially nonexistent. We do not claim that no research has been done on this subject, as some studies on women and financial aid in higher education do exist. Hossler, Hu, and Schmidt studied women and financial aid in higher education and found that women apply and enroll at lower rates when financial aid is not available (1999). This gap disappeared when controlling for family financial support, suggesting that women are more sensitive to tuition costs than men are. Consequently, women probably apply, enroll, and graduate at higher rates than men when given financial aid.

Some investigation has occurred on the effect of financial aid on retention and graduation. In general, Wohlgemuth et al. find that providing financial aid does increase the rate of retention (2007). Furthermore, Hossler, Gross, and Ziskin find that women are retained more than men are when institutional aid is offered (2006). However, this was not the main focus of their study, and their coding when gender is unknown is questionable. Furthermore, Hossler, Gross, and Ziskin include all missing data as female. The potential issues of this practice are many but easily stated. We can assume that at least some portion of those who do not list their gender are male. One possible example is men who fear they will not receive fair treatment due to their perception of institutions attempting to help females more than males. Perhaps realizing this issue themselves, Hossler, Gross, and Ziskin state that an investigation into women on financial aid in higher education deserves its own study. We hope to add substantively to these studies.

Among the strongest of the analyses on women and financial aid in higher education is that of Fenske, Porter, and DuBrock (2000). In their study, they analyzed the persistence of women majoring in science, engineering, and mathematics (SEM).[1] Measuring persistence by graduation rates, they found evidence suggesting that women have a lower attrition rate than other groups of financial aid recipients. Their analysis is highly focused on SEM majors and does not address the need for a more generalized study of male and female use of financial aid in higher education.

We seek to do an analysis similar to Fenske, Porter, and DuBrock but with a broadened scope from SEM majors to all students, with a larger emphasis on gender differences. We show how women who receive financial aid differ from both men and women who do not receive financial aid. In essence, we argue that women take better advantage of the financial opportunities given them and that those that receive financial aid are significantly different from those that do not receive financial aid. Women see themselves as responsible to graduate once they have received financial aid. Thus,

receiving financial aid is a strong motivator for women to complete their postsecondary education. When the opportunities and resources are available to them, women will be more likely to graduate from college.

Methods

To test this hypothesis, we will apply the 1987 National Postsecondary Student Aid Survey data and use logit regressions to determine the likelihood of different groups graduating from college. This data set includes information on 12,628 students who applied for Guaranteed Student Loans (GSL). Within this data set are variables indicating whether the student received financial aid ("Any Aid") and, if so, how much ("Aid Amount"). We limit our analyses to only students in need of financial aid. We do so by only including students who have applied for GSL. We recognize that not all students in need of financial aid apply for GSL. Therefore, our study is scientifically applicable to GSL applicants and arguably not to all students in need of financial aid. However, applying for GSL shows a need for financial aid, and the use of the GSL applicant data allows us to generalize onto all students with financial aid needs. Using GSL applicants provides a way to compare aid recipients to non-aid recipients, while eliminating bias that may arise from including students who have no need for financial aid.

Using many control variables, we will test to see if women complete their postsecondary education more than men when given student financial aid. Some of the key controls included are age, income, marital status, and race. Especially important is the control "Total Cost," which indicates the reported total cost per one year of school, depending on where that particular student attended college. If gender is unknown, the observation will not be included in the model. Doing so specifically addresses the methodological issue of Hossler, Gross, and Ziskin's study. These tests will allow us to analyze any relationship between gender and graduation rates among financial aid recipients and between recipients and non-recipients.

Limitations

The main limitation to this study is the available data, in particular the year collected. It is reasonable to argue that data from 1987 is irrelevant to today's world. While we maintain that the principles and hypothesis still hold true today, we admit it is a reasonable critique. The National Center of Education Statistics has done a similar survey as recently as 2012 but will only give out the data to those with a license. Unfortunately, as undergraduates we do not qualify to obtain a license and are forced to use older data.

Perhaps due to data age, the data set itself proposed some issues. The data started in ASCII format and was saved on the University of Michigan's Inter-University Consortium for Political and Social Research (ICPSR) web site. The data was publicly available for download and SAS instructions provided. A professional full-time staff member at the university converted the data from ASCII format to a format readable

by more modern statistical analysis software like Stata. Unfortunately, it seems that a portion of the data failed to convert. The observations that failed to convert were dropped, and the remaining 12,000 observations were used for this study.

Another issue with this dataset is the way some of the races are coded. The appendix contains the exact coding and tabulations of the race variable. The main issue with the race coding is the combining of Asian and Pacific Islander. Perhaps combining the two groups into one was accepted practice when this dataset was collected, but political science methodology has grown and combining the two groups is rarely, if ever, done anymore. As seen in all of the Appendix tables, the Asian variable is seemingly statistically significant. We choose to ignore these results because of the potential issues caused by the combining of Asian and Pacific Islander into one race category and the impossibility of disentangling the two in this data.

Also, there is a discrepancy between the data set and the codebook. Although the stated universe is "all" students who applied for and received GSLs, data exists for whether or not each student "received any financial aid." We assume, then, that loans do not qualify as financial aid, and we can make broader assumptions about recipients and non-recipients, even though all students have received GSLs. This makes our universe a sample of financial aid recipients and non-financial aid recipients who have all exhibited a need for aid. It does not include, however, students who did not apply for a GSL. We do argue that applying for GSL shows a need for financial aid and thus allows us to generalize our results onto all students in need of financial aid. Despite the limitations explained above, we maintain our general results are accurate and applicable.

Findings

The reported coefficients from our analyses is found in the Appendix. There, we also include demographic tabulations of the 1987 National Postsecondary Student Aid Survey data available to us. We began by using the simplest model possible by regressing if a person had "completed degree/course of study" on gender. The results were statistically insignificant. Such a finding seemed odd as much of the current literature and data indicate that women are graduating at higher rates than men are (Executive Office of the President of the United States 2014). The simple answer to this is to look at the longitudinal data on graduation rates. This 1987 data fits into the time period where most data indicate that men and women graduated at statistically the same rate (Ibid.). Please see Figure 5 in the Appendix for more information. Model 1 in Table 8 (see Appendix) is in line with Current Population Survey data as calculated and presented by the White House's Council of Economic Advisers. The consistency between existing literature and data on graduation rates in 1987 works to support the claim that our data set, although limited, is valid.

The lack of statistical difference in the gender variable in the simple model adds intrigue as it becomes significant in the simple model that tests our theory (see Appendix Table 8, Model 2). In this logistic model, we added the interactive term of "Female and Any Aid." This interactive term is the main variable of interest in Table 8 (see

Appendix). Here, we see that women have statistically different logged odds of graduating or completing their study than men given they receive any financial aid.

Table 1

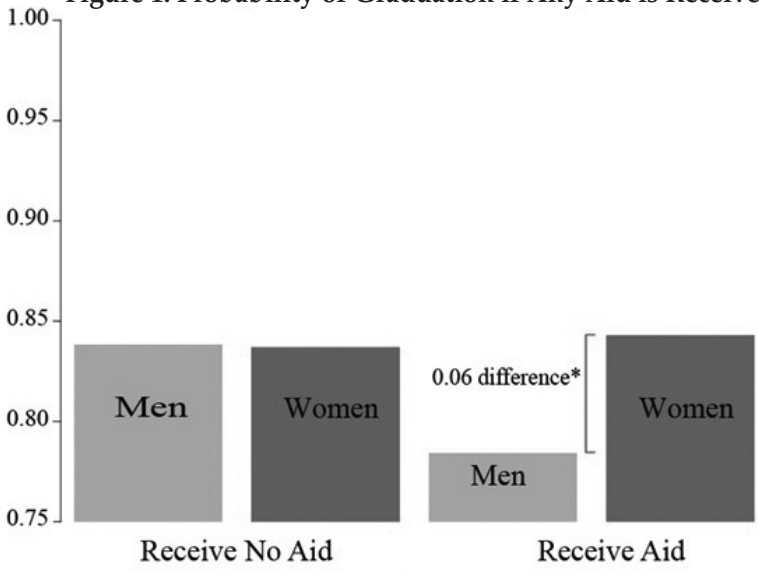
VARIABLES	(2)	(7)
Female	-0.156** (0.0710)	0.0258 (0.119)
Any Aid	0.00164 (0.0781)	-0.278** (0.134)
Female × Any Aid	0.309*** (0.106)	0.364** (0.175)
American Indian		-0.482 (0.382)
Asian		-1.246*** (0.166)
Black		-0.178 (0.158)
Hispanic		-0.452*** (0.164)
Age		-0.0395 (0.0270)
Age2		0.000291 (0.000341)
Income		2.75e-09 (1.09e-07)
Married		-0.183* (0.0962)
Separated		-0.123 (0.277)
Total Cost		0.0001*** (2.83e-05)
Constant	1.758*** (0.0539)	2.413*** (0.514)
Observations	11,552	4,026

Models 2 through 7 in Table 8 (see Appendix) support the claim that women with financial aid graduate at higher rates than men do with financial aid. The simplest of these models, Model 2, shows that females receiving financial aid have an 84 percent likelihood of graduation, while males have a 78 percent likelihood of graduation. This 6 percent is statistically significant. Model 7 shows that after including all relevant controls, women receiving aid still have statistically significantly higher logged odds of graduating. Figure 1 is a visual representation of Model 7 Table 8 (see Appendix).

Models 2 through 6 in Table 9 (see Appendix) are conceptually important to our theory. Here, "Aid Amount" is added to the model. Doing so filters the observations to only those that received some aid. In effect, all variables in models 2 through 6 in Table 9 (see Appendix) are interacted with "Any Aid." Because Models 2 through 6 only contain

those that received financial aid, and control for how much aid was received and the total cost of one year of schooling, the gender variable becomes more telling of our theory. Every model except Model 3 in Table 9 (see Appendix) shows that women have higher logged odds of graduating than men given that both are receiving the same amount of financial aid and their schooling costs the same.

Figure 1: Probability of Graduation if Any Aid is Received



*Statistically significant at the $p < 0.05$ level.

Table 10 (see Appendix) attempts to uncover if there is one particular subgroup of women raising the odds of graduation or completion. In Table 10 (see Appendix), the observations are limited to women only and allow us to compare the women in this data set. Models 2 through 6 have the "Aid Amount" control variable and are filtered to only those observations that received some aid. The total cost of one year of schooling is very significant in all models in Table 10 (see Appendix). Interestingly, as the total cost of a year of school goes up, the woman is more likely to graduate. (See Figure 2 below.) This finding also appears to be true for men, as this control is statistically significant in all models of Table 9 (see Appendix) as well. One possible explanation for this trend is that only people that have the means and drive to finish a degree choose to attend a more expensive school. Those that question if they have the time, resources, or drive to finish would logically not risk as much money by attending a more expensive program. It is likely that those attending the more expensive school are systematically different from those that attend the less expensive schools.

Table 2

VARIABLES	(2)	(6)
Female	0.185** (0.0815)	0.363*** (0.135)
Total Cost	0.000142*** (2.29e-05)	0.000136*** (3.35e-05)
Aid Amount	-3.47e-06 (1.64e-05)	-3.18e-06 (2.38e-05)
American Indian		-0.275 (0.538)
Asian		-1.652*** (0.227)
Black		-0.256 (0.226)
Hispanic		-0.697*** (0.234)
Age		-0.0187 (0.0386)
Age2		-0.000112 (0.000492)
Income		4.09e-07** (1.93e-07)
Married		-0.257* (0.144)
Separated		-0.124 (0.367)
Constant	1.294*** (0.0960)	2.104*** (0.716)
Observations	5,240	1,904

Among women, the amount of aid is also significant. (See Models 2 through 6 in Table 10 in the Appendix.) In the table, the coefficients are very small, ostensibly indicating that the aid amount has no substantive effect. However, "Aid Amount" is calculated in single dollar increments, and aid is rarely if ever given in single dollar increments. For example, each additional $1,000 of aid given to a female increased her logged odds of graduation by 1 percent. The median amount of aid given in this data set is $2,370. A female student with the median amount of financial aid has, according to our results, 86.7 percent likelihood of graduating from college, as compared to females in the 25th percentile of aid (85 percent likelihood of graduation) or females in the 75th percentile of aid (88 percent likelihood of graduation). Realizing that the coefficient of "Aid Amount" will change by hundreds and thousands helps us understand the substantive effect is more than initially indicated by the small coefficient. (Figure 3 illustrates this point.)

Another variable that seems to be significant in both Table 9 and Table 10 (see Appendix) is race. White is used as the baseline for the race comparisons listed in

Figure 2: Probability of Graduation

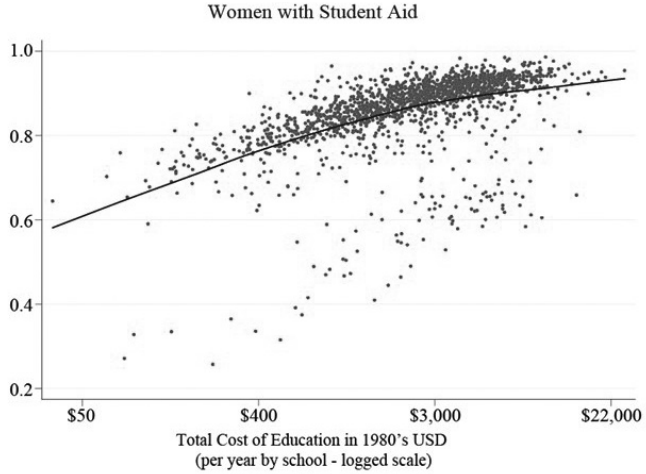


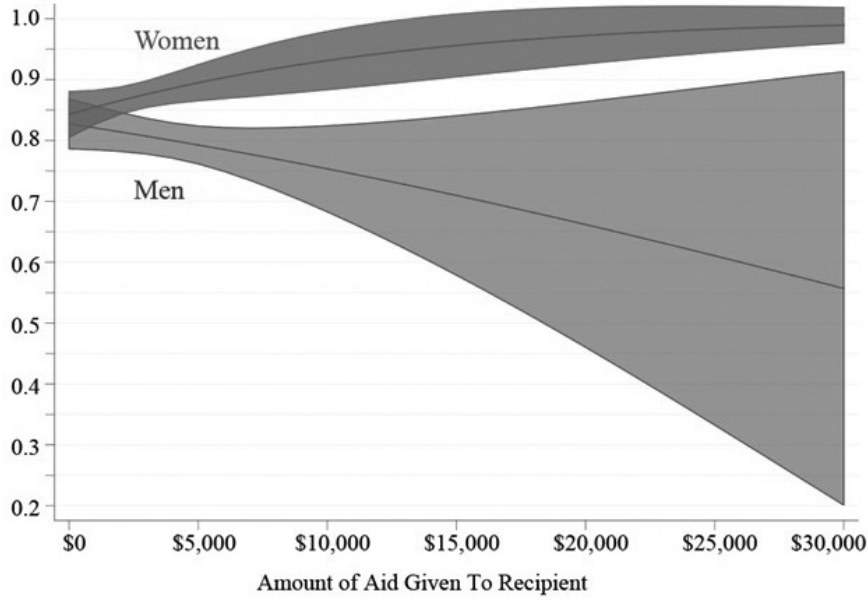
Table 3

VARIABLES	(2)	(6)
Total Cost	0.000152*** (3.37e-05)	0.000178*** (5.54e-05)
Aid Amount	5.84e-05** (2.69e-05)	9.70e-05** (4.62e-05)
American Indian		-0.416 (0.825)
Asian		-1.591*** (0.396)
Black		0.0609 (0.300)
Hispanic		-0.761** (0.314)
Age		-0.0191 (0.0502)
Age2		5.95e-05 (0.000624)
Income		2.11e-07 (2.45e-07)
Married		0.0576 (0.194)
Separated		-0.124 (0.405)
Constant	1.300*** (0.117)	1.783* (0.952)
Observations	2,851	1,096

the Appendix tables. Hispanic is significant in Table 9 (see Appendix) in all models where race is included. In Table 10 (see Appendix), among women, Hispanic is not as significant until income is considered. The data seem to indicate that Hispanics have lower logged odds of graduating when compared to whites. (See Figure 4.)

The other piece of the race variable that comes out significant in every instance is Asian. We have not neglected to notice this occurrence, but we have reason to believe this finding is inaccurate. As noted in the limitations section above and in the Appendix, Asian and Pacific Islander are coded together in this 1987 dataset. While combining Asian and Pacific Islander may have been common practice in 1987, it is not today. Today, Asian and Pacific Islander are coded separately for many reasons. Because of this issue, we choose not to claim any valid results comparing the odds of Asians or Pacific Islanders to the baseline White category.

Figure 3: Probability of Graduation



Conclusion

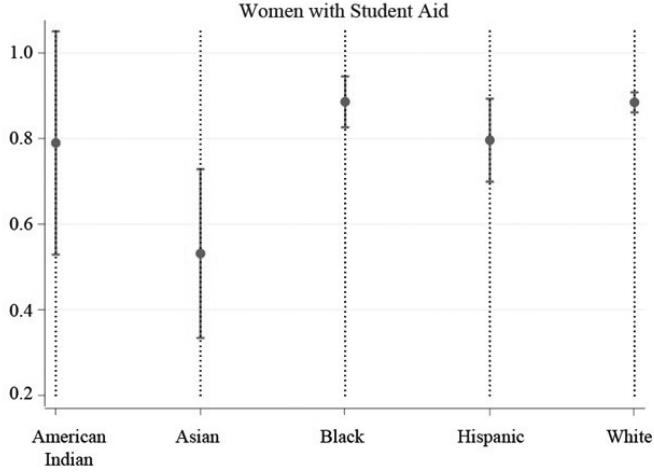
We find many noteworthy factors relating to likelihood of graduation. Among women, the amount of aid given significantly increased the likelihood of graduation. In both the simplest and most comprehensive models, we find that females with aid are more likely to graduate than females without aid and males, both with and without aid. This is our most substantive finding. It seems the data from the 1987 National Postsecondary Student Aid Survey support our hypotheses that women use student financial aid more effectively than men do.

Concluding that women use student financial aid better than men do supports the economic development literature referenced above. Wong and Psacharopoulos

appear to support the idea that women use resources more effectively than men do by showing how children improve when the woman has control of the income. We argue that this theory is not limited to development economics. We find evidence to suggest that the same theory is true in higher education aid within United States.

The implications of these results reach into both practical and academic spheres. For the institutions deciding who gets student financial aid, the results of these analyses may be particularly helpful. For academia, this study may aid in increasing the external validity of some gendered economic development theories.

Figure 4: Probability of Graduation



The limitations of this study are the data. However, the 1987 National Postsecondary Student Aid Survey provides a place to start. The more recent versions of this survey, done as recently as 2012, will likely have fixed the data and coding issues. Further research on more recent data would provide better insight into the current use of student financial aid. If our findings hold, there would also be a need to identify what specific mechanisms lead to women's increased graduation rates as a result of receiving financial aid. This information will help us know how to apply those factors to men so that members of both sexes can more effectively use the resources available to them.

NOTE

1. Now referred to as "STEM."

APPENDIX

Description of data set

In our analyses, we included the variable age^2 to account for the distribution of ages in the population.

All observations received some amount of financial aid in this table.

Table 4

"Have completed degree/course of study"	Frequency	Percent
No	1,713	14.83
Yes	9,839	85.17

Dependent Variable: graduation status.

Table 5

Sex	Frequency	Percent
Male	5,761	45.62
Female	6,867	54.38

Key Independent Variable: female.

Table 6

Any Aid	Frequency	Percent
No	6,816	53.98
Yes	5,812	46.02

Independent Variable: any aid.

Table 7

Race	Frequency	Percent
American Indian or Alaska Native	102	.81
Asian or Pacific Islander	719	5.67
Black, not Hispanic	1,073	8.5
Hispanic	781	6.18
White, not Hispanic	9,953	78.82

Independent Variable: race.
Independent Variable: age.

Figure 5

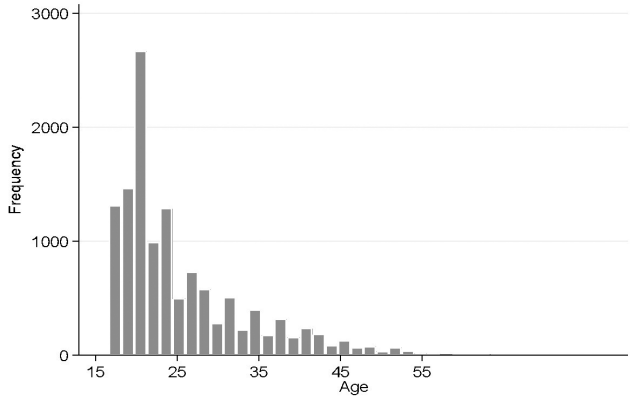


Table 8

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.0198 (0.0526)	-0.156** (0.0710)	-0.184** (0.0717)	-0.119 (0.0728)	-0.0225 (0.115)	-0.0223 (0.115)	0.0258 (0.119)
Any Aid		0.00164 (0.0781)	0.00711 (0.0786)	-0.0224 (0.0787)	-0.0431 (0.127)	-0.0676 (0.128)	-0.278** (0.134)
Female × Any Aid		0.309*** (0.106)	0.294*** (0.107)	0.242** (0.107)	0.362** (0.168)	0.352** (0.168)	0.364** (0.175)
American Indian			-0.196 (0.285)	-0.140 (0.284)	-0.380 (0.378)	-0.394 (0.379)	-0.482 (0.382)
Asian			-0.910*** (0.0906)	-0.942*** (0.0908)	-1.086*** (0.155)	-1.131*** (0.156)	-1.246*** (0.166)
Black			0.0935 (0.103)	0.125 (0.103)	-0.0350 (0.150)	-0.0964 (0.153)	-0.178 (0.158)
Hispanic			-0.148 (0.107)	-0.138 (0.108)	-0.293* (0.158)	-0.325** (0.158)	-0.452*** (0.164)
Age				-0.0836*** (0.0163)	-0.0532** (0.0256)	-0.0404 (0.0262)	-0.0395 (0.0270)
Age2				0.0008*** (0.000244)	0.000414 (0.000328)	0.000268 (0.000334)	0.000291 (0.000341)
Income					-3.74e-08 (1.03e-07)	-2.60e-08 (1.04e-07)	2.75e-09 (1.09e-07)
Married						-0.230** (0.0932)	-0.183* (0.0962)
Separated						0.00207 (0.272)	-0.123 (0.277)
Total Cost							0.0001*** (2.83e-05)
Constant	1.759*** (0.0390)	1.758*** (0.0539)	1.849*** (0.0566)	3.398*** (0.254)	2.873*** (0.489)	2.782*** (0.490)	2.413*** (0.514)
Observations	11,552	11,552	11,552	11,552	4,179	4,179	4,026

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.0448 (0.0544)	0.185** (0.0815)	0.130 (0.0833)	0.147* (0.0841)	0.376*** (0.134)	0.363*** (0.135)
Total Cost	0.000179*** (1.64e-05)	0.000142*** (2.29e-05)	0.000147*** (2.34e-05)	0.000124*** (2.27e-05)	0.000136*** (3.38e-05)	0.000136*** (3.35e-05)
Aid Amount		-3.47e-06 (1.64e-05)	1.09e-05 (1.66e-05)	1.85e-05 (1.64e-05)	1.03e-06 (2.39e-05)	-3.18e-06 (2.38e-05)
American Indian			-0.411 (0.371)	-0.374 (0.370)	-0.264 (0.538)	-0.275 (0.538)
Asian			-1.356*** (0.138)	-1.386*** (0.137)	-1.600*** (0.224)	-1.652*** (0.227)
Black			0.123 (0.143)	0.118 (0.144)	-0.193 (0.221)	-0.256 (0.226)
Hispanic			-0.345** (0.156)	-0.344** (0.156)	-0.662*** (0.233)	-0.697*** (0.234)
Age				-0.0653*** (0.0245)	-0.0371 (0.0376)	-0.0187 (0.0386)
Age2				0.000599* (0.000363)	9.71e-05 (0.000482)	-0.000112 (0.000492)
Income					3.94e-07** (1.90e-07)	4.09e-07** (1.93e-07)
Married						-0.257* (0.144)
Separated						-0.124 (0.367)
Constant	1.249*** (0.0577)	1.294*** (0.0960)	1.401*** (0.101)	2.683*** (0.396)	2.293*** (0.713)	2.104*** (0.716)
Observations	11,126	5,240	5,240	5,240	1,904	1,904

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Total Cost	0.000197*** (2.25e-05)	0.000152*** (3.37e-05)	0.000155*** (3.42e-05)	0.000141*** (3.37e-05)	0.000177*** (5.49e-05)	0.000178*** (5.54e-05)
Aid Amount		5.84e-05** (2.69e-05)	6.54e-05** (2.75e-05)	6.62e-05** (2.69e-05)	9.40e-05** (4.48e-05)	9.70e-05** (4.62e-05)
American Indian			-0.185 (0.553)	-0.154 (0.554)	-0.429 (0.818)	-0.416 (0.825)
Asian			-1.405*** (0.219)	-1.421*** (0.219)	-1.594*** (0.398)	-1.591*** (0.396)
Black			0.0760 (0.180)	0.0732 (0.180)	0.0351 (0.294)	0.0609 (0.300)
Hispanic			-0.386* (0.211)	-0.389* (0.210)	-0.778** (0.313)	-0.761** (0.314)
Age				-0.0429 (0.0311)	-0.0178 (0.0501)	-0.0191 (0.0502)
Age2				0.000437 (0.000454)	4.35e-05 (0.000621)	5.95e-05 (0.000624)
Income					2.15e-07 (2.45e-07)	2.11e-07 (2.45e-07)
Married						0.0576 (0.194)
Separated						-0.124 (0.405)
Constant	1.251*** (0.0626)	1.300*** (0.117)	1.388*** (0.125)	2.211*** (0.504)	1.793* (0.960)	1.783* (0.952)
Observations	6,093	2,851	2,851	2,851	1,096	1,096

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

This table shows differences in factors influencing graduation rates among women only. Men are excluded from this table.

Figure 6

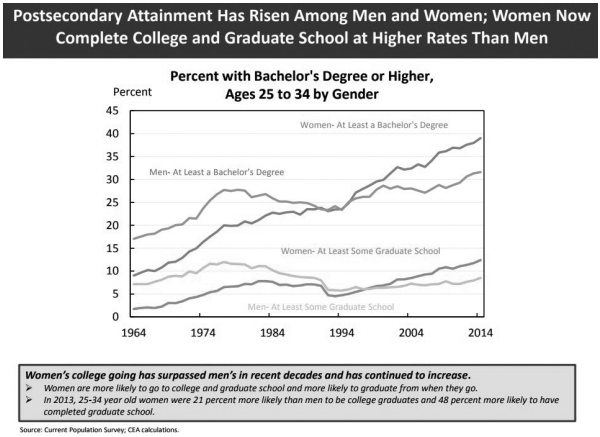


Figure is from the October 14, 2014, update of the Women's Participation in Education and the Workforce report by the Council of Economic Advisers. We include their graphic to show where our 1987 data fit in the overall trend.

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