A THUMB ON THE SCALE? ABILITY, INCOME, AND DEGREE COMPLETION IN A PUBLIC UNIVERSITY

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Abstract

This paper examines academic ability, ability to pay, and degree completion for bachelor's degree students at a large, selective public university. We ask: How does the path to a degree compare for low-income and high-income students of similar academic ability? Does income act as a "thumb on the scale?" The evidence analyzed here suggests that it does, and that the disadvantage to lower-income students is more pronounced than some prominent higher education observers claim.

Affordability, Participation, and Degree Completion

The literature on access and affordability presents two competing views. Some say that lower-income students are increasingly being priced out, especially from top-tier institutions. Others argue that participation is largely a success story for higher education.

The View that Lower-Income Students Are Being "Priced Out"

National data suggest that participation and persistence have long been related to income, and that the situation has become more pronounced since the late 1970s and early 1980s. For example, overall participation rates moved from about 70 percent to about 90 percent for students from the top income quartile during that period, while fluctuating at around 50 percent or so for the bottom income quartile (Fitzgerald & Delaney, 2002).

Carnevale and Rose (2003) have provided dramatic evidence on how ability to pay relates to access, especially in selective colleges and universities. Consider the numbers 146, 74, and 3. The figure 146 represents the number of top-tier colleges and universities in the U.S.; this is based on several of the usual metrics, including entering students' high school grades, SAT scores, and acceptance rates (those 146 institutions include the university, Penn State that we focus on in this paper). Seventy-four percent is the proportion of students at these 146 highly selective institutions who came from families in

the top socioeconomic quartile. And just 3 percent of students at these colleges and universities came from the bottom socioeconomic quartile.

Carnevale and Rose's analysis includes SAT and high school grades, parental income, admissions preferences, and more, and it delivers a clear and stark message. Socio-economic background appears to be an extremely important factor in terms of who goes to America's best college's and universities. "The reality that many high school students from low-SES families are qualified for college but do not attend or attend but go to colleges that are less selective than their qualifications justify is not widely recognized" (Carnevale & Rose, 2003, p. 41). "The conventional view that academic preparation is a monolithic barrier to access and choice among low-SES students is greatly overstated" (Carnevale & Rose, 2003, p. 38). "There is even less socioeconomic diversity than racial or ethnic diversity at the most selective colleges" (Carnevale & Rose, 2003, p. 11).

Those findings are buttressed by Thomas Mortensen's Postsecondary Education OPPORTUNITY, which looks across American higher education, mostly via analyses of large national datasets compiled by the U.S. Census Bureau and the National Center for Education Statistics. Mortensen's results over many years have illustrated that at every stage on the path to a baccalaureate, "family income plays a strong, positive role" (for example, see "The Track to a Bachelor's Degree from College," 2001, p.1).

Don Heller is cited perhaps as widely as anyone working on the intersection of policy, affordability, access, and accountability. In testimony to U.S. Congress, he referenced a vast body of research confirming that "lower income students are the most sensitive to rising tuition prices, and they are the first to be priced out" (Heller, 2005, p. 17); that "highest income students have very little price sensitivity" (Heller, 2005, p. 17); that a recent federal report shows "that over 400,000 high school graduates who are academically qualified to attend a four-year college are unable to do so because of cost barriers" (Heller, 2005, p. 19); and that research "has demonstrated that merit aid is awarded disproportionately to students from higher income families, many of whom do not need that assistance to be able to go to college" (Heller, 2005, p. 19).

On that last point, Heller has also noted that "in 2003-04, institutions awarded more than $2 billion in grant aid to dependent students with family incomes in excess of $108,000, or approximately twice the median family income of all dependent students in the nation in that year. He recommended "that these institutions conduct an evaluation of their own financial aid programs to determine whether they are working in consort with the goal of expanding access for underserved populations, or whether they are simply rewarding wealthier students who have had many social, financial, and academic advantages in the years before they went to college" (Heller, 2006, pp. 2-3).

Similarly, as reported in *The Chronicle of Higher Education* (Leubsdorf, 2006), many students at four-year public colleges and universities face a gap between their ability to pay for college and the cost of attending, even with money from financial aid. Sixty-three percent of students do not have enough money – from their family's expected

contribution plus financial aid – to cover tuition and other expenses of attending college (those figures are based on data from a national 2003-04 survey of colleges and universities by the National Center for Education Statistics). The same report looked at students who do have enough money to pay for college yet receive financial aid anyway, noting that students from upper-income families, earning an average of $89,400 a year, had $3,400 more than necessary to pay for college without loans and $6,000 with loans. In other words, nationally, many students are not having their financial need met, while many are receiving aid but really do not have need.

The View that Access Is "Largely a Success Story"

On the other hand, some recent prominent reports have suggested that higher education is largely effective in terms of affordability, participation and degree completion. In the 2005 book *Equity and Excellence in American Higher Education*, Bowen, Kurzweil and Tobin examined whether participation and outcomes differ according to the academic ability and socioeconomic status of students at 19 of the nation's more selective private and public institutions (again, that dataset included Penn State). Bowen and his colleagues wrote that students from low-income families do appear to be disadvantaged, but only to a small extent. They saw "basic equality" (p. 134) and concluded that a "consistent pattern suggests that socioeconomic status does not affect progression" from application through admission, enrollment, and graduation (p. 100).

Similarly, a 2006 policy report (*A Rising Tide*, directed by Robert Zemsky at the University of Pennsylvania) concluded that higher education in Pennsylvania is expensive but affordable. That message was essentially positive, intended to "give pause to those who believe American higher education has a cost crisis or that the tuitions that colleges and universities charge are thwarting the opportunities of young people in large numbers" (The Education Policy and Leadership Center and Learning Alliance for Higher Education, 2006, p. 39). Those authors wrote that "higher education in Pennsylvania is largely a success story" and that public higher education in the Commonwealth of Pennsylvania is "largely effective" in terms of participation and degree completion" (pp. 6-7).

Looking at the Evidence from One Public University

The literature's competing perspectives led us to examine how family income relates to access and degree completion at Penn State. Overall, the university's average graduation rates are high. The six-year rate is 84 percent at the flagship campus (a lower university-wide rate of 66 percent reflects a 53 percent graduation rate at other campuses, whose mission includes a two-year role for some location-bound students). But those averages describe students in general; what can the evidence tell us about lower income students, in particular?

Research Design and Data Sources

For the purposes of this study, we focus on academic ability and ability to pay in relation to participation and degree completion. We have chosen this focus because much research indicates that these considerations are important. Also, they are of great practical

interest in terms of, for example, how an institution structures its aid, whom it admits, and the objectives it sets for fundraising. We use family income, drawn from the Free Application for Federal Student Aid (FAFSA), as our measure of ability to pay. We use freshmen fall-semester gpa as our measure of academic performance (basically this is first-semester gpa; a small number of students have some summer session courses on their transcripts as well.) Numerous retention and degree attainment studies in the past have found that first-semester and first-year grades play a significant part in explaining degree completion (Adelman, 2006; Desjardins, Kim & Rzonca, 2003; Reason, 2003).

Data Sources

The cohort we are studying includes 11,930 full-time baccalaureate students who began at Penn State at any of the 19 campuses relevant to this study in summer or fall 1999. We tracked those students through summer 2005 to determine six-year graduation rates. We mostly use internal Penn State electronic databases, such as transcript and financial aid files. A FAFSA figure for Expected Family Contribution – which is, of course, the amount a family is expected to contribute toward the cost of college – is available for about 80 percent of Penn State's bachelor's degree students. We also examine data from the National Student Clearinghouse to explore what happened, academically, to students who did not graduate from Penn State.

Analysis and Results

Of the 11,930 full-time baccalaureate students who began at Penn State in 1999, 7,923 (66 percent) had graduated by 1995. This paper analyzes the relationship among ability to pay, academic ability, and graduation rates for those students, and whether Penn State non-completers subsequently enrolled elsewhere. It also summarizes the results of regressing twelve different variables onto graduation.

Entering Students and Family Income

We have cited several reports that link participation with socioeconomic status and/or family income. An obvious first-cut question is whether this applies at Penn State, which (like all public universities) traditionally sees access as an important part of its mission.

	U.S. Family Income Quintile, 1998 dollars[1]	# Students within Income Range	% Students within Income Range
Lowest fifth	$0 - $21,599	974	10.4%
Second fifth	$21,600 - $37,692	1,343	14.4%
Middle fifth	$37,693 - $56,019	1,682	18.0%
Fourth fifth	$56,020 - $83,690	2,530	27.1%
Highest fifth	$83,691 and higher	2,796	30.0%

[1] Source: U.S. Census Bureau (2004)

Table 1. Distribution of Penn State 1999 First-time Full-time Cohort by National Family Income Quintiles

Table 1 relates Penn State's entering students and their 1998 reported family income from FAFSA to the U.S. family income distribution for the same period. Income data were not available for 2,605 students; they are not included in the quintiles. Table 1 shows that at Penn State, family income is not as strongly related to the makeup of the entering class as might be expected based on the profile of the nation's 146 most selective colleges and universities. Nonetheless, Table 1 shows that at Penn State, lower-income students are proportionally under-represented and higher-income students are over-represented.

Ability to Pay, Academic Ability, and Graduation Rates

Table 2 summarizes family income data for all students in Penn State's fall 1999 entering cohort who completed the Free Application for Federal Student Aid (FAFSA). As shown (and realizing that many of the students who do not complete the FAFSA are probably from higher-income families), 20 percent of these Penn State freshmen came from families with incomes of $32,454 or less; 20 percent came from families with incomes of $98,013 or more.

	Family Income
Lowest Quintile	$0 - $32,454
2nd Lowest Quintile	$32,471 - $53,343
Middle Quintile	$53,350 - $72,427
4th Quintile	$72,431 - $98,009
Highest Quintile	$98,013 - $1,028,997

Table 2. Family Income (from FAFSA; N=9,326)

Table 3 shows the distribution of first-fall semester grade point averages.

	Fall 1999 GPA
Lowest Quintile	0.00 – 2.29
2nd Lowest Quintile	2.30 – 2.79
Middle Quintile	2.80 – 3.14
4th Quintile	3.15 – 3.50
Highest Quintile	3.51 – 4.00

Table 3. Fall 1999 Grade Point Averages (N= 11,930)

Table 4 maps graduation rates onto the high and low income quintiles from Table 2 and the high and low gpa quintiles from Table 3. The resulting contrasts are pronounced. As shown, 89 percent of high-income, high-GPA students graduate within six years. That contrasts with the 72 percent graduation rate for low-income students of similar academic ability, for a difference of 17 percentage points. And although the absolute graduation rates

for low gpa students are much lower, at 36 percent and 20 percent, the difference between the graduation rates of high income students and low income students is very similar, at 16 percentage points.

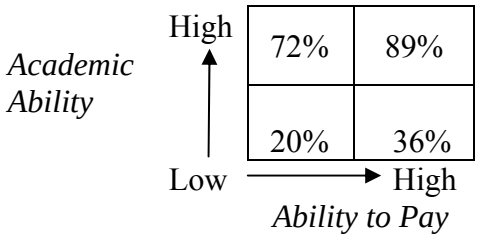

Table 4. Six-Year Graduation Rates by Academic Ability and Ability to Pay

Space does not permit showing detailed data that break down Table 4's results for Penn State's various colleges and campuses. However, we have examined those data, and strikingly similar patterns occur throughout the university. That is, almost regardless of how we define groups of students – high ability, low ability, by college, by campus – high income students graduate at rates about 15 to 20 percentage points higher than do low income students of similar academic ability.

Multivariate Analysis of Factors Relating to Degree Completion

Because a considerable body of research suggests that many factors (high school gpa, standardized test scores, residence on- or off-campus, study skills, and so on) relate to degree completion, we conducted a multivariate analysis on the dataset for 11,930 Penn State students. Since the outcome of interest is dichotomous – either someone graduated or they did not – we use logistic regression for this analysis.

Variable	Coefficient	Wald χ^2	Odds Ratio
Age in Fall 1999 (15-45 years)	-0.0597	2.9569	0.942
Gender (female=0)	-0.1117	*3.9206	0.894
Minority (minority=0)	-0.0411	0.2417	0.960
First generation (no=0)	-0.1065	3.3588	0.899
Residency (Pennsylvania=0)	-0.3042	***11.5094	0.783
Fall semester gpa (0.00-4.00)[1]	1.1492	***774.6980	3.156
High school class rank (in percentiles, 2-99)	0.0089	***31.5127	1.009
SAT score (50-point increments)	-0.0114	1.1500	0.989
Total financial aid (in $1,000's)	-0.0060	0.7795	0.994
Family income (in $10,000's)	0.0468	***34.6123	1.048
On- or off-campus (off-campus=0)	0.8148	***135.3860	2.259
Campus (non-University Park=0)	0.6144	***57.3922	1.849
Model χ^2 = 1622.7212 ***		* p<.05	
Nagelkerke R^2 = 0.3573		** p<.01	
d.f. = 12		*** p<.001	
Concordant (predicted to observed) = 80.6%			

[1] The gpa increment is a full point – for example, the difference between a 2.50 and 3.50.

Table 5. Factors Relating to Six-Year Graduation (All Penn State Campuses)

The dependent variable is graduation within six years. In building models and choosing variables, we ran Pearson correlation analyses and eliminated variables with correlation coefficients of 0.3 or greater to reduce collinearity (this removed Pell recipient status as a variable; it was highly collinear with income). A full analysis of twelve possible predictors of graduation was modeled, and a stepwise model was also run on these twelve variables. In addition, because the profile of students who start at the University Park campus differs from those who start at Penn State's other campuses, separate models (both full and stepwise) were run for University Park and other campuses (that is, rather than using campus location as one of twelve independent predictors of graduation). Table 5 summarizes the test results for the full model, for all campuses.

Overall Model Fit. As shown in Table 5, the Nagelkerke R^2 was 0.3573 for the full model. This was the highest R^2 of any of our models. This model was able to predict 80 percent of the observed cases. The model χ^2 statistic indicates that the model is significant overall.

Coefficients and Odds Ratios. Logistic regression coefficients estimate the change in the log-odds of the outcome based on a one-unit change in an independent variable. Those estimates are not easily interpreted, except for the fact that coefficients may be positive or negative; a positive coefficient indicates an increase in the log odds of the dependent variable while a negative coefficient indicates a decrease. So, for example, in Table 5, the results for gender show a lower likelihood of graduation for males, since that parameter estimate is negative (-0.1117) and gender is coded as male = 1.

Although the mathematics behind odds ratios are not intuitive (they represent an exponential log transformation of the coefficients), odds ratios themselves are quite easy to interpret. The odds ratios for independent variables in this logistic regression represent the difference in the odds of graduating based on a one-unit change in an independent variable. For instance, in Table 5, the odds ratio for gender is 0.894. Thus, the odds for males graduating is just 0.894 that of the odds of females graduating. Likewise, the odds ratio for cumulative gpa in Table 5 of 3.156 suggests that the odds of graduating increase by 3.156 (that is, by 215.6 percent) for a full-point increase in gpa. The relative magnitude of the association between the dependent variable and each dichotomous independent variable can be readily compared. For example, the odds ratios of 0.894 for gender and 0.783 for residency indicate that there is a greater negative impact associated with being out-of-state than with being male. Because continuous variables such as age, aid amounts, and family income have more than two possible outcomes, their odds ratios cannot be compared as easily.

Significant Predictors. The likelihood of graduating in six years appears to be positively and significantly associated with the following student characteristics (as shown in the results for the Wald χ^2 statistics in Table 5):

* female
* in-state resident
* higher first-semester gpa
* higher high-school class rank
* higher family income
* living on campus
* University Park location (versus other campuses).

The logistic regression results confirm that academic ability and income are related to the likelihood of graduation. Increases in both first-semester gpa and high school class rank both relate significantly to improved odds of graduation. For instance, every $10,000 increase in family income raises the odds of graduation by 4.8 percent.

The following student characteristics appear *not* to be statistically significant: age, minority/non-minority, first-generation status, SAT score, and total aid. This means that, for example, that we would *not* expect different graduation outcomes for minority and non-minority Penn State students who are similar in other respects, such as high school class rank, family income, and so on.

Alternative Logistic Regression Models. As noted, separate models (both full and stepwise) were also run for the University Park flagship campus and other campuses. Those results are not tabulated in this paper because the findings are primarily of interest to an internal, Penn State audience. But in brief, all the models were significant based on the χ^2 statistic, and all were able to correctly predict at least 75 percent of the observed cases. The Nagelkerke R^2 statistic ranged from 0.2512 to 0.3559 for those other models. In general, when campus location was withdrawn as a variable and the analyses separated by location, the results were similar in terms of the direction and significance of the other variables. The only exception was gender, which was a significant predictor in the full model. When the analyses were separated, gender was no longer statistically significant for students at University Park. At other locations, gender remained significant; at non-University Park campuses, females continued to have higher odds of graduation than did males.

Non-Completers and Subsequent Enrollment at Other Institutions
Determining all the reasons why students enrolled at Penn State but left before earning a degree is beyond the scope of this paper. But we have explored whether students who left Penn State continued their education at other institutions, and how income levels and academic ability related to those enrollment patterns.

	Lowest Income Quintile		**2nd Lowest Income Quintile**		**Mid Income Level Quintile**		**2nd Highest Income Quintile**		**Highest Income Quintile**		**Total**
Fall 1999 GPA Quintile	# Non-completers	% Enrolled Elsewhere	# Non-completes	% Enrolled Elsewhere	# Non-completes	% Enrolled Elsewhere	# Non-completes	% Enrolled Elsewhere	# Non-completes	% Enrolled Elsewhere	# Non-completes
Lowest GPA	388	43%	234	49%	234	53%	203	54%	185	62%	1,244
2nd Lowest	172	36%	149	48%	149	44%	144	41%	137	62%	751
Mid-GPA	131	44%	114	52%	99	55%	102	47%	90	56%	536
2nd Highest	84	48%	96	59%	92	61%	90	58%	72	54%	434
Highest GPA	76	58%	82	62%	66	70%	60	72%	57	74%	341
Total	851	43%	675	52%	640	54%	599	52%	541	61%	3,306

[1.] 701 non-completers did not have income data available; those students are not included in this table.

Table 6. Enrollment Rates at Other Institutions for Penn State Non-Completers[1]

Table 6 presents data extracted from the National Student Clearinghouse, which is a comprehensive database of students enrolled at over 2,800 colleges and universities. At the time of this study, participating two-year and four-year colleges and universities, along with other trade and vocational institutions, enrolled 91 percent of the students in higher education in the United States. The Clearinghouse provides information on whether students who left Penn State subsequently attended other institutions of higher education.

As shown in Table 6, 61 percent of the students at the highest income level enrolled at another school compared to 43 percent of those at the lowest income level. In other words, the majority of the university's non-completers are *not* dropping out of higher education. However, these data provide evidence that, once again, income matters. Within each level of academic ability, greater proportions of higher income students re-enrolled at other institutions than did lower income students.

Conclusions and Practical Implications

Some have argued, and we believe, that America's colleges and universities do a very good job for most students. Nonetheless, it appears to us that it is reasonable to examine closely whether and to what extent a particular segment of students – those from lower-income families – may be systematically and materially disadvantaged in earning a degree from the most selective higher education institutions in the United States.

This paper has examined the evidence on academic ability, ability to pay, and degree completion in detail. We have used four different approaches to explore a detailed source of objective data for nearly 12,000 students in a selective public university. Our results are clear and consistent. When other factors are taken into account, differences in ability to pay relate substantively and significantly to the likelihood that students will graduate in six years.

Analyses such as this can inform decisions about admissions, financial aid, fundraising, and the mix of need-based and merit-based aid. These matters are of great import for higher education, and for the students and families that the nation's public universities and colleges serve.

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