

Who Benefits Most from Financial Aid? The Heterogeneous Effect of Need-Based Grants on Students' College Persistence*

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Objectives. This study assesses whether need-based grants are equally conducive to the college persistence of students from various economic strata and the extent to which a redistribution of funds can narrow economic-based inequality in college persistence. *Methods.* To estimate the causal effect of need-based grants on several persistence outcomes the discontinuity created in the dollar amounts of Pell grants when the students have siblings attending college is exploited. The analyses use a nationally representative sample of students enrolled at four-year institutions in 1995. *Results.* While the allocation of Pell Grants responds to students' pecuniary constraints, institutional and state grants expand the circle of recipients to more well-off students. Yet, it is only the persistence of students from the bottom half of the income distribution that is sensitive to aid amounts. If the need-based funds granted to affluent students had been diverted to these students, the gap in first-year persistence would have been closed. *Conclusions.* For a redistribution of funds to boost degree attainment and achieve equality of educational opportunity it must be based on stricter means-tested allocations of nonfederal funds as they are the main source of need-based aid.

One of the troubling findings regarding human capital trends in the United States is the stark inequality in the attainment of a bachelor's degree: students from the top of the family income distribution are substantially more likely to earn a bachelor's degree than students from the bottom. Low-income students are not only less likely to enroll in college than economically privileged students (Alon, 2009; Haveman and Wilson, 2007), but they are also less likely to attain a bachelor's degree, even after successfully navigating most of the postsecondary pipeline. For example, Bowen, Chingos, and McPherson (2009) report that among students who began attending a four-year college in 1992, only 40 percent of those in the bottom income quartile graduated, compared to 72 percent in the top quartile (see also Haveman and Wilson, 2007; Advisory Committee on

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SOCIAL SCIENCE QUARTERLY, Volume 92, Number 3, September 2011

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DOI: 10.1111/j.1540-6237.2011.00793.x

Student Financial Assistance (ACSFA), 2010). That the gap exists even after netting out noneconomic aspects of family capital, such as human, social, and cultural resources, underscores that family financial resources are critical to the year-to-year persistence and degree attainment of economically disadvantaged students (ACSFA, 2010; Haveman and Wilson, 2007). Accordingly, in order to equalize the likelihood of achieving bachelor's degrees in the United States, policy that adequately addresses economic inequality among students is imperative (ACSFA, 2010).

Means-tested financial aid is designed to promote the attainment of bachelor's degrees by low-income students by increasing their likelihood of enrollment and lessening their chances of dropping out of school for lack of funds. The effect of financial aid on persistence in college, the focal interest of this study, is twofold: it lowers the tuition costs for financially constrained students, and it reduces their need to direct time away from academic activities to working in jobs (Cabrera, Nora, and Castaneda, 1992; Goldrick-Rab, Harris, and Trostel, 2009). In short, by lowering economic barriers for low-income students, financial aid can promote the year-to-year persistence and college graduation likelihood of these students. This policy can, therefore, diminish economic disparities in the attainment of a degree and curb the reproduction of economic inequality.

However, for college persistence rates to be equalized, low-income students need to be provided with sufficient resources to allow smooth progress toward a college degree (Bowen, Kurzweil, and Tobin, 2005). Alas, even after taking into account all available grants and loans in addition to family contributions, low-to-moderate income students face substantial unmet needs (ACSFA, 2010; Long and Riley, 2007). Moreover, as the annual debts accumulate during the college years, and savings and other resources are depleted, the financial pressures on low-income students intensify. Thus, the gaps among equally qualified students from different income groups in degree attainment are expected to persist, despite the financial aid provisions.

This study advances the current scholarship by considering the relationship between financial aid and persistence in college from the perspective of social equity: namely, by assessing whether need-based grants are equally conducive to the college persistence of students from various economic strata and the extent to which a redistribution of funds can narrow economic-based inequality in college persistence. This angle furnishes important and timely implications for financial aid policy in an era of growing economic inequality and shifts in financial aid policy. Since the late 1970s, not only have wage and wealth inequality risen (Haveman et al., 2004; Wolff, 2001), but tuition levels have also soared.¹ Yet the total value of aid distributed has

¹Between 1979 and 2009, tuition rose 176 and 223 percent in constant value at private and public four-year institutions, respectively (College Board, 2009a:Table 4).

not kept pace with the sharp rise in tuition. During the same period, federal financial aid has shifted from a grant-based to a loan-based system (College Board, 2009b). As a result of these trends, the proportion of average college expenses at a public four-year institution that could be met by a Pell Grant, the largest means-tested federally financed assistance to postsecondary students, declined by 15 percentage points, from 50 percent in 1987–1988 to 35 percent in 2009–2010 (College Board, 2009b:Figure 12b). Thus the share of family contribution required to cover college expenses significantly increased, especially for students in the lower half of the income distribution (College Board, 2009a:Figure 9). Moreover, as tuition levels have risen, states have responded to political pressure from the affluent and the middle classes by shifting funds away from need-based financial aid (Ehrenberg, 2005). Specifically, the proportion of state grants based on financial need declined from 91 percent in 1981–1982 to 72 percent in 2007–2008 (College Board, 2009b:Figure 19).

Rooted in this context is the question of whether a redistribution of funds can narrow the persistence gap between students from the top and bottom of the income distribution. To address this question we need first to establish that means-tested grants are conducive to students' college persistence. The estimation of the causal effect of need-based aid on college persistence is not straightforward because of the endogeneity between financial aid eligibility and subsequent academic success (Alon, 2005; Bettinger, 2004). That is, financial aid is expected to enhance persistence and graduation; yet, the same factors that enhance need-based grant eligibility (such as an economically disadvantaged family background) are negatively related to persistence and graduation. To deal with this issue, the current analytical strategy exploits a discontinuity in the dollar amounts of need-based grants that has never been fully tested—namely, the discontinuity created in aid awards of students when their siblings concurrently attend college. Experimenting with this discontinuity is an invaluable contribution given that, to date, there are only a few studies that have demonstrated the causal effect of aid on college persistence.

The empirical investigation also expands the external validity of previous estimates of the causal effect of aid on persistence by using a unique nationally representative data set, rather than data from a single institution, state, or sector, as has been done until now. The data, drawn from the National Postsecondary Student Aid Study (NPSAS) and the Beginning Postsecondary Students Longitudinal Study (BPS), provide accurate measures of financial aid provisions and annual persistence of all four-year college students in the United States during the mid-1990s. These rich data also offer a broad view of the important differences in the allocation of federal grants versus need-based funds received from other sources; permit a critical sensitivity test for the discontinuity created by siblings attending college; and allow distinguishing transfer students from dropouts.

Estimating the Causal Effect of Need-Based Financial Aid on College Persistence

The assessment of the net effect of need-based aid on persistence in college follows a model in which Φ is the standard cumulative normal distribution:

$$\Pr(PERSISTENCE = 1|x) = \Phi(\alpha FINAID + \beta'X). \quad (1)$$

The college persistence outcomes (first- and second-year persistence, as well as graduation within six years) are determined by student financial aid amounts received in the first year from all need-based grants (FINAID) and a vector of observed attributes that influence college success (\mathbf{X}). In general, early research that estimated this model has found that the receipt of a financial aid award is positively related to higher rates of persistence (see, e.g., Chang Wei, and Horn, 2002; Cofer and Somers, 2000; DesJardins, Ahlburg, and McCall, 2002; Dowd, 2004; Gross, Hossler, and Ziskin, 2007; Heller, 2003; Horn and Peter, 2003; Kerkvliet and Nowell, 2005; Light and Strayer, 2000; Paulsen and St. John, 2002; St. John and Starkey, 1995; St. John, Hu, and Weber, 2001).

Yet, the problem of endogeneity caused an underestimation of the positive effect in some cases, and spawned negative effects in other cases (Alon, 2005, 2007). The problem with a straightforward estimation of this model is that financial aid eligibility is correlated with the same observed and unobserved family and personal characteristics that influence persistence in college. This relationship produces biased estimates for α in Equation (1). However, discontinuities in the need-based financial aid formula can be exploited in order to identify the causal effect of aid on persistence. Z , a variable that influences eligibility for financial aid but is exogenous to the unobservable attributes that influence college persistence, allows for unbiased estimates of the dollar amount parameter (α). Using this discontinuity in an instrumental variable (IV) model can resolve the above problem by creating a new (predicted) financial aid estimate that is uncorrelated with the resulting error term (Maddala, 1983; Newey, 1987; Pindyck and Rubinfeld, 1998).

A new line of research that considers the interrelationship between financial aid eligibility and college persistence demonstrates the positive impact of need-based aid on subsequent academic success. For example, Singell (2004) simultaneously modeled persistence and enrollment for students attending a large public university. He found that need-based financial eligibility lowered persistence, but that an increase in the amount of grants and subsidized loans increased the first-year persistence probability. Similarly, by exploiting a discontinuity in aid allocations related to parental marital status, Alon (2007) demonstrated that although need-based aid eligibility was negatively related to graduation, aid amounts exerted a positive influence on graduation for students attending selective private institutions. Bettinger (2004) exploited several discontinuities in Pell Grant policy (including family size), and found that Pell Grants increased first-year

persistence for a sample of students attending Ohio's public postsecondary institutions.

This study expands this scholarship by exploiting one of the largest discontinuities in the Pell Grant formula: number of siblings currently attending college (Bettinger, 2004; Kane, 1999). Every student who completes the Free Application for Federal Student Aid (FAFSA) is asked to provide information on parental income, parental net worth,² family size, number of siblings currently attending college, and dependency status. This information is used to calculate the *expected family contribution* (EFC) to college costs and, therefore, the student's eligibility for the Pell Grant program. The number of siblings attending college decreases the EFC and therefore creates a discontinuity in first-year Pell Grant eligibility and award size. Moreover, the total dollar amount of all need-based grants (from federal, state, institutional, and other sources) is expected to show the same pattern of discontinuity, both because the amount received includes Pell Grant dollars and because other sources of aid may use the EFC in their allocation decisions.

The instrument used in this study is a dummy variable that indicates whether a respondent's siblings were attending college at the time that the respondent was a freshman (1995–1996). Indeed, among the students in the current sample, 45 percent of the students with no siblings attending college received need-based grants, compared to 55 percent among students with student siblings. Overall, the first group collected \$1,754 from such grants, while the second was awarded \$2,383. As is subsequently demonstrated in this article, this relationship is maintained after the \mathbf{X} vector is netted out. Moreover, a critical sensitivity analysis reveals that this discontinuity is unique to need-based aid and thus does not exist in the allocation of merit-based grants. This evidence indicates a nonzero average causal effect of “siblings attending college” on financial aid receipt (Wooldridge, 2002).

These individual variations in family circumstances can be exploited in order to instrument for the impact of need-based grants on persistence outcomes since, ostensibly, whether there are siblings in college should not affect one's college persistence. Under this framework, the average effect produced for the instrumented variable (siblings attending college) is the effect of grants on persistence for students whose need-based financial aid amount was influenced by family circumstances (i.e., siblings attending college).³ This instrument should not be confused with family size, another source of discontinuity in the Pell Grant formula, which is negatively related to academic outcomes due to the diffusion of resources (Coleman, 1988; Heer, 1985; Steelman et al., 2002). To isolate this instrument from family

²Net worth is determined by savings and checking account balances, as well as by the net values of farms, businesses, and other investments.

³The use of a dummy variable allows for a “local average treatment effect” (LATE) interpretation, suggested by Imbens and Angrist (1994), Angrist and Imbens (1995), and Angrist, Imbens, and Rubins (1996).

size, the models control for family size by comparing students of the same family size but with different numbers of siblings in college.

It is possible, however, that the “assignment” of having student siblings is not random, and that this instrument reflects unobserved differences among families that can bias the estimated effect in both directions. On the one hand, downwardly biased estimates can result if, for example, families that send only one child to college choose the child with greater chances of succeeding (Bettinger, 2004). On the other hand, if parents who send several kids to college place a higher value on higher education, then their kids may be better off in several unobservable ways that positively influence college persistence, which would lead to an upward bias of the estimates. Controlling for a long vector of observed characteristics may help to minimize these biases by capturing some of the unobserved differences. The specification, therefore, contains an array of relevant characteristics (\mathbf{X}). Among them are the characteristics of the four-year postsecondary institution; individual demographic characteristics; individual academic preparation; family background; socioeconomic level of high school attended; and student expectations and motivation. The specification for the graduation outcome also includes the chosen major. The inclusion of this vector of background variables goes a long way toward ensuring the exclusion restriction requirement that the instrument “siblings currently attending college” is uncorrelated with the error term in the persistence equation. Nonetheless, as with any implementation of IV with observational data, some unobserved differences may remain unaccounted for by this array.

Data, Variables, and Methods

Data

Unlike previous studies that relied on data from a particular university or a state, this study uses a nationally representative data set. The empirical analyses are based on the restricted-use National Postsecondary Student Aid Study (NPSAS), which is linked to the Beginning Postsecondary Students Longitudinal Study (BPS). The NPSAS is a comprehensive national survey designed to determine how students and their families pay for postsecondary education. The data provide exceptionally detailed administrative information about the type and amount of financial aid received by each student. BPS data provide complete information on progress in college and annual persistence for the relevant NPSAS cohort for the entire undergraduate period. For the current analysis, I use the BPS cohort based on NPSAS:96, with the first BPS followup in 1998 and the second in 2001. I limit the analysis to 7,748 dependent students, enrolled at any four-year institution in the fall of the 1995–1996 academic year. The analyses are weighted with appropriate weights.

Variables

Persistence Outcomes. The main dependent variable is FIRST-YEAR PERSISTENCE. Using nationally representative data allows for the examination of two versions of persistence in the 1995–1996 academic year: persistence at the first institution attended and that at any institution. This distinguishes between students who transferred to another school and those who withdrew from college, which is a concern in studies that assess persistence via non-national data sets (Bettinger, 2004). SECOND-YEAR PERSISTENCE is measured as the retention during the second to third year transition (at any school). SIX-YEAR GRADUATION is measured by the attainment of a bachelor's degree by 2001 (at any school).

Financial Aid. The persistence outcomes of students are linked to their FIRST-YEAR NEED-BASED GRANTS: that is, the total need-based grants received from all sources in 1995–1996. It is the *first-year* aid that is spotlighted since both the accurate administrative records about the receipt of need-based grants and the information on siblings currently attending college (the instrument) are limited to the first year of college. Consequently, the first-year aid amounts reported are both accurate and sensitive to students' financial constraints and family circumstances. I focus on *grants* because the utility function between them and college persistence is straightforward, while this may not be the case with other types of aid, especially loans. Moreover, *means-tested* grants directly respond to students' financial needs. Not surprisingly, ample evidence demonstrates that grants are more effective in promoting persistence than are loans (Alon, 2007; Cofer and Somers, 2000; St. John and Starkey, 1995; St. John, Hu, and Weber, 2001). I also use the data on the total amount received from the Pell program in 1995–1996 (FIRST-YEAR PELL GRANT) and the total amount of merit-only grants in 1995–1996 (FIRST-YEAR MERIT-BASED GRANTS). Juxtaposing the two types of means-tested grants, Pell and the total need grants, is designed to uncover important differences between the allocation of federal, state, and institutional resources. Merit aid is considered in a sensitivity analysis regarding the scope of the discontinuity generated by siblings attending college.

Control Variables. The multivariate analyses control for the characteristics of the four-year postsecondary institutions attended by the students in the sample (selectivity level and public vs. private sector); individual demographic characteristics (race/ethnicity and sex); individual academic preparation (number of AP courses, test scores, and high school GPA); family background (parents' marital status, parents' highest level of education, family size, and geographic region); socioeconomic level of high school attended (percent of student body receiving free lunch); and student

expectations and motivation (educational attainment expectations and the number of institutions applied to). The specification for the graduation outcome also includes the student's major. The Appendix provides descriptive statistics for all variables.

Family Income. To ascertain the magnitude of the economic gap among students who enrolled at four-year institutions in 1995–1996, the sample is disaggregated into income quartiles, according to the family incomes of dependent students in 1994. The Appendix reports the income range of each quartile. The EFC is \$954 for the lowest quartile (family income lower than \$28,000); \$3,970 and \$9,403 for the two middle quartiles, respectively; and \$22,858 for the top quartile (family income higher than \$76,000).

Results

The Economic Gap in College Persistence

Table 1 reports several persistence outcomes by income quartiles. Predictably, the gaps in financial resources translate into persistence gaps, and the differences among the income groups are monotonic. Only 64 percent of students in the bottom quartile returned to their first institution after the first year, compared to 75 percent of their affluent counterparts. The rate of first-year persistence is higher when students who transferred to another school are included, yet the interquartile gaps remain stable. The gaps across the income groups carry over into the transition from the second to the third year of college, and eventually into graduation, suggesting that transfer behavior serves as a temporary buffer against permanent dropout for low-income students (Goldrick-Rab, 2006). The annual gaps in transition rates

TABLE 1
Rates of Persistence in College by Income Quartiles

	1st-Yr. Persistence		2nd-Yr. Persistence	6 Yr.
	First Inst.	Any Inst.	Any Inst.	Graduation Rate
<i>Parental Income Quartile</i>				
1—Lowest income	0.64	0.75	0.74	0.48
2—Lower-middle income	0.71	0.82	0.74	0.58
3—Upper-middle income	0.73	0.86	0.79	0.67
4—Highest income	0.75	0.86	0.82	0.74
4-1 Gap	0.12	0.11	0.09	0.26
4-2 Gap	0.05	0.04	0.08	0.16

SOURCE: BPS: 1996/2001; NPSAS:96.

accumulate during the college years, which results in substantial gaps in the college completion rates (16 and 26 percentage points between the bottom two quartiles and the top quartile, respectively). Thus, low-income students who began their studies at a four-year school are less likely to attain a bachelor's degree than their affluent counterparts, even given financial aid provisions. Yet, without aid, the gaps would probably have been larger.

Provision of Need-Based Financial Aid

About 70 percent of the freshmen attending a four-year institution in 1995 received need-based aid (of any type, including loans). Table 2 reports receipt and amounts of need-based grants by income quartiles. The allocation of Pell Grants responds to students' pecuniary constraints: the majority of students in the bottom income quartile receive a Pell Grant in the first year (71 percent, with an average amount of \$1,874), as do a quarter of the lower-middle income quartile (\$1,022 on average), while students in the top half of the income distribution generally do not qualify for Pell (only seven students in the third quartile were Pell recipients). In sum, students from the bottom two income quartiles shared the entire Pell Grant "cake."

These amounts are small and insufficient to cover students' financial need during college, and are supplemented by need-based grants from states, institutions, and other sources. Institutional grants are the main source of need-based aid, making up roughly half of the need-based grants package, while federal and state sources contribute about 20 percent each. The sensitivity of these aid provisions to financial constraints, however, is less clear. While these grants do benefit the Pell recipients from the bottom two

TABLE 2
First-Year Financial Aid Status by Income Quartiles

	Parental Income Quartile			
	1 Lowest	2 Lower Middle	3 Upper Middle	4 Highest
Pell Grant Status				
Share of recipients—1st year (1995–96)	71.4%	22.5%	0.4%	0
Average amount among recipients (\$)	1,874	1,022	711	0
Average amount—total (\$)	1,338	230	3	0
Need-Grants Status				
Share of recipients—1st year (1995–96)	79.5%	58.1%	34.8%	19.2%
Average amount among recipients (\$)	4,529	3,767	3,842	3,051
Average amount—total (\$)	3,600	2,187	1,337	585

SOURCE: BPS: 1996/2001; NPSAS:96.

quartiles, they also expand the circle of recipients to more well-off students. About a quarter of the total need-based funds were allocated to middle- and upper-class students (35 and 20 percent of the students in the upper-middle and top quartiles, respectively, received these need-based grants). Clearly, schools do consider EFC when allocating aid to their students, since they add necessary funds to the recipients of the small Pell Grants and mitigate the unmet needs of low-income students; yet, they also use a substantial share of “need-based” funds as a financial incentive for rich students to attend their institutions (Duffy and Goldberg, 1998; Golden, 2006; McPherson and Schapiro, 1998). This, in a way, reflects the fact that aid allocations are adjusted to the cost of attendance, and affluent students are more likely than low-income students to attend costly and wealthy institutions. The question is: How much of the persistence gap among the income groups, reported in Table 1, could have been avoided if the funds allocated to affluent students had been redirected to supplement the aid of low-income students? To answer this redistribution question, the causal link between financial aid and persistence in college must first be established.

The Causal Influence of Financial Aid on Persistence

The first step in establishing causal estimates is finding a robust discontinuity in the allocation of need-based aid. Table 3 reports the shares of aid recipients and the total amounts allocated separately for each income stratum, and according to whether a student has siblings currently attending college. A clear-cut discontinuity is evident in the allocation of first-year Pell Grants to students in the bottom two quartiles, establishing the sensitivity of the Pell formula to having student siblings. The discontinuity is more apparent for students in the lower-middle income quartile (total allocation is \$448 vs. \$146), probably because a substantial share of them was on the margin of receiving aid, while the deprived circumstances of the bottom quartile students entitled them to the maximum Pell allowance anyway. This suggests the particular suitability of using this variable to instrument for the aid amounts of students in the lower-middle income stratum.

As expected, the figures for total first-year need-based grants also exhibit a similar discontinuity since the amounts include Pell Grant dollars or because other aid sources rely, to some extent, on the EFC for granting aid. Notably, the discontinuity of need aid according to siblings attending college stretches to students from the top two income strata. Remarkably, there is no such discontinuity in the allocation of merit-based grants to freshmen, which indicates that the discontinuity we find regarding need-based aid is not random. This sensitivity check assures that the nonzero average causal effect of the instrument is limited to the receipt of need-based financial aid.

Exploiting this discontinuity, I fit IV probit models of first-year persistence (from the first institution attended) regressed on a continuous variable

TABLE 3

Discontinuity in First-Year Financial Aid Status by "Siblings Attending College" and Income Quartiles

	Grants—First Year (1995–96)					
	Pell		Need Grants		Merit Grants	
	% Received	Average Amount	% Received	Average Amount	% Received	Average Amount
<i>1—Lowest Income</i>						
Sibs. in coll.: no	0.69	1,291	0.78	3,408	0.19	637
Sibs. in coll.: yes	0.78	1,482	0.85	4,196	0.19	478
<i>2—Lower-Middle Income</i>						
Sibs. in coll.: no	0.15	146	0.53	1,959	0.26	809
Sibs. in coll.: yes	0.42	448	0.71	2,776	0.26	983
<i>3—Upper-Middle Income</i>						
Sibs. in coll.: no	0.00		0.30	1,046	0.25	815
Sibs. in coll.: yes	0.01		0.46	2,044	0.20	677
<i>4—Highest Income</i>						
Sibs. in coll.: no	0		0.16	399	0.17	696
Sibs. in coll.:yes	0		0.27	977	0.25	804

SOURCE: BPS: 1996/2001; NPSAS:96.

that indicates the dollar amount of need-based grants and the vector of controls.⁴ Whether there were siblings attending college serves as the instrument. The model is fitted to the entire population, and separately for each income group. The results of the first stage demonstrate the causal effect of siblings on aid provisions that is maintained after the X vector is netted out for all income groups (results not shown). When everything else is equal, siblings attending college adds about \$500–800, on average, to the first-year grant amount.

Table 4 reports the results of the second stage along with estimates from a simple probit of first-year persistence on aid dollars. For ease of interpretation, the marginal effects of the point estimates of need-based amounts are reported (in \$100 increments), holding all the other variables at their mean (Long, 1997). The probit results for the entire population show that a \$100 increase in need grants significantly raises the first-year-first-institution persistence probability by 0.001. However, the estimate for the marginal effect of aid on persistence is larger (0.005) when this endogeneity is taken into account. Note that the Wald test of exogeneity is significant, suggesting that

⁴Consistent and efficient estimators are obtained via maximum likelihood based on Amemiya generalized least squares (AGLS), while estimators for probit are made with endogenous regressors (Wooldridge, 2002).

TABLE 4
Marginal Effects of Each Additional \$100 Need Grant Received in the First Year on First-Year Persistence (at First Institution)

Dep. Var.: First-Yr. Persistence	Parental Income Quartile							
	Total	1 Lowest	2 Lower Middle	3 Upper Middle	4 Highest			
Probit	0.001	**	0.002	**	0.0004	0.001	**	
Controls	yes	yes	yes	yes	yes	yes	yes	
Pseudo R^2	0.17	0.16	0.18	0.17	0.17	0.17	0.19	
IV Probit	0.005	**	0.009	**	0.003	0.003	-0.001	
Controls	yes	yes	yes	yes	yes	yes	yes	
Wald test of exogeneity	3.65	0.43	13.07	**	0.14	0.14	0.14	
Log likelihood	-41975.6	(54)	-10689.3	(54)	-10457.16	(52)	-9872.132	(54)
BIC	84434.7	21787.3	21308.23	1,949	20152.42	1,917	19672.3	
N	7,748	1,937	1,949	1,917	1,937	1,937	1,937	
Instrument: siblings attending college								

*Point estimate significant at 5 percent; **point estimate significant at 1 percent.

SOURCE: BPS: 1996/2001; NPSAS:96.

the null hypothesis of no endogeneity can be rejected so that the IV specification provides a better fit for the data than the probit specification (Wooldridge, 2002). The results for the four income groups indicate a high level of heterogeneity. For students coming from the poorest families (bottom income quartile) an additional \$100 in need-based grant in the first year significantly increases the probability of first-year persistence at first institutions by about 0.002 (probit estimate) or 0.004 (IV probit estimates), on average. The IV probit estimates have no added value over the probit estimates since the Wald test of exogeneity is insignificant (Wooldridge, 2002).⁵

However, for the model fitted to the students in the lower-middle income quartile, the IV estimate is substantially larger than the one produced by the probit specification (and the Wald test of exogeneity is found to be highly significant). For these students, each additional \$100 in first-year need-based grants significantly increases their persistence probability by about 0.009, on average. When means-tested grants are set to zero dollars, the predicted persistence probability is very low (around 0.38). Increasing aid awards to around \$1,000 adds about 0.1 to the predicted probability (to 0.48). The persistence probability of students with awards of \$3,000 and \$4,000 is predicted at 0.67 and 0.76, respectively. Clearly, for students in this income bracket, means-tested grants are critical to their ability to persist in college.

From these results it is impossible to ascertain whether the difference in the effectiveness of aid amounts between the two bottom quartiles is technical or substantive. Technically, there may be some kind of ceiling effect in the estimates of students in the bottom income quartile because, since these students have maxed out their aid provisions, there is not enough variance in the aid amounts to yield larger estimates. Moreover, the difference may derive from the fact that the marginal effect is calculated while all the variables (including aid) are set to the group's mean. Since the aid provisions for the bottom quartile were higher than those for the second quartile, the marginal effect is calculated at different locations on the aid distribution: for the bottom quartile, the marginal effect is calculated at the average amount of \$4,063, while for the second quartile, it is calculated at only \$2,722. Other characteristics differ as well. The average second quartile student was more likely to be white, take AP courses, and have a higher test score and college-educated parents than the average low-income student. Hence, the estimates are calculated at different points in the distribution, which may explain the intergroup differences.

These dissimilarities are pivotal, though, because they can determine how the group is able to transform aid into persistence. It is therefore possible that each dollar invested in the education of lower-middle income quartile students can yield higher returns, in terms of persistence and human capital acquisition, than a dollar invested in their poorer, less academically prepared

⁵Although the IV probit estimates are still consistent, they have larger standard errors and, as a result, do not reach statistical significance.

TABLE 5

Marginal Effects of Each Additional \$100 Need Grants Received in the First Year on Various Persistence Outcomes

Income Quartile	1 Lowest	2 Lower Middle	3 Upper Middle	4 Highest
<i>Dep. Var.: First-Yr. Persistence—Any Inst.</i>				
Probit	0.001**	0.000	0.000	0.000
IV probit	0.003	0.008**	0.003	-0.002
<i>Dep. Var.: Second-Yr. Persistence—Any Inst.</i>				
Probit	0.001**	0.001**	0.001**	0.001
IV probit	0.007**	0.010**	0.004	0.002
<i>Dep. Var.: 6-Yr. Graduation</i>				
Probit	0.001*	0.002**	0.001*	0.001
IV probit	0.006*	0.010**	0.007	-0.001
N	1,937	1,949	1,917	1,937
Instrument: siblings attending college				
Wald test of exogeneity is significant only in the specification fitted to lower-middle-income students.				

*Point estimate significant at 5 percent; **point estimate significant at 1 percent.

SOURCE: BPS: 1996/2001; NPSAS:96.

peers. In this case, the intergroup variation in the magnitude of the estimates is more than a statistical artifact. Aid prevents students from both bottom income quartiles from dropping out of college, but the persistence of students who are on the margin of being eligible for need-based aid (i.e., those in the lower-middle income quartile) is the most sensitive to aid increments.

This is not the case for students in the top two quartiles. The influence of aid on the first-year persistence of students in the upper-middle income strata is marginal (0.001–0.003), while the persistence of students in the top quartile is completely insensitive to the amount of aid received.⁶ These grants may influence the college choice decisions of affluent students, but they have no bearing on whether they enroll in the second year. I replicate the IV specification with additional persistence outcomes. The results for first- and second-year persistence from any institution and six-year graduation, reported in Table 5, support the conclusions for first-year-first-institution persistence. Notably, the estimates produced for the two outcomes for first-year persistence (at both the first and at any school) are in the same ballpark—an imperative finding that expands the generalizability of prior estimates based on data from one institution. By facilitating the transition from the first to the second year, grant aid received in the first year of college boosts the chances of a timely graduation for low-income students: the growth in the probability is 0.006 and 0.010 for the bottom and

⁶For these groups, both probit and IV estimates are similar (the Wald test is insignificant).

second-to-bottom quartiles, respectively. Presumably, the cumulative effect of aid throughout the college year is even larger.⁷ Students in the upper-middle quartile also benefit from aid, although their gains are smaller than those of their peers in the lower-middle quartile. Yet, the persistence in college and degree attainment of upper-class students is impervious to the aid they receive.

A Redistribution of Funds

From the perspective of persistence in college (as opposed to that of college enrollment/choice), these findings suggest that the aid granted to affluent students is a waste of resources. This broaches the issue of a redistribution of funds. The data in Table 2 indicate that the share of total need-based funds allocated to the highest income group is about 8 percent of the total need-based grants budget, each student in the top quartile receiving \$585, on average.⁸ The most pertinent counterfactual question is how much higher would the first-year persistence rate of lower-middle-income students (second quartile) have been if the need-based dollars given to the most affluent students had been reallocated to the former. The results of the simulation, based on the IV estimates of Table 4, are presented in Figure 1 according to the level of students' current aid provisions.

The nonlinearity of the model implies that the effect of a change in the dollar amounts depends on the level of the current amount of aid provisions. The predicted persistence probability of students with meager aid provisions is very low; yet, additional aid is expected to have the largest impact on their persistence. For the average student in the lower-middle-income quartile who is currently receiving \$1,000, the predicted growth in the first-year persistence probability as a result of such a redistribution is 0.06, which is an upsurge of 13 percentage points. The expected growth is 0.052 for students whose current allocation is \$3,000, and 0.035 for students who receive \$5,000 (increases of 8 and 4 percentage points, respectively). The average predicted growth for the average (on all characteristics, including the amount of aid) lower-middle quartile student is 0.046.

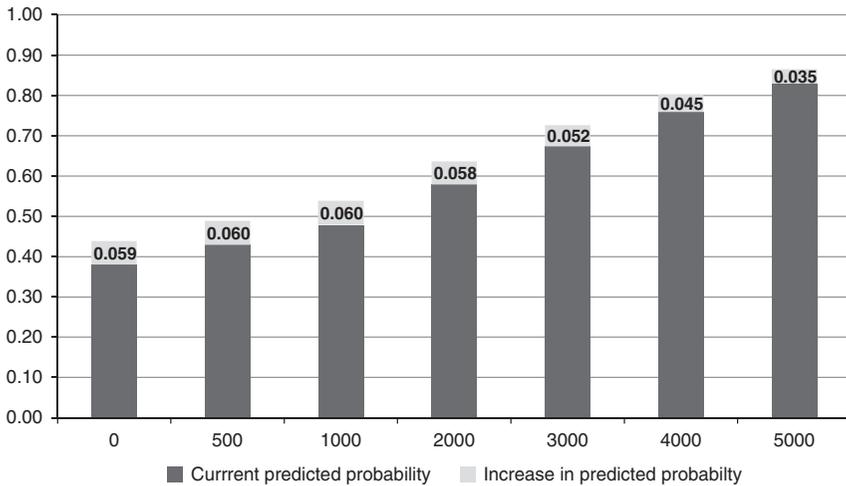
The supplementary funds can be used to inflate the provisions of current recipients, to expand the share of recipients, or to do both. A smart allocation can raise the first-year persistence level of lower-middle-income quartile students and eventually moderate the persistence gap. Given that the persistence gap between students in the second and fourth quartiles is 0.05 percentage points (see Table 1), this simulation suggests that if the need-based funds that entice affluent students to rich schools had been

⁷This cannot be tested directly with the data at hand because information on need-based aid is available only for the first year.

⁸Twenty percent of these students received need aid, and the average grant was \$3,051.

FIGURE 1

The Growth in the Probability of First-Year Persistence Due to a Redistribution of Funds: Lowest-Middle-Income Quartile Students



diverted to augment the aid for low-middle-income students, the gap in first-year persistence would have been eliminated. This bolsters the conclusion of the Advisory Committee on Student Financial Assistance (2010) that if grant aid from all sources—federal, state, and institutional—had been adequate to offset college expenses for financially constrained students, the economic gap in enrollment and persistence rates would not have existed.

Conclusion

Any attempt to raise the share of college educated individuals in the United States must begin with the population in which bachelor's degree attainment rates are especially low: high school graduates from the bottom half of the income distribution. An effective strategy has to be multifaceted, and must improve prior academic preparation, access to higher education (enrollment), and persistence in college. Considering these options, the Advisory Committee on Student Financial Assistance (2010) brings forth evidence that shows that all three solutions elevate the bachelor's attainment rates of qualified low- and moderate-income high school graduates, but the most effective sole solution is the one that deals with college persistence.

The findings marshaled in this investigation demonstrate that need-based grants are a potentially effective instrument for raising the college persistence rates of economically disadvantaged students to the level of their affluent

peers. The results refine the emerging scholarship on the causal effect of need-based grants on persistence in college by showing that the benefits, in terms of persistence, are not equally distributed in the student population. Low- and middle-income students gain immensely from receiving need-based grants, while upper-class students do not need aid in order to stay in college. Increasing the grant allocations to students in the bottom half of the income distribution can boost the share of college graduates among them, and narrow the persistence gap between them and their more affluent classmates. Hence, a more appropriate distribution of aid funds can facilitate the production of human capital among low-income students, increase the share of bachelor's degree recipients in the general U.S. population, and curb the reproduction of economic inequality.

The pending question is how to achieve these goals. The simple answer is to create greater differentiation in the provision of funds: reduce, or even eliminate, the financial awards, both need and merit based, allocated to affluent students and use these funds instead to augment the grants for low-income students. This can be achieved if nonfederal sources of aid, namely, those from states and postsecondary institutions, follow the means-tested Pell formula more closely. This is in accordance with the recommendation of the Advisory Committee on Student Financial Assistance (2010:5) that "federal policy must seek to ensure that states and public colleges hold Pell Grant recipients harmless against increases in cost of attendance, through increases in state and institutional need-based grant aid." Alas, this is easy to do in simulations but rather difficult to implement in real life, especially given the recent trends in financial aid policy. Certainly, similar outcomes can be achieved by *increasing* the size of Pell grants, since its formula for aid allocation is right on target: it distributes federal funds to the population that benefits from aid the most. Unfortunately, using federal resources to supplant students' unmet needs will put a huge financial burden on public resources because Pell grants are just a small component of the current packaging of need-based grants. A profound change, therefore, cannot circumvent the need for a shift in the priorities and aid allocation mechanisms of states and institutions with big endowments. To boost degree attainment and achieve equality of educational opportunity, any surge in the budget of the Pell program must be accompanied by stricter means-tested allocations of nonfederal funds.

The investment in financial aid in the United States is vast—in 2008–2009 alone a total of \$168 billion was allocated to finance students' postsecondary expenses (College Board, 2009b). This investment in financial aid is all the more impressive given the fact that the United States still lacks a comprehensive national welfare system and has not established national standards for most kinds of benefits (Quadagno, 1987; Skocpol and Ikenberry, 1983). This investment in student financial aid underscores a shared commitment to higher education in light of its importance to the social good of the nation. Restoring this commitment, which has been severely

deteriorating in recent decades, must encompass an updated appreciation of growing economic inequality and its serious ramifications for equality of educational opportunity.

Appendix: Characteristics of Students Attending four-Year Institutions in 1995–1996, BPS: 1996/2001; NPSAS:96

Variable	Definition	Mean/%	<i>SD</i>
Persistence first year—any institution	Transition from first to second year at first institution	0.71	
First year—first institution	Transition from first to second year at any institution	0.82	
Second year—first institution	Transition from second to third year at first institution	0.77	
Graduation status	6-year graduation proportion	0.62	
Financial aid 1st year (1995–96)	\$ total Pell Grant	402	(792.14)
	\$ total need grants	1,932	(3376.11)
	\$ total merit grants	737	(2035.02)
Parental income	Parents' income in 1994 reported on the FAFSA for dependent students; if not available, then parents income earned from work and parents' untaxed income from the FAFSA were used; if not available, parent-reported income or the sum of parents' income was used; approximately 35 percent imputed		
1—Lowest income	Range (\$) 0–28,285	15,100	(8,295.02)
2—Lower-middle income	28,290–50,000	40,049	(6,297.83)
3—Upper-middle income	50,003–76,136	62,570	(7,520.89)
4—Highest income	76,155–1,000,000	122,940	(69,920.75)

Variable	Definition	Mean/%	SD
Institution selectivity level	Test scores of incoming freshmen 1995–96		
Tier 4	Median 840	0.74	
Tier 3	Median 1,040	0.12	
Tier 2	Median 1,100	0.08	
Tier 1	Median 1,240	0.06	
Institution sector	Public/private institution	0.64	
Race/ethnicity			
White		0.71	
Black, not of Hispanic origin		0.10	
Hispanic, regardless of race		0.11	
Asian/Pacific Islander		0.07	
Other, including American Indian/Alaska Native		0.01	
Sex	Female = 1, male = 0	0.55	
HS GPA	HS cumulative grade point average in high school: 1–7 scale	4.54	(2.78)
Test scores	Derived SAT/ACT combined score	914	(239.24)
# AP courses	# of AP courses taken in HS	0.52	(1.15)
EFC	Expected family contribution; a composite measure of student's financial ability to bear the college costs, including income, wealth, and other financial resources, as well as family structure; for students not filling the FAFSA the NCES imputed EFC based on family size, income, assets, and number of siblings in college	9,394	(11,974.28)

Variable	Definition	Mean/%	<i>SD</i>
Parents highest education	Classified in descending order		
Post BA degree	A dummy variable indicating at least one parent with a post-BA degree	0.23	
BA degree	A dummy variable indicating a parent with the highest education has a BA degree	0.25	
Some college education	A dummy variable indicating a parent with the highest education has some college education	0.16	
HS degree or less	A dummy variable indicating both parents with a HS diploma or less	0.36	
Parents marital status	1 = married; 0 = otherwise	0.63	
Family size	Family size	4.09	(1.26)
Region	Geographic region: percent in South	0.29	
HS	socioeconomic status	1 = poor	student body: 25% eligible for free lunch; 0 = otherwise
0.12			
Degree expected: BA	The highest level of education student ever expect to complete: BA or higher	0.76	
# Institutions applied to	Number of postsecondary institution applied to before college	0.26	(0.44)
Major in 2001	Dummies for humanities, social, life sciences, physical/math, engineering/computer science, business, vocational/technical/professional		
	A dummy variable indicating whether siblings were attending	0.28	

Variable	Definition	Mean/%	SD
Siblings attending college	college between July 1, 1995 and June 30, 1996		

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