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College Financing Choices and Academic Performance

The rapid increase in student loan debt outstanding has garnered significant media and policy attention over the past several years. In contrast, little is known about the short-term academic consequences of borrowing to finance college attendance. We use detailed student-level administrative data to examine the relationship between the type and amount of student loans used to pay for college and students' academic performance, choice of major, and retention rates. The results suggest that students who take out loans have lower grade point averages (GPAs) than students who do not. Among students with debt, those with greater student loan balances have lower GPAs, take fewer credits per semester, and have lower retention rates. This is true conditioning on detailed background characteristics as well as in individual fixed effect specifications that control for unobserved time-constant characteristics of students. These results can help inform policies to mitigate the adverse effects of increasing education debt.

Over the past decade, the rising cost of postsecondary education in the United States has led to increases in both the incidence and amount of student loan debt at graduation. In 2006, 59% of graduating seniors had some amount of student loan debt, with an average balance of $19,000. By 2013, loan debt was held by 69% of graduating and the average balance had increased to $28,400 (TICAS 2014). Student loan debt has also increased in the broader population: From 2004 to 2014 the number of individuals of all ages with student loan debt increased by 89% and the average amount of debt increased by 77% to $26,000 (Haughwout et al. 2015). As a result of this growth, the total amount of student loan debt outstanding reached $1.16 trillion in the fourth quarter of 2014 (FRB 2015; FRBNY 2015).

Despite the substantial rise in student loan debt, until recently the literature has primarily focused on the credit constraints associated with student loan borrowing (Cameron and Taber 2004; Carneiro and Heckman 2002; Keane and Wolpin 2001). However, as the ever-growing student

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loan debt balances have attracted the attention of policy makers, a nascent literature on the negative consequences of student loan debt for later life economic and social outcomes has begun to emerge (Brown et al. 2013; Dettling and Hsu 2014).

One area of research that has yet to receive any attention is the effect of student loan borrowing on academic outcomes. This is due to the limited availability of high-quality data on the amount and type of student borrowing, as well as any linkage of that information to outcomes like college major, grade point average (GPA), and college completion. The majority of previous work on the effect of student loan debt on academic outcomes employs aggregate data rather than individual data, and a 2014 report by the New America Foundation highlights the lack of student-level data at the federal level and the need for such data to facilitate research. One exception to the use of aggregate data is Rothstein and Rouse (2011), who use individual-level data for one university to show that students who earn scholarships are more likely to choose careers in the public sector upon graduation than comparable students with loans and no scholarships. However, little comparable work exists for other academic outcomes. Recent work using university institutional data has examined how Science, Technology, Engineering, and Mathematics (STEM) field choices (especially for minority students) are affected by academic preparation (Arcidiacono, Aucejo, and Holtz 2015), but currently no research examines whether financial constraints may be an equally important contributor to STEM field choice. One exception is Schmeiser, Stoddard, and Urban (2016), who find that an intervention aimed at high loan amount students increased the probability that students switched to more lucrative majors.

This study uses a unique administrative dataset on students of the Montana State University System that contains detailed information from secondary school through college. We use these data to determine whether the type and amount of loans used is related to academic performance, choice of major, and retention rates among those who borrow to finance their educations.

We find strong and consistent relationships between borrowing decisions, nonloan aid, and various measures of academic performance. After controlling for academic ability (ACT), background characteristics, and detailed student ZIP code–level demographic characteristics, we consistently find that nonloan aid is associated with positive academic outcomes: higher GPAs, enrollment in more credits, a greater probability of majoring in a STEM field, and being more likely to be retained in the next year.

The effects of loan aid are more nuanced. GPAs are generally lower for students who take out loans and among borrowers who take out larger

loans. However, when individual-level fixed effects are included in the model, students who transition from having no student loans in some semesters to having a student loan during other semesters have higher GPAs in the semester when they borrow. In contrast, students who decrease the size of their loan have higher GPAs in those semesters. Students with loans enroll in more credits, an effect that appears in both regressions with and without individual fixed effects. However, the students with larger loans tend to complete fewer credits than the students with smaller loans. These findings suggest that having access to student loan debt can allow students to take on additional credits, but as the amount of debt increases students begin to see detrimental effects on academic performance.

BACKGROUND

College students have a plethora of options in financing their postsecondary educations, including federally subsidized loans, private loans, grants, scholarships, and personal savings. The federal government provides subsidized and unsubsidized Stafford loans that allow dependent college freshmen to borrow up to $9,000 ($5,500 subsidized, $3,500 unsubsidized) annually. These amounts increase to $11,000 and $13,000 for sophomores and for those in their junior year and beyond, respectively.[1] These amounts are also higher for independent students. In addition, students from low-income families may be eligible for Pell grants. The maximum amount for 2016–2017 is $5,815, and there is no requirement to repay these funds. Formally, Pell grants are determined by calculating a household's expected family contribution (EFC), though most households that make under $30,000 per year annually are eligible. Marx and Turner (forthcoming) show that Pell grants can crowd out federal student loans, where each dollar in Pell aid reduces loans by $1.80. Perkins Loans are another potential federal loan available for students with substantial financial needs, where students can borrow up to $5,500 per year in addition to receiving other forms of federal loan and nonloan aid. However, these loans are administered through colleges and universities and are limited in supply, so not all those who qualify can obtain a Perkins Loan.

In addition to federal loans and grants, students from households with good credit can apply for private loans. While students themselves are less likely to have a strong enough credit file or enough assets to borrow on their own, parents can cosign and obtain private student loans. This

1. See the Federal Student Aid Office of the US Department of Education for more information on student aid financing options (https://studentaid.ed.gov/sa/types).

process is less common: private loans comprised roughly 7% of student loan originations in 2012 (CFPB 2012). Students can also obtain federal Parent PLUS loans, which again must be cosigned by a parent.[2] More affluent families may be able to finance the cost of college out of pocket through savings.

Finally, colleges, states, communities, and private donors offer a wide array of scholarships and grants for students of a variety of backgrounds and abilities. These can consist of merit aid, need-based scholarships, academic scholarships, athletic scholarships, or even specific scholarships from private groups, such as a $1,000 scholarship for college freshmen above average height (5′10″ for women and 6′2″ for men) from the Tall Clubs International. Some of these scholarships require upfront search costs for the applicant to identify scholarships for which he or she will be competitive. Others are more mechanical in nature: 250 students graduating from high schools in Montana near the top of their class and with high ACT scores are offered scholarships to attend Montana public universities of their choosing. Students need not apply for these scholarships.

THEORY AND HYPOTHESES

How might student loans affect performance in college? Based on the literature on financing of secondary schooling, it is not clear a priori what effects might be observed, as there are many mechanisms through which individuals can finance their postsecondary education. Furthermore, students frequently use multiple methods of financing. For example, the effects of loan aid and nonloan aid are likely to differ, though students may have both.

Non-loan aid has been more heavily researched than loan aid. First, nonloan aid is significantly associated with higher probabilities of enrollment in college (Deming and Dynarski 2009; Castleman and Long 2016) and with higher rates of college completion (Bettinger et al. 2012; Goldrick-Rab et al. 2012). Somewhat surprisingly, there is little research to date on how nonloan aid is related to performance during college in terms of GPAs, majors, or credits.

Student loans might affect student performance in college through several potential channels. It could be that students with more aggressive loan packages focus more time and energy on school in hopes of higher lifetime earnings with which to repay their debt. This hypothesis is consistent with Stinebrickner and Stinebrickner (2003), who show that an additional hour

2. In our sample, 7% of students have Parent PLUS loans.

of work-study negatively affects grade performance. In this case, we might expect greater student loan amounts to be associated with higher GPAs, as they give students the flexibility to focus more time on studies and less time on work.

Avery and Turner (2012) point out that students pursuing majors with higher expected lifetime earnings may have greater loan amounts. We thus posit that STEM majors, who anticipate greater wages, may be associated with higher loan amounts. This is consistent with Rothstein and Rouse (2011) who find that students randomly assigned full scholarships were more likely to enter public sector jobs (associated with lower pay) than observationally similar students who relied on loans to finance their education. Greater loan amounts might also increase retention rates if students perceive that they need the higher future salaries resulting from college completion to repay debts.

Loans and nonloan aid may also lead to higher performance in college if students are aware of the academic requirements that need to be met in order to maintain eligibility for loans and grants. For example, both Pell grants and federal Stafford loans require students to make "satisfactory academic progress" which is based on minimal GPA requirements (2.0 for undergraduates), credit requirements (12 credits per semester), and pace requirements (passing at least two thirds of all courses attempted). Schudde and Scott-Clayton (2014) find that failure to meet these requirements has a negative effect on persistence, but it is not clear from previous research whether these requirements lead to overall average increases in academic performance during enrolled periods and whether the academic effects are different for loan aid and nonloan aid.

Consistent with the empirical finding from Mani et al. (2013) that preoccupation with finances inhibits cognitive function, greater amounts of student loan debt may also impose an emotional burden on students as they contemplate their ability to repay their loans. This may result in stress or feeling an obligation to work while in college (outside of work study) that may be detrimental to academic performance, lowering GPAs and reducing credits per semester. These adverse effects of debt might be especially substantial if the student's self-assessed probability of completing college is low. Students might also be more likely to pursue higher earning majors after taking on high loan amounts as a strategy to repay the loans in the future. This could yield a poor match of student ability to major and thus poor academic performance. Since these effects are ambiguous, we take the question of the effect of student loan debt on outcomes to the detailed data described below.

DATA AND METHODS

Data Description

The data for this project are administrative panel data from the Montana University System (MUS). These data include students' high school information, demographic information, the Montana postsecondary campus attended, and the degree pursued. The MUS data are novel for the detailed individual-level college funding information. These data identify the source of funds (federal, institutional, state, etc.), the type and amount of award (need-based, merit-based, athletic payments, work study, loans, etc.), and the fraction of tuition covered by the loans. Our data do not include private loans. These data also include semester-by-semester enrollment, credits, major, GPA, and courses taken. To our knowledge, we are the first researchers to use individual student loan data to examine the effect of student debt on postsecondary educational outcomes.

For this analysis, we restrict our attention to the two largest four-year institutions in Montana, where data quality is highest. Montana State University and the University of Montana are roughly comparable to many public institutions throughout the United States. Student enrollment levels are similar across the two campuses, with enrollment of about 13,000 undergraduate students at Montana State University and about 15,000 undergraduates at the University of Montana. These enrollment numbers are roughly comparable to the average enrollment at public-four year universities in the United States of about 11,000 students. About 60% of students at both universities come from Montana. Although tuition rates at these universities are below the national average, they are comparable as a fraction of state median household income. Financial decisions are also similar at the two schools and approximate national averages. At Montana State, 65% of students graduate with debt; at the University of Montana 62% have student loans. This compares to a national average of 69% of college graduates with student loans. In 2013, the average graduate of Montana State University had about $27,000 in debt. This is slightly less than the average debt at the University of Montana ($30,000) and the national average of $28,400.[3] The supply of aid is comparable across universities, with options to finance college through federal aid, state aid, and merit or school-based aid, i.e., consistent throughout the MUS. The only differences would come from scholarships in specific programs (e.g., there will be more STEM-based scholarships associated

3. The Project on Student Debt (2014), *Student Debt and the Class of 2013*. Institute for College Access and Success. Report accessed on May 14, 2015 at http://ticas.org/posd/home.

with those attending Montana State University, as there are more STEM majors offered there).

The data span 2002 through 2012,[4] or 36 semesters, and follow 97,084 students with loans for at least some portion of their time in college. Our final sample includes 322,759 student-semester observations with full coverage across all variables, and 438,753 who have all variables except for ACT scores. (Some specifications focus only on borrowers; there are 159,064 borrowers with all data and 229,685 who have all data except ACT scores.) We limit our analysis to in-state students, to abstract from tuition and loan differences due to the choice of an out-of-state institution. However, we are able to examine both the effects of loans and the amount of tuition covered by loans as tuition charges at the University of Montana and Montana State typically vary from year to year, with a current difference between campuses of about 15%.

To further control for socioeconomic status, we gather demographic characteristics of a student's ZIP code of origin from the American Community Survey and the 2010 US Census. These include ZIP code median income, percent nonwhite, the distribution of educational attainment (percent of adults without a high school diploma, percent with only a high school degree, percent with some college, percent with a Bachelor's degree or higher), population density, and an indicator for whether the population is above 25,000 individuals.

Table 1 reports summary statistics on the loan, demographic, and academic characteristics of the students we study. Appendix 1 disaggregates the summary statistics across the two campuses to show that these characteristics are similar. Of these students, 53% take out a federal loan, with an average loan amount of $4,200 that covers about 94% of tuition charges. On average, students receive approximately $1,280 in nonloan aid, such as merit or athletic scholarships, work-study payments, and other school specific scholarships or grants. Approximately one in every three students is a Pell grant recipient; this compares with about 38% of students nationally who receive Pell grants at four-year degree-granting institutions.[5]

On average, students take 12.2 credits per semester. The average number of semesters completed is 4.4, suggesting the average standing is a second semester sophomore. However, the average number of

4. Since there was an intervention at Montana State University regarding debt amounts and academics, we restrict the data to end in 2012, though it continues through 2014. See Schmeiser, Stoddard, and Urban (2016) for more on this policy.

5. Based on author calculations from 2011 to 2012 National Postsecondary Student Aid Study (NPSAS:12).

TABLE 1
Summary Statistics

	Observations	Mean	Std. dev.
Academic characteristics			
Institutional GPA	438,753	2.89	0.75
Semester GPA	438,753	2.82	1.06
Institutional credits	438,753	58.49	39.57
Semester credits	438,753	12.22	4.64
STEM major	438,753	0.45	0.50
Number of semesters	438,753	4.39	3.07
Loan characteristics			
Have loan	438,753	0.53	0.50
Amount of aid not from loans ($000s)	438,753	1.28	1.88
Loan amount for borrowers ($000s)	230,648	4.04	2.46
Loan/tuition ratio for borrowers	230,648	0.94	0.15
Student characteristics			
White	438,753	0.87	0.33
Male	438,753	0.50	0.50
Pell	438,753	0.33	0.47
ACT score	322,759	23.35	4.03
Zip code characteristics			
% No HS education	438,753	5.93	3.48
% HS only	438,753	22.74	7.76
% Some college	438,753	30.57	3.89
% Nonwhite	438,753	7.70	7.78
Urban area	438,753	0.82	0.38
Population density	438,753	1,372.33	2,286.74
Observations (unique students)	97,084		
Observations (student-semester)	438,753		

cumulative credits, 58.5, is significantly lower than one would expect from a first semester senior. Approximately 45% of students declare a STEM major at these two universities. This number may seem high at first glance, but given that Montana State is a land grant university with many agriculture-based majors and a large school of engineering, this is not surprising.

Methods

How are borrowing behaviors related to academic choices and outcomes? We use the MUS individual-level panel data to understand how loan composition affects a student's performance in college, measured by the student's GPA, semester credits, their choice of major (STEM vs. non-STEM), and retention. All of these models control for ACT scores as a

proxy for students' academic abilities.[6] (We convert the scores of students who took the Scholastic Assessment Test (SAT) to American College Test (ACT) units for ease of comparison.)

Family income is likely to influence both borrowing behavior and academic choices. The best measure we have for income is the student's Pell grant status, with Pell grants received by about a third of our sample. Students eligible for Pell grants tend to come from lower income families or to be economically independent. However, we also include ZIP code median income, percent nonwhite, the distribution of educational attainment (percent of adults without a high school diploma, percent with only a high school degree, percent with some college, percent with a bachelor's degree or higher), population density, and an indicator for whether the population is above 25,000 individuals. We also control for student level attributes: race, gender, the number of credits accumulated prior to that semester, the number of semesters the student has completed (i.e., their standing in school), a campus dummy,[7] and dummies for semester (Fall, Spring, or Summer). Specifications also include year fixed effects. Equation 1 summarizes the basic form of the specifications:

$$\begin{aligned} Y_{\{i,t\}} = {} & \alpha_0 + \alpha_1 X_{\{i,t\}} + \alpha_2 White_i + \alpha_3 Male_i + \alpha_4 Pell_{\{i,t\}} + \alpha_5 Credits_{\{i,t\}} \\ & + \alpha_6 Semesters_{\{i,t\}} + \alpha_7 ACT_i + \alpha_8 ZipChars_i + \delta_{\{year\}} + \beta_{\{semeter\}} \\ & + \gamma_{\{campus\}} + \varepsilon_{\{i,t\}}. \end{aligned} \tag{1}$$

The specifications examine several independent variables of interest (depicted by $X_{\{i,t\}}$). The first set of analysis looks at a dummy for whether or not the student received a loan in the given semester to look at differences among borrowers and nonborrowers. The second set of regressions examine the impact of the total amount of nonloan aid the student received, including merit-based scholarships, athletic scholarships, grants, work-study aid, and other nonloan aid. Several studies have found that greater amounts of nonloan aid are associated with higher rates of college attendance, retention, graduation, and career choice (Waddell and Singell Jr 2011; Dynarski 2003; DesJardins and McCall 2007; Castleman and Long 2016; Minicozzi 2005). Finally, we restrict the sample to students who borrow to finance their education and use the ratio of loans to tuition charges to examine the effects of the intensive margin. Outcome variables

6. We convert SAT scores to ACT scores. We also run specifications with and without ACT score, since this variable is missing for 20% of the sample. The results remain largely unchanged.

7. Specifically, we include a dummy for whether or not the campus was Montana State University, where the University of Montana is the excluded group.

($Y_{\{i,t\}}$) are alternately semester or cumulative GPA, the number of credits taken in a given semester, choice of a STEM major, and retention in the following semester or the following year. All standard errors are clustered at the individual student level. This is to account for the fact that errors for an individual are likely correlated over time; clustering produces more conservative standard error measures. We estimate these regressions for the full sample of students as well as for first-year freshmen, for women, for nonwhite students, and for Pell grant recipients.[8]

Even with this rich set of individual controls, it may be the case that students who take out loans, or those with greater loan amounts, differ in unobserved ways from students who do not borrow or who borrow less. These unobserved characteristics may be correlated with academic choices. To allow for this possibility, we also estimate individual fixed effect regressions that control for any time invariant characteristics of the student that may be correlated with academic outcomes. However, because retention is a one-time decision and major choices do not vary much from semester to semester, only semester GPA and semester credit hours can be analyzed in this individual fixed effect regression framework. In our first specification, we rely on a sample of students who had loans in at least one semester and did not have loans for another semester. In our second specification, the fixed effects approach requires that students have variation in the amount of loan aid (or nonloan aid) across semesters. Students that only appear for one semester or appear for multiple semesters but experience no changes in their loan or nonloan aid will not contribute to the fixed effects samples.

RESULTS

The results for semester GPAs are reported in Table 2. On average, students with loans have approximately 0.05 point lower GPAs than students without loans. This effect is slightly smaller than the effect of a one-point decrease in a student's ACT score (scores range from 0 to 36 points). There are also significant effects along the intensive margin: a 10 percentage point increase in the ratio of loans to tuition reduces GPA by about .08 points (column (3)).[9] Results are roughly consistent for subcategories of subsidized and unsubsidized loans. However, the effect of

8. In Appendix 2 we show that if we control for loan aid or having a loan in the regressions where we are most interested in non-loan aid (and vice versa), our results remain consistent.

9. Dividing by tuition allows us to control for changes in tuition across campuses over time.

TABLE 2
Student Loans and Student Average GPAs

	Dependent variable = student semester GPA					
	Pooled cross sections			Individual student fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Loan dummy	−0.047***	—	—	0.104***	—	—
	(0.005)			(0.006)		
Amount aid not loans	—	0.049***	—	—	0.014***	—
		(0.001)			(0.001)	
Loan/tuition (if have loans)	—	—	−0.771***	—	—	−0.370***
			(0.015)			(0.016)
Pell dummy	−0.000	−0.051***	−0.044***	0.054***	0.052***	0.009
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
ACT score	0.052***	0.046***	0.045***	—	—	—
	(0.001)	(0.001)	(0.001)			
White	0.110***	0.114***	0.119***	—	—	—
	(0.009)	(0.012)	(0.012)			
Male	−0.266***	−0.243***	−0.240***	—	—	—
	(0.005)	(0.007)	(0.007)			
Cumulative credits	0.013***	0.012***	0.012***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of semesters	−0.119***	−0.096***	−0.092***	—	—	—
	(0.002)	(0.003)	(0.003)			
Census controls	Yes	Yes	Yes	Yes	Yes	Yes
Campus FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Term FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual student fixed effects	No	No	No	Yes	Yes	Yes
Observations	322,759	322,759	159,064	438,753	438,753	229,685
Adjusted R^2	0.181	0.186	0.166	0.007	0.006	0.009

Notes: Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. *$p < .05$, **$p < .01$, ***$p < .001$, +$p < .10$.

other kinds of financial aid, such as merit aid, scholarships, athletic support, work-study, and grants, are starkly different: increasing the amount of nonloan aid by $1,000 *increases* the student's GPA by 0.05 points (column (2)). We also find similar results when examining the effect of student loans and financial aid on cumulative institutional GPA.

Columns (4)–(6) report the results including individual fixed effects. The total number of observations here is greater than in the previous specification, as ACT scores are missing for many students, but are excluded in

the individual fixed effect regressions as they are time invariant.[10] These fixed-effect specifications are identified by variation over a student's time in college, where in some semesters the student takes out loans and in other semesters the student does not borrow, or where the amount of loan or nonloan aid varies across semesters. These results are particularly compelling because unobserved individual background and ability are uncorrelated with the effects of loans estimated in these specifications. Column (4) shows that in semesters when a student chooses to borrow, GPAs are 0.1 points higher than in the semesters when the student forgoes loans. However, column (6) shows that for students who borrow, a 10% increase in loans relative to tuition reduces GPA by about 0.40 points. In contrast, column (5) shows that greater nonloan aid increases GPA. The results for Pell grants are consistent with this finding. While columns (1)–(3) show that students who receive Pell grants tend to have lower GPAs than students who do not, for students who receive Pell grants in some semesters but not in others, their GPAs are 0.05 points higher in the Pell aid semesters.

Student achievement appears to be related to the level of student loans, but it may be the case that students with a higher fraction of loans choose to take a different number of credits per semester or choose different types of majors. The number of credits could be lower if these students are simultaneously working an outside job (although work study payments are included as part of a student's aid package). The number of credits could also be higher if students choose higher levels of financial aid in order to devote additional time and energy to school. Table 3 reports the relationship between loans and semester credit hours. In these results, students with loans take an average of 0.22 more credits than those without loans (column (1)). Furthermore, column (4) shows that for students who do not borrow every semester, in the semesters when they take out loans, they also take on 1.3 more credits. This is also the case for additional nonloan aid: a $1,000 increase in the amount of nonloan aid increases average credits by 0.2 to 0.3 units (columns (2) and (5)). As in Table 2, while Pell grant recipients tend to take fewer credits than nonrecipients, among Pell grant recipients the semesters where they received the grants are associated with about 0.5 more semester credits. In contrast, larger levels of borrowing have a negative effect on credit accumulation. Conditional on getting a loan, a 10% increase in the amount of tuition covered by loans decreases semester credits by nearly half a credit

10. The inclusion of ACT scores does not change the basic results in columns (1)–(3).

TABLE 3
Student Loans and Semester Credits

	Dependent variable = number of semester credits					
	Pooled cross sections			Individual student fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Loan dummy	0.224***	—	—	1.269***	—	—
	(0.020)			(0.030)		
Amount aid not loans	—	0.256***	—	—	0.272***	—
		(0.006)			(0.008)	
Loan/tuition (if have loans)	—	—	−4.519***	—	—	−3.642***
			(0.062)			(0.072)
Pell dummy	−0.226***	−0.658***	−0.495***	0.617***	0.411***	0.281***
	(0.023)	(0.025)	(0.026)	(0.029)	(0.032)	(0.034)
ACT score	0.156***	0.137***	0.126***	—	—	—
	(0.003)	(0.003)	(0.004)			
White	0.368***	0.531***	0.438***	—	—	—
	(0.037)	(0.037)	(0.046)			
Male	−0.633***	−0.608***	−0.488***	—	—	—
	(0.021)	(0.021)	(0.026)			
Cumulative credits	0.074***	0.072***	0.067***	0.029***	0.030***	0.037***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of semesters	−0.816***	−0.789***	−0.639***	—	—	—
	(0.010)	(0.010)	(0.012)			
Census controls	Yes	Yes	Yes	Yes	Yes	Yes
Campus FE	Yes	Yes	Yes			
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Term FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual student fixed effects	No	No	No	Yes	Yes	Yes
Observations	322,759	322,759	159,064	438,753	438,753	229,685
Adjusted R^2	0.190	0.197	0.202	0.028	0.023	.033

Notes: Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. *$p < .05$, **$p < .01$, ***$p < .001$, +$p < .10$.

(columns (3) and (6)). This is true in both the pooled cross sections, and when comparing performance across semesters when loan amounts vary for a given student.

Taking the results of Tables 2 and 3 together implies that having access to loan aid may modestly increase the number of semester credits, but relatively larger loans decrease both performance and credit accumulation. On the other hand, nonloan aid (both federal Pell grants and other nonloan aid) increase both credits and grades.

TABLE 4
Student Loans and Choice of STEM Major

	Dependent variable = 1 if STEM major		
	(1)	(2)	(3)
Loan dummy	−0.027***	–	–
	(0.004)		
Amount aid not loans	–	0.007***	–
		(0.001)	
Loan/tuition (if have loans)	–	–	−0.064***
			(0.011)
ACT score	0.011***	0.011***	0.011***
	(0.000)	(0.000)	(0.001)
White	0.013*	0.017**	0.024**
	(0.006)	(0.006)	(0.008)
Male	0.190***	0.192***	0.192***
	(0.004)	(0.004)	(0.005)
Pell dummy	−0.021***	−0.047***	−0.023***
	(0.004)	(0.004)	(0.004)
Cumulative credits	0.001***	0.001***	0.000+
	(0.000)	(0.000)	(0.000)
Number of semesters	−0.001	−0.000	0.004**
	(0.001)	(0.001)	(0.001)
Census controls	Yes	Yes	Yes
Campus FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Term FE	Yes	Yes	Yes
Observations	322,759	322,759	159,064
Adjusted R^2	0.097	0.097	0.097

Notes: Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. *$p < .05$, **$p < .01$, ***$p < .001$, +$p < .10$.

More demanding majors may have lower grades and students may enroll in fewer credits to be successful. Lower credit accumulation and lower grades may not be indicative of less successful college careers if a student who takes out more loans is choosing to do so to pursue a more difficult major that may lead to a higher paying career. To examine this possibility, we look at how financial aid affects the choice of a STEM major. One caution in interpreting these results are that the STEM major choice is highly persistent, which makes individual fixed effect regressions unsuitable. Thus, the results in Table 4 may be partly related to unobserved individual variation.

The results in Table 4 indicate that students who take out loans are 2.7 percentage points less likely to choose a STEM major (column (1)). For students with loans, increasing the percentage of tuition covered by loans by 10 percent decreases the probability of becoming a STEM major by 0.6% (column (3)). On the other hand, $1,000 more in nonloan aid increases the probability of being a STEM major by 0.7%. To put these magnitudes in context, the gap in STEM majors incidence between nonborrowers and borrowers is roughly comparable to a 3-point decrease in ACT scores. Furthermore, the gap is larger than the difference in incidence of STEM majors between white and nonwhite students. Recent work (Arcidiacono, Aucejo, and Holtz 2015) finds that academic preparation and mismatches with university quality have significant implications for minority students' choices of STEM fields. Given the size of the differences in majors between borrowers and nonborrowers, our results suggest that financial constraints may be an equally important contributor to lower rates of STEM majors.

Our results suggest that larger loans are negatively related to student outcomes across a variety of measures. However, if students who receive loans are more likely to complete college or to complete it in a timely manner, the overall academic effect of student loans may still be positive. Table 5 reports the effects of loan amounts on enrollment in school a year later. Do students with loans or with relatively large loans persist more in their academic programs? Note that the number of observations in the table is smaller, as we exclude graduating seniors in examining persistence. As with number of credits, the results here indicate that receiving a loan is positively associated with academic progress, though the effect is small: receiving a loan increases the probability of retention by 0.1%. However, and again paralleling the results for debt accumulation, a higher amount of nonloan aid increases retention by 0.1 points.

These results indicate significant academic disparities between students who use loans to finance their education, even controlling for race, Pell grant status, and ACT scores. To see how these gaps evolve over a student's academic career and vary across specific subgroups of students, Table 6 compares the baseline results in Tables 3–5 with results restricted to only incoming freshmen. Table 6 indicates that loans tend to have more adverse effects on incoming freshmen, for whom the negative effects on GPA, credits, and retention are greater in magnitude.[11] Freshman students who take out a loan have a GPA, i.e., 0.07 point lower than those without loans and a 10% increase in loans relative to tuition decreases GPA by about

11. STEM results are not reproduced for freshmen as many have not yet declared a major.

TABLE 5
Student Loans and Retention Rates (Freshmen through Juniors)

	Dependent variable = 1 if enrolled in subsequent year		
	Freshmen through juniors		
	(1)	(2)	(3)
Loan dummy	−0.012***	—	—
	(0.002)		
Amount aid not loans	—	0.013***	—
		(0.001)	
Loan/tuition (if have loans)	—	—	−0.154***
			(0.008)
ACT score	0.006***	0.006***	0.005***
	(0.000)	(0.000)	(0.000)
White	0.022***	0.029***	0.024***
	(0.004)	(0.004)	(0.006)
Male	−0.022***	−0.020***	−0.020***
	(0.002)	(0.002)	(0.003)
Pell dummy	−0.011***	−0.043***	−0.019***
	(0.003)	(0.003)	(0.003)
Cumulative credits	0.008***	0.008***	0.008***
	(0.000)	(0.000)	(0.000)
Number of semesters	−0.068***	−0.065***	−0.063***
	(0.002)	(0.002)	(0.002)
Census controls	Yes	Yes	Yes
Campus FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Term FE	Yes	Yes	Yes
Observations	150,001	150,001	72,398
Adjusted R^2	0.227	0.229	0.216

Notes: Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. $*p < .05$, $**p < .01$, $***p < .001$, $+p < .10$.

0.1 point. In unreported regressions examining cumulative GPA, we find that these effects of loans on GPA compound as students move through their academic career. Although freshmen with loans on average have about the same number of credits as those without loans, those with larger loans enroll in fewer credits than those with smaller loans; a 10 percentage point increase in the ratio of loans to tuition is associate with a reduction of about half a credit. Freshmen with loans are also 3% less likely to return the following school year. Larger loans also reduce retention: among students

TABLE 6
Student Loans and Outcomes among First Semester Freshmen

	(1) Semester GPA	(2) Semester credits	(3) Enrolled next year
Loan dummy	−0.070***	0.018	−0.028***
	(0.009)	(0.039)	(0.004)
	(*n* = 51,146)	(*n* = 51,146)	(*n* = 46,520)
Loan/tuition (if have loans)	−1.003***	−5.206***	−0.216***
	(0.028)	(0.118)	(0.015)
	(*n* = 24,403)	(*n* = 24,403)	(*n* = 22,124)

Notes: Each cell represents results from a separate regression. Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. *$p < .05$, **$p < .01$, ***$p < .001$, +$p < .10$.

with loans, those whose ratio of loans to tuition is 10 percentage points greater are 2% less likely to return.

IMPLICATIONS AND CONCLUSIONS

By taking advantage of a unique administrative panel dataset with a wealth of details on student loan debt, academic outcomes, and postgraduation earnings, we provide novel insights into the effect of student loan debt and financial aid on student outcomes. Overall, our results suggest that student loan debt adversely affects academic performance and college completion. This is particularly clear when comparing their effects to nonloan forms of aid. The adverse effects of student debt appear to be especially pronounced among freshmen, with student debt reducing GPA, number of credits, and reenrollment. In certain instances, *take up* of student loans appears to enable students to take additional credits and increase their GPA, likely by allowing them to focus on their studies, but in all cases, larger loan *levels* are associated with more adverse academic outcomes than lower levels of borrowing.

Our findings provide evidence that the ever-increasing amounts of student debt undergraduates are accumulating is likely to adversely affect their academic performance. The finding that students who take on loans and accumulate more debt are more likely to drop out of school is particularly concerning, as these students will need to meet their loan obligations without earning the higher salaries that result from a college degree. These results suggest that reducing the need for students to

borrow, as well as the amount of debt they accumulate, could yield social benefits.

These findings speak to ongoing policy debate, indicating that grants and scholarships have positive impacts on enrollment in college (Deming and Dynarski 2009; Castleman and Long 2016) and college completion (Bettinger et al. 2012; Goldrick-Rab et al. 2012). Our results extend the list of positive academic outcomes: larger amounts of nonloan aid are associated with higher GPAs, more credits, and a greater probability of a STEM major. Even though Pell grants are used by lower income students who on average have lower academic performance, after controlling for student heterogeneity using student fixed effects, Pell grants are also associated with these positive academic outcomes. These findings suggest continued attention to the effects of the decline in state support for higher education and the increased reliance on loans as a substitute. The findings of the contemporaneous academic effects of loans also suggest that ex-post loan forgiveness policies, while they may have benefits on other economic outcomes, may not fully mitigate the adverse effects of an over-reliance on borrowing.

The results also come at a moment of heightened attention to financial aid in college and efforts to improve the quality of student decisions. For example, the Department of Education is implementing the first randomized control trial of student loan counseling across college campuses.[12] Student loan counseling may be a policy lever through which students can learn more about their opportunities for financing postsecondary education and this program may encourage persistence among borrowers. If counseling increases the probability of students receiving nonloan aid, our results suggest that counseling could simultaneously improve academic outcomes for students. Finally, work by Castleman and Page (2016) finds that nudging students to reapply for financial aid with text message reminders increases applications. To the extent that these reminders allow students to have more options for financing their educations through nonloan aid, the findings of this paper imply that these efforts may also lead students to improve their academic performance. In the event that stress or an increased cognitive loan due to student loans are mechanisms that inhibit students' college performance, interventions should consider adding a financial coaching component to help students manage the many simultaneous challenges they face.

12. See https://www.ed.gov/news/press-releases/us-department-education-announces-loan-counseling-experiment-and-new-college-completion-toolkit for more on this program.

We caution readers that the results in this paper are a case study of two public universities within one state. Ideally, future research will test these findings in other settings, such as private colleges, community colleges, and public universities within other states. We also recognize the potential endogeneity of financial aid and academic performance. Thus, we encourage future research to design field studies that exogenously change components of student aid to determine the mechanisms through which students are affected by loan and nonloan aid.

APPENDIX 1

Summary Statistics by Campus (Standard Deviations in Parentheses)

	University of Montana	Montana State University	Total
Term GPA	2.84	2.82	2.83
	(1.10)	(1.01)	(1.06)
Credits per semester	12.22	12.14	12.18
	(4.72)	(4.58)	(4.65)
STEM major dummy	0.35	0.54	0.45
	(0.48)	(0.50)	(0.50)
Number of semesters per campus	4.32	4.47	4.40
	(3.02)	(3.11)	(3.07)
Loan dummy	0.54	0.52	0.53
	(0.50)	(0.50)	(0.50)
Amount aid not loans	1.30	1.27	1.29
	(1.86)	(2.01)	(1.88)
Loan $ conditional on loans > 0	4.00	4.08	4.04
	(2.50)	(2.41)	(2.46)
White	0.86	0.89	0.87
	(0.35)	(0.31)	(0.33)
Male	0.48	0.53	0.50
	(0.50)	(0.50)	(0.50)
Pell dummy	0.34	0.32	0.33
	(0.47)	(0.47)	(0.47)
ACT score	23.01	23.70	23.35
	(3.92)	(4.11)	(4.03)
% No HS education	6.66	4.81	5.72
	(1.98)	(3.56)	(3.04)
% High school only	25.03	20.61	22.78
	(4.50)	(9.20)	(7.61)
% Some college	30.98	30.15	30.56
	(2.60)	(3.61)	(3.18)
% Nonwhite	7.51	6.02	6.75
	(5.24)	(6.64)	(6.04)
Urban area	0.88	0.77	0.82
	(0.33)	(0.42)	(0.38)
Observations	215,574	223,163	438,753

APPENDIX 2

Student Loans and Student Average GPAs

	Term GPA		Term Credits		STEM Major	
	(1)	(2)	(3)	(4)	(5)	(6)
Loan dummy	−0.030***	—	0.317***	—	−0.024***	
	(0.005)		(0.020)		(0.004)	
Amount aid not loans	0.048***	0.038***	0.266***	0.233***	0.006***	0.001
	(0.001)	(0.002)	(0.006)	(0.010)	(0.001)	(0.002)
Loan/tuition (if have loans)	—	−0.728***	—	−4.252***	—	−0.063***
		(0.015)		(0.062)		(0.011)
Individual student fixed effects	No	No	No	No	No	No
Observations	322,759	159,064	322,759	159,064	322,759	159,492
Loan dummy	0.105***	—	1.275***	—	—	—
	(0.006)		(0.030)			
Amount aid not loans	0.015***	0.005*	0.275***	0.300***	—	—
	(0.001)	(0.002)	(0.008)	(0.012)		
Loan/tuition (if have loans)	—	−0.367***	—	−3.451***	—	—
		(0.016)		(0.072)		
Individual student fixed effects	Yes	Yes	Yes	Yes	—	—
Observations	438,753	230,648	438,753	230,648	—	—
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Campus controls	Yes	Yes	Yes	Yes	Yes	Yes
Campus FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Term FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors are clustered at the individual student level and are reported in parentheses. All models control for ZIP code level characteristics from the American Community Survey including percent no high school education, percent of high school education, percent some college, percent nonwhite, population density, median household income. We also control for whether or not the individual is from an MSA with over 25,000 residents, a proxy for urbanicity. *$p < .05$, **$p < .01$, ***$p < .001$, +$p < .10$.

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