2019

Outcomes of Need-based Financial Aid

Choice of Major & After-graduation Earnings

ERDC
Education Research & Data Center

AUTHOR

Micah Sanders

Education Research and Data Center

ABOUT THE ERDC

The research presented here uses data from the Education Research and Data Center, located in the Washington Office of Financial Management. ERDC works with partner agencies to conduct powerful analyses of learning that can help inform the decisionmaking of Washington legislators, parents, and education providers. ERDC's data system is a statewide longitudinal data system that includes de-identified data about people's preschool, educational and workforce experiences.

ADDRESS

Education Research and Data Center
106 11th Ave SW, Suite 2200
PO Box 43124
Olympia, WA 98504-3113

PHONE

360-902-0599

FAX

360-725-5174

EMAIL

erdc@ofm.wa.gov

Executive Summary

Prior research into need-based financial aid has generally focused on its impact on graduation. This paper attempts to control for potential selection bias stemming from differing financial aid award policies among schools and student choice. This paper further explores the potential relationship between need-based aid and outcome variables apart from and beyond graduation, such as choice of major and after-graduation earnings. The main findings of this research are that:

- The impact of the four financial aid variables (grants, subsidized loans, unsubsidized loans, and work study) are inconsistent across outcomes variables. While grants are positively related to student success, work study and subsidized loans are significantly related to some outcome measures but not others. No substantive relationship is found between unsubsidized loans and any of the included outcomes.
- With respect to graduation, the effect of financial aid allocations are generally unrelated to the school at which they are awarded. However, there is a direct relationship between the effect of financial aid allocations and the school at which they are awarded when it comes to students' choice of major.
- Work study seemed to have a positive relationship with student persistence to graduation, but a negative relationship to their pursuit of both STEM and in demand degrees.

Introduction

Student success in college is often measured by whether or not a student earns a diploma. OFM has tracked the relationship of student financial aid and graduation through three previous studies and found, on the whole, that awarding monetary support to low income students has increased the collective success of low income students attending Washington public four year schools. Three previous papers in this series have linked financial aid awards in the form of grants, loans, and work study to improved graduation rates across schools and student characteristics.

Financial aid awards have been previously shown to effectively decrease tuition costs while decreased tuition costs have been linked to increased graduation rates. This linkage seems to function across institutions and student success outcomes and may be why financial aid has also been consistently linked to increased graduation rates. It is important to consider, however, the ways in which financial aid may influence student decisions *prior* to graduation, and how these decisions play into outcomes beyond graduation. In prior studies, ERDC has not directly explored the impact of institutions on student success or how outcomes other than graduation are related to financial aid.

A focus on graduation as the outcome of interest may miss important nuances related to a broader concept of student success. Students generally don't attend college with the sole purpose of graduating. Rather, students attend college for numerous reasons including securing a well-paying job or entering a certain career field. These goals require choices well in advance of graduation including which school to attend and what major to pursue. Each of these decisions may impact a student's ability to graduate in ways the standard financial aid/graduation model can't address. It is therefore advisable to analyze student success in the context of each *student's* success criteria rather than institutional criteria for success.

This is not to argue that institutional policies don't impact student success. Another confounding variable to consider is the inconstant provision of financial aid resulting from differing award policies across schools. Each of Washington's public four-year institutions awards financial aid according to their own formulas and income thresholds resulting in potentially vastly different awards being offered by different schools to the same student. This award discrepancy may influence both the school a student decides to attend and their path to success.

Since the available data doesn't include information on financial aid awards not accepted, it is therefore necessary to assume that financial aid awards follow a constant formula at the school level. However, the interaction of school policies with financial aid awards makes detecting school influences difficult with standard modeling techniques. To control for school effects, this study correlates the impacts of specific need based financial aid types (grants, loans, and work study) with student outcomes (graduation, STEM participation, in demand program participation, and workforce earnings) after controlling for student characteristics (demographics and income factors), using a mixed effects generalized linear model.

Background

This paper is the final paper in a series analyzing the impact of financial aid on students in Washington public higher education. The first paper in this series (Benson, 2017) found that four-year students receiving financial aid were less likely to graduate from college than those who did not need aid, while community and technical college students were found to graduate at higher rates when receiving financial aid. The second paper in the series (Benson, 2018) found that, the more of a student's need that was met, the greater the chance the student would graduate. In the third study, (Benson, 2019), the three most common forms of aid were shown to be positively related to graduation. The results agree with other research which has found that grant aid (Nguyen, 2018), subsidized loans (Dowd, 2004), and work study (Nora, 2006) can positively influence graduation rates.

This paper also explores metrics for student success other than graduation. While graduation is by far the most common outcome used to measure the efficacy of financial aid awards (Dynarski, 2003), the literature contains examples of alternative measures of student success. The relationship between financial aid and student earnings after graduation (Arcidiacono, 2005), STEM degree attainment (Castleman, 2018), and student hiring post-graduation (Rothstein, 2011) have been explored but no consensus impact of financial aid on these outcomes has been reached. Further, prior research has not fully explored how *institutions* influence these other measures of success. Research has shown that institutional spending (Ryan, 2004), student body composition (Calcagno, 2008), and institutional characteristics (Astin, 1996) each influence student persistence to graduation in ways that are unique to each institution.

Given the systematic influence institutions may have on student success, it may be helpful to analyze student outcomes that are less directly linked to a student's school choice. While a student's choices in pursuit of graduation may be directly influenced by institutional policy, their earnings after graduation may be less so. Similarly, institutions may influence a student's choice to pursue a STEM or in demand degree. All three of these outcomes have been shown to have positive relationships to financial aid awards (Castleman, 2018; Rothstein, 2011; Arcidiacono, 2005). Similarly, actively controlling for school choice as part of the modeling can help limit the influence of school policies on student success outcomes (Dale, 2002).

Data

Students included in this analysis are taken from the population of 2007-8 and 2008-9 Washington public high school graduates. Students who directly entered Washington four-year, public institutions after high school were tracked for up to 6 years or the awarding of a degree, whichever came first. Students who failed to complete at least 15 credits were excluded from the sample. The sample was further refined to include only

students who received some need-based financial aid. For the analysis of choice of degree field, the dataset is reduced to include only students who graduated with a recorded major. Similarly, for the workforce earnings portion of the analysis, students who were not employed in a wage earning job in the State of Washington during the 2017 calendar year are excluded from the dataset as wage data was not available for these individuals.

Methods

Comparison between student variables and the four analyzed outcome measures. The basis for the outcome comparison portion of this analysis is a logit regression model. Each outcome variable is analyzed using a standard, identical regression formula to produce a comparable set of outcomes. This formula includes student demographics, income factors, and financial aid variables previously shown to influence student persistence to graduation (Benson, 2019). Details on these variables can be found in Table A1 in the appendix.

Due to different criteria for inclusion in outcomes, datasets for each analysis differ. Analyzing different datasets may result in biased results arising from outliers which could influence the comparisons that form the basis of this research. An analysis of the data reveals a small number of outliers in the underlying data. To correct for this, a Cook's Distance estimate (Cook, 1977) is produced for each observation, and outliers exceeding a threshold of 4/n are removed accordingly. This modified dataset is also used for the analysis of school effects as it provided a better opportunity for convergence.

A mixed model to control for school impacts on outcomes. Mixed effects generalized linear models are generally used to estimate the impacts of longitudinal datasets where there the data can be broken down into clear subsets of the whole dataset. For this study, schools act as subsets of the data as their impact on post-graduation hiring, persistence, and coursework are limited to those students who attend the school. Each school is modeled independently and the results recombined to produce a general estimate. This controls for selection bias arising from student financial aid awards that are relative to the policies of the school attended as well as student choice of school as it relates to success outcomes. The modeling is applied to each of the four distinct outcome variables that will determine the log likelihood that a student will graduate, graduate with a degree in a STEM field, graduate with a degree in an in demand field, or achieve earnings above the average cohort earnings.

Results

Summary statistics for each dataset are presented in Table A1 in the appendix. For each outcome there are two models run. The first was a logit analysis (with outliers removed), the results of which can be found in Table A2 in the appendix. A mixed effects logit model is run to test if there was significant selection bias due to school clustering, the results of which can be found in Table A3 in the appendix. Finally, the coefficients for

logit and mixed models are compared. The results of this comparison can be found in Table A4 in the appendix.

The first step in this analysis is to produce a regression model along the lines of the previous paper (Benson, 2019) to create a baseline to which to compare the mixed effects model. This model includes the same variables used in the mixed effects model but without the school groupings. The values of the coefficients of this model are not as important or interpretable as their signs and *relative* magnitudes. To control for the effects of school choice, a mixed effects model is run using the same covariates (but grouping student outcomes by school).

Graduation. Each included variable is found to be significant before controlling for school effects with the exception of families median income and unsubsidized loans. This is both by design and expected. The negative signs on low income, FRPL, and Pell eligible show that being low income reduces the probability of graduation. Similarly, this regression shows that all significant types of financial aid are positively related to graduation. These results are similar to those found in the previous papers (Benson, 2019).

Controlling for school choice does not change the sign relationship or significance level of any of the included variables and graduation. All three significant financial aid variables saw minor movement in their coefficients but overall school choice had only a minimal impact. This indicates that graduation was minimally influenced by cost factors relating to the choice of school.

Figure 1: Impacts of Financial Aid on Graduation

	Logit Model	Mixed Model	Absolute Difference	Percentage Difference
Grants	2.63***	2.40***	-0.24	-9.02%
Subsidized Loans	2.64***	2.51***	-0.13	-4.86%
Work Study	5.40***	5.86***	0.46	-8.49%
Unsubsidized Loans	0.00	0.01	0.00	NA

Significance codes: *** = 99.99%, ** = 99.9%, * = 99%, . = 95%

Earnings Above Average. In this model all demographic variables have a statistically significant relationship with earnings above average. Being male is positively related to greater earnings compared to being negatively related to graduation. This is likely a reflection of the well documented gender earnings deficit. It is also important to note that the signs on all other significant variables remained the same as for graduation. Demographics remained significant at the same levels while the significance of several income factors erodes.

Earnings above average are generally unrelated to financial aid awards in this model. While grants were lightly related, the rest of the financial aid mechanisms were both non-significant and small. This result likely derives from a confounding factor not present in the graduation outcome. As only students who enter the workforce soon after graduation were reflected in the data, it is possible that the results reflect bias in the

dataset rather than a true effect. In particular, high performing students who attend grad school and students who move out of state after graduation are not well represented in the data for this model. This produced positive effects for students who drop out early and secure jobs and because they have been in the labor force longer, they are likely to earn more than those who persist to graduation. Since graduation and time in labor force are not included in this model, the effect sizes for the financial aid variables may be muted or lose significance.

Figure 2: Impacts of Financial Aid on Earning Above Average

	Logit Model	Mixed Model	Absolute Difference	Percentage Difference
Grants	0.44*	0.37*	-0.07	-15.4%
Subsidized Loans	0.40	0.35	-0.05	-12.9%
Work Study	-0.92	-0.17	0.75	81.4%
Unsubsidized Loans	0.00	0.00	0.00	NA

Significance codes: *** = 99.99%, ** = 99.9%, * = 99%, . = 95%

STEM. The results of this outcome deviate in some way from the graduation outcome. White, hispanic, and free and reduced price lunch were no longer significant, and work study are not significant after controlling for school. Since this model included only graduates, these changes may be related to either the graduate population or the STEM graduates themselves.

This model shows that there is a school effect on STEM graduation. Three of four financial aid variables were significant before controlling for school but only two are significant after. Work study went from highly significant to not significant and the significance of subsidized loans decreased. Similarly, the coefficients for all three are noticeably more muted (closer to 0) after controlling for school. This indicates that within the graduate population there are clearly some impact of school choice/programs on student success in STEM degree attainment.

Figure 3: Impacts of Financial Aid on STEM Degrees

	Logit Model	Mixed Model	Absolute Difference	Percentage Difference
Grants	1.44***	1.15***	-0.29	-20.3%
Subsidized Loans	0.78**	0.62*	-0.16	-20.0%
Work Study	-3.24***	-1.75	1.48	45.8%
Unsubsidized Loans	0.01	0.01	0.00	NA

Significance codes: *** = 99.99%, ** = 99.9%, * = 99%, . = 95%

In Demand Programs. For in demand degrees, demographic variables are generally significant and sign-stable between this model, graduation and STEM with the exception of low income and FRPL which trade significance between models. However, as these

variables were highly correlated, this is not a particularly important result and was likely a function of the model design rather than a difference in relationship.

Two financial aid variables are also highly significant before and after controlling for institution. Both grants and work study remained significant after controlling for school but are somewhat muted in amplitude. The big difference between this outcome and other outcomes is that the sign of work study differs from graduation but agrees with the STEM outcome. In fact, this model shows that the provision of financial aid to work study generally decreased the rate of graduation from in demand programs and that is not due to school effects.

Figure 4: Impacts of Financial Aid on In Demand Degrees

	Logit Model	Mixed Model	Absolute Difference	Percentage Difference
Grants	0.85***	0.66***	-0.20	-23.0%
Subsidized Loans	0.24	0.09	-0.15	-62.0%
Work Study	-3.17***	-2.63***	0.54	-17.1%
Unsubsidized Loans	0.00	0.01	0.00	NA

Significance codes: *** = 99.99%, ** = 99.9%, * = 99%, . = 95%

This study intended to determine if there is a school effect on student success. After controlling for outliers, each outcome variable seemed to be relatively independent of school choice influence relative to demographics and income factors. However, amongst outcome variables, both graduate-only models were influenced by school choice for financial aid variables. This may indicate that the impact of school choice is non-linear or cumulative.

Conclusion

This study shows that the impact of financial aid on student success depends both on the type of financial aid *and* the outcome variable used to measure success. Further, this study indicates that the effects of financial aid allocations are generally unrelated to the school at which they are awarded for the purposes of graduation but directly related to the types of degrees students received. This implies that institutional effects were present but their scale is contextualized to the sub-population of interest. In short, it is likely necessary to control for school when examining student success in the context financial aid.

While this study does not provide specific indications of the magnitude of the effect of financial aid on student success, the results may be interpreted in a relative fashion to show that not all financial aid is created equal. Work study in particular seems to be positively related to student persistence to graduation but negatively related to the pursuit of desirable degrees. These results indicate that as far as financial aid is concerned, it mattered both *how* aid was allocated and *where* it was allocated in regard to its effect on student success.

Given the comparative nature of this analysis, no concrete estimates of the *magnitude* of the impact of financial aid on earnings or degree choice was produced in this research. Further study could help elicit relationships between outcome variables and detailed financial aid variables, while controlling for additional demographic variables such as location, ability, and major choice. Such research would require extensive analysis and would therefore be appropriate for a future, standalone study.

References

Arcidiacono, P. (2005). Affirmative action in higher education: How do admission and financial aid rules affect future earnings? *Econometrica* , 1477-1524.

Astin, A. W. (1996). *Degree Attainment Rates at American Colleges and Universities: Effects of Race, Gender, and Institutional Type.* Los Angeles: Higher Education Research Insititute.

Benson, G. (2017). *Persistence and Completion of Students Recieving Need-based Financial Aid.* Olympia: WA Office of Financial Management.

Benson, G. (2018). *Unmet Meed amongFinancially Needy College Students in the State of Washington.* Olympia: WA Office of Financial Management.

Benson, G. (2019). *Analysis of Alternative Interventions.* Olympia: WA Office of Financial Management.

Calcagno, J. C. (2008). Community college student success: What institutional characteristics make a difference? *Economics of Education Review*.

Castleman, B. L. (2018). Can Financial Aid Help to Address the Growing Need for STEM Education? The Effects of Need-Based Grants on the Completion of Science, Technology, Engineering, and Math Courses and Degrees. *Journal of Policy Analysis and Management*, 136-166.

Cook, R. D. (1977). Detection of Influential Observations in Linear Regression. *Technometrics*, 15-18.

Dale, S. B. (2002). Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *The Quarterly Journal of Economics*, 1491-1527.

Dowd, A. C. (2004). Income and Financial Aid Effects on Persistance and Degree Attainment in Public Colleges. *Education Policy Analysis Archives*.

Dynarski, S. M. (2003). Does aid matter? Measuring the effect of student aid on college attendance and completion. *American Economic Review*, 279-288.

Nguyen, T. D. (2018). The Effects of Grant Aid on Student Persistance and Degree Attainment: A Systematic Review and Meta-Analysis of the Causal Evidence. *CEPA Working Paper No. 18-04*.

Nora, A. L. (2006). Examining the tangible and psychosocial benefits of finacial aid with student access, engagement, and degree attainment. *American Behavioral Scientist*.

Rothstein, J. a. (2011). Constrained after college: Student loans and early-career occupational choices. *Journal of Public Economics*, 149-163.

Ryan, J. F. (2004). The relationship between institutional expenditures and degree attainment at baccalaureate colleges. *Research in Higher Education*, 97-114.

Appendix: Tables

Table A1. Summary Statistics

		Graduates	Earnings Above Average	STEM Degree	In Demand Degree
		N=8817	N=5618	N=7324	N=7418
Outcome		0.77	0.51	0.21	0.29
Demographics	Male	42.3%	69.6%	38.5%	38.6%
	White	64.9%	64.8%	66.3%	66.4%
	Asian	17.5%	18.5%	18.3%	18.4%
	Hispanic	9.1%	9.5%	9.0%	8.9%
	Normalized GPA	0.82	0.83	0.84	0.84
Income Factors	FRPL Status	38.5%	37.4%	36.8%	36.9%
	Pell Eligible	57.1%	55.9%	55.4%	55.4%
	Ever Independent	13.2%	13.0%	14.5%	14.5%
	Total Need	0.64	0.70	0.67	0.68
	Families Median Income	0.71	0.72	0.71	0.71
	% Low Income	32.8%	32.5%	32.0%	32.0%
Financial Aid	Grants	44.7%	45.1%	46.3%	46.2%
	Subsidized Loans	22.4%	22.8%	22.3%	22.3%
	Work Study	1.4%	1.5%	1.6%	1.6%
	Unsubsidized Loans	40.3%	40.6%	41.8%	41.8%
Insitution	A	1090	599	801	806
	B	207	108	149	150
	C	1115	630	780	791
	D	2074	1302	1818	1846
	E	2942	2060	2620	2653
	F	1389	919	1156	1172

Table A2. Logit Models with Outliers Removed

		Graduates	Earnings Above Average	STEM Degree	In Demand Degree
Demographics	Intercept	-2.50 ***	-1.74 ***	-3.79 ***	***
	Male	-0.56 ***	0.42 ***	1.10 ***	0.47 ***
	White	0.72 ***	0.43 ***	0.18	0.11
	Asian	0.98 ***	0.55 ***	0.70 ***	0.49 ***
	Hispanic	0.59 ***	0.38 **	-0.05	
	Normalized GPA	1.29 ***	0.62 ***	1.25 ***	0.89 ***
Income Factors	FRPL Status	-0.46 ***	-0.11	-0.13 .	***
	Pell Eligible	-1.26 ***	-0.27 ***	-0.40 ***	***
	Ever Independent	-1.01 ***	-0.07	-0.22 *	0.13 .
	Total Need	2.81 ***	0.17	0.89 ***	0.65 ***
	Family Median Income	0.36	0.59 **	-0.30	
	% Low Income	-1.17 ***	0.27	-0.93 ***	
Financial Aid	Grants	2.63 ***	0.44 *	1.44 ***	0.85 ***
	Subsidized Loans	2.64 ***	0.40 .	0.78 **	0.24
	Work Study	5.40 ***	-0.92	-3.24 ***	***
	Unsubsidized Loans	0.00	0.00	0.01	0.00

Table A3. Mixed Models with Outliers Removed.

		Graduates	Earnings Above Average	STEM Degree	In Demand Degree
	Intercept	-2.50 ***	-1.74 ***	-3.79 ***	-2.43 ***
Demographics	Male	-0.56 ***	0.42 ***	1.10 ***	0.47 ***
	White	0.72 ***	0.43 ***	0.18	0.11
	Asian	0.98 ***	0.55 ***	0.70 ***	0.49 ***
	Hispanic	0.59 ***	0.38 **	-0.05	-0.19
	Normalized GPA	1.29 ***	0.62 ***	1.25 ***	0.89 ***
Income Factors	FRPL Status	-0.46 ***	-0.11	-0.13 .	-0.22 ***
	Pell Eligible	-1.26 ***	-0.27 ***	-0.40 ***	-0.34 ***
	Ever Independent	-1.01 ***	-0.07	-0.22 *	0.13 .
	Total Need	2.81 ***	0.17	0.89 ***	0.65 ***
	Family Median Income	0.36	0.59 **	-0.30	-0.11
	% Low Income	-1.17 ***	0.27	-0.93 ***	-0.26
Financial Aid	Grants	2.63 ***	0.44 *	1.44 ***	0.85 ***
	Subsidized Loans	2.64 ***	0.40 .	0.78 **	0.24
	Work Study	5.40 ***	-0.92	-3.24 ***	-3.17 ***
	Unsubsidized Loans	0.00	0.00	0.01	0.00

Table A4. Comparisons of the Coefficients Between the Logistic and Mixed Models

		Graduates		Earnings Above Average		STEM Degree		In Demand Degree	
		N=16942		N=9091		N=13177		N=13560	
		Diff.	Diff. %	Diff.	Diff. %	Diff.	Diff. %	Diff.	Diff. %
Demographics	Male	0.00	-0.2%	0.00	0.0%	0.00	0.2%	0.01	2.0%
	White	-0.06	-8.1%	-0.01	-3.2%	0.06	32.1%	0.04	34.4%
	Asian	0.22	22.3%	0.10	17.8%	-0.20	-28.6%	-0.10	-21.0%
	Hispanic	-0.03	-5.6%	0.01	3.8%	0.03	-62.2%	0.03	-16.2%
	Normalized GPA	0.22	17.5%	0.10	16.7%	-0.27	-21.9%	-0.11	-12.3%
Income Factors	FRPL Status	-0.01	2.5%	-0.01	12.6%	0.02	-15.2%	-0.01	3.4%
	Pell Eligible	-0.05	3.9%	-0.03	10.1%	0.03	-6.9%	0.00	0.4%
	Ever Independent	-0.08	8.0%	-0.02	29.4%	0.02	-8.1%	-0.03	-21.2%
	Total Need	0.04	1.6%	0.12	67.7%	-0.14	-16.0%	-0.02	-2.6%
	Families Median Income	0.40	111.0%	0.04	6.5%	-0.27	90.2%	-0.05	47.6%
	% Low Income	0.00	0.3%	0.06	21.1%	-0.04	4.8%	-0.03	10.2%
Financial Aid	Grants	0.24	9.0%	0.07	15.4%	-0.29	-20.3%	-0.20	-23.0%
	Subsidized Loans	0.13	4.9%	0.05	12.9%	-0.16	-20.0%	-0.15	-62.0%
	Work Study	-0.46	-8.5%	-0.75	81.4%	1.48	-45.8%	0.54	-17.1%
	Unsubsidized Loans	-0.01	-1473.6%	0.00	12.9%	0.00	-10.6%	0.00	54.7%

ERDC
Education Research & Data Center

Office of Financial Management
Better information. Better decisions. Better government. Better Washington.