

PLUS or Minus?
The Effect of Graduate School Loans on Access, Attainment, and Prices

ONLINE APPENDIX: NOT FOR PUBLICATION

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Appendix A: Additional Tables and Figures

Table A.1: Characteristics of graduate programs by cost of attendance relative to Stafford Loan limit

<i>Predicted limit increase =</i>	<i>Zero</i>		<i>Greater than zero</i>	
	(1) Pre	(2) Post	(3) Pre	(4) Post
Unique programs	253	253	85	85
Percent (0-100) entering students who are:				
API	5.7	6.0	6.1	7.2
Black	9.1	10.0	5.8	6.3
Hispanic	19.6	20.8	9.2	9.9
White	53.9	50.0	52.8	52.3
International	9.8	10.0	22.3	20.8
Men	36.8	36.7	51.9	51.7
Average loans (2018\$)				
PLUS	\$9	\$78	\$14	\$1,035
Stafford	\$4,905	\$5,874	\$5,993	\$6,058
State or private	\$175	\$224	\$745	\$254
Total	\$5,088	\$6,176	\$6,751	\$7,347
Federal loan limit (2018\$)	\$19,559	\$20,912	\$23,396	\$29,913

Notes: The sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006 (N = 2345). Pre is 2004-2006, post is 2007-2010. API = Asian or Pacific Islander.

Table A.2: Robustness of estimated effects on program enrollment and composition

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
<i>A. Binary treatment</i>							
Treat _p x Post	-8.7 (12.7)	-0.37 (0.33)	-0.52 (0.39)	0.93 (0.38)*	3.38 (1.31)*	-1.61 (1.37)	-0.05 (0.70)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
<i>B. Average COA 2004-2006</i>							
Projected limit increase (\$1k) x Post	-1.3 (1.3)	-0.05 (0.04)	-0.03 (0.04)	0.06 (0.03)+	0.34 (0.11)**	-0.13 (0.12)	0.04 (0.06)
Observations	2,366	2,366	2,366	2,366	2,366	2,366	2,366
<i>C. Predicted FTFY COA</i>							
Projected limit increase (\$1k) x Post	1.1 (1.8)	-0.39 (0.15)**	-0.11 (0.24)	0.38 (0.17)*	0.29 (0.38)	-0.18 (0.21)	-0.06 (0.25)
Observations	2,338	2,338	2,338	2,338	2,338	2,338	2,338
<i>D. Unweighted</i>							
Projected limit increase (\$1k) x Post	-1.2 (1.5)	-0.10 (0.05)+	-0.08 (0.13)	0.14 (0.05)**	0.12 (0.13)	-0.03 (0.08)	0.06 (0.08)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
<i>E. Expand post-period to 2013</i>							
Projected limit increase (\$1k) x Post	-0.8 (1.5)	-0.10 (0.05)+	0.38 (0.13)**	0.04 (0.07)	0.06 (0.14)	-0.12 (0.12)	0.01 (0.08)
Observations	3,652	3,652	3,652	3,652	3,652	3,652	3,652
<i>F. 10 student minimum</i>							
Projected limit increase (\$1k) x Post	-1 (1.2)	-0.04 (0.05)	-0.02 (0.05)	0.05 (0.04)	0.38 (0.14)**	-0.14 (0.16)	0.01 (0.07)
Observations	2,947	2,947	2,947	2,947	2,947	2,947	2,947
<i>G. Include HBCU programs</i>							
Projected limit increase (\$1k) x Post	0.5 (0.8)	-0.08 (0.05)	-0.05 (0.07)	0.03 (0.05)	0.09 (0.18)	-0.20 (0.13)	0.02 (0.14)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345

Notes: Unless otherwise noted, the sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006. Each panel contains point estimates from separate regressions of first-year enrollment or percentage of entering students (0-100) with the given demographic characteristic on an interaction between post-Grad PLUS entry cohort and treatment. All specifications also include entry cohort and program fixed effects. In Panels D through I, the treatment is the projected federal loan limit increase based on the program's 2006 average cost of attendance (COA). In Panel A, the treatment is an indicator for whether the program had a 2006 COA above the Stafford Loan limit. In Panel B, the treatment is the projected limit increase based on the average COA for the program between 2004 and 2006. In Panel C, the treatment is the projected limit increase based on the predicted COA for a full-time, full-year student in 2006. Columns (2) through (7) estimates weighted by the size of the entering cohort except where noted. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table A.3: Effect of projected and realized increases in federal loan limits on enrollment and the composition of entering graduate students, school-level estimates

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
<i>A. OLS estimates</i>							
Projected limit increase (\$1k) x Post	-2.0 (3.6)	-0.05 (0.03)+	-0.03 (0.02)	-0.002 (0.02)	0.02 (0.10)	0.12 (0.09)	-0.09 (0.04)*
<i>B. IV estimates</i>							
Federal loan limit (\$1k)	-1.7 (2.7)	-0.05 (0.02)*	-0.03 (0.02)+	-0.001 (0.02)	0.02 (0.07)	0.1 (0.08)	-0.08 (0.03)*
95% CI	[-7.0, 3.6]	[-0.08, -0.01]	[-0.06, 0.002]	[-0.03, 0.03]	[-0.13, 0.16]	[-0.05, 0.25]	[-0.14, -0.01]
<i>C. Pre-Grad PLUS mean</i>	817.8	9.5	15.5	5.6	54.3	11.7	42.5

Notes: The sample includes public and nonprofit higher education institutions with graduate student enrollment in each of the 2004 through 2010 academic years (N = 428). Panel A displays point estimates from regressions of first-year enrollment or percentage of entering students (0-100) with the given demographic characteristic on an interaction between post-Grad PLUS entry cohort and the projected federal loan limit increase in the institution (see text for details). Panel B displays point estimates from instrumental variables models in which the interaction between the projected limit increase and the indicator for post-Grad PLUS serves as the excluded instrument for the realized federal loan limit (F-stat = 348). Panel C displays dependent variable means, measured in 2004-2006. All specifications also include entry cohort and institution fixed effects. Columns (2) through (7) estimates weighted by the size of the number of entering graduate students at baseline. API = Asian or Pacific Islander. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$, + $p < 0.1$.

Table A.4: Characteristics of constrained and unconstrained borrowers by entry cohort

<i>Entry cohort =</i>	<u>Unconstrained borrowers</u>		<u>Constrained borrowers</u>	
	<i>2002-2004</i>	<i>2005-2008</i>	<i>2002-2004</i>	<i>2005-2008</i>
Demographics (measured at college entry)				
Race/ethnicity				
API	0.07	0.06	0.05	0.05
Black	0.14	0.14	0.13	0.15
Hispanic	0.19	0.21	0.14	0.15
White	0.57	0.55	0.62	0.59
Texas resident ¹	0.88	0.89	0.80	0.83
Age	27.5	27.7	28.0	28.2
Financial aid received in entry year (2018\$)				
Grants	\$1,902	\$2,395	\$1,941	\$2,863
Federal Stafford loans	\$13,684	\$13,034	\$23,242	\$22,874
Federal PLUS loans	\$32	\$107	\$12	\$1,869
Federal Perkins loans	\$307	\$218	\$224	\$180
State and private	\$319	\$412	\$2,226	\$1,765
Total loans	\$14,342	\$13,770	\$25,704	\$26,689
EFC (2018\$)	\$5,532	\$6,466	\$10,200	\$9,670
COA (2018\$)	\$22,217	\$24,291	\$32,762	\$36,371
Broad field of study ²				
Health	0.26	0.24	0.12	0.18
Education	0.20	0.22	0.14	0.15
Academic	0.17	0.16	0.17	0.12
Law	0.04	0.03	0.33	0.29
Business	0.10	0.12	0.11	0.11
Social services	0.05	0.05	0.02	0.04
Engineering	0.02	0.02	0.01	0.01
Number of students	30,506	49,146	10,655	27,647

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. API = Asian or Pacific Islander. EFC = expected family contribution. COA = cost of attendance.

1. Among those with nonmissing residency information (unconstrained pre N = 28,837, post N = 41,891; constrained pre N = 7,986, post N = 17,041).
2. Among those with nonmissing field of study at entry (unconstrained pre N = 42,445, post N = 9,116; constrained pre N = 9,116, post N = 21,551).

Table A.5: Placebo estimates

	(1) API	(2) Black	(3) Hispanic	(4) URM	(5) Age
Constrained x treated cohort	0.002	0.005	0.009	0.013	0.010
	(0.004)	(0.006)	(0.006)	(0.009)	(0.118)
Dep var mean (const, pre-period)	0.052	0.131	0.137	0.274	28.03
	(6) Male	(7) College ed parent	(8) In-state	(9) EFC	(10) Index
Constrained x treated cohort	-0.002	-0.008	0.003	-1180	-0.001
	(0.008)	(0.009)	(0.018)	(497)*	(0.001)
Dep var mean (const, pre-period)	0.471	0.648	0.815	10,200	0.804

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of the baseline characteristic indicated in the column heading on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for belonging to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. URM = underrepresented minority. EFC = expected family contribution (adjusted for inflation using CPI-U and reported in 2018\$). Index is a linear prediction from a regression of the probability of earning a graduate degree within 10 years of entry on all baseline characteristics. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$.

Table A.6: Effects of Grad PLUS on constrained students' receipt of specific degrees

Years since entry =	1	2	3	4	5	6	7	8	9	10
<i>A. Master's degree</i>										
Constrained x treated cohort	-0.005 (0.014)	0.009 (0.009)	0.003 (0.009)	0.0004 (0.009)	0.0004 (0.009)	0.001 (0.009)	0.002 (0.009)	0.001 (0.009)	0.001 (0.009)	0.0003 (0.009)
Dep var mean (const, pre-period)	0.271	0.438	0.488	0.509	0.519	0.526	0.530	0.534	0.538	0.540
<i>B. Professional degree</i>										
Constrained x treated cohort	‡	-0.006 (0.009)	0.001 (0.005)	0.004 (0.005)	0.006 (0.005)	0.006 (0.005)	0.006 (0.005)	0.006 (0.005)	0.007 (0.005)	0.007 (0.005)
Dep var mean (const, pre-period)	‡	0.239	0.285	0.293	0.296	0.298	0.299	0.300	0.301	0.301
<i>C. Doctoral degree</i>										
Constrained x treated cohort	‡	‡	‡	‡	0.0017 (0.003)	0.0038 (0.004)	0.0045 (0.005)	0.0054 (0.005)	0.0052 (0.005)	0.0043 (0.005)
Dep var mean (const, pre-period)	‡	‡	‡	‡	0.013	0.017	0.020	0.023	0.026	0.029

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of the probability of the type of degree received (indicated in the panel heading) by the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for belonging to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses.

‡ results suppressed

Table A.7: Effects of Grad PLUS on constrained students' receipt of specific degrees by field of study

Years since entry =	2	3	4	5	6	7	8	9	10
<i>A. Law degree (JD)</i>									
Constrained x treated cohort	-0.010 (0.007)	0.001 (0.004)	0.003 (0.004)	0.004 (0.004)	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)
Dep var mean (cons, pre-2005 cohorts)	0.227	0.246	0.250	0.252	0.253	0.253	0.253	0.254	0.254
<i>B. MBA</i>									
Constrained x treated cohort	-0.010 (0.014)	-0.009 (0.014)	-0.008 (0.014)	-0.008 (0.014)	-0.008 (0.014)	-0.007 (0.014)	-0.007 (0.014)	-0.007 (0.014)	-0.007 (0.014)
Dep var mean (cons, pre-2005 cohorts)	0.145	0.151	0.154	0.155	0.156	0.157	0.158	0.158	0.159
<i>C. Education master's degree</i>									
Constrained x treated cohort	0.004 (0.004)	0.003 (0.004)	0.003 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)
Dep var mean (cons, pre-2005 cohorts)	0.073	0.085	0.091	0.095	0.098	0.100	0.102	0.103	0.104
<i>D. Other health master's degree (excl. MPH and nursing)</i>									
Constrained x treated cohort	0.004 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)
Dep var mean (cons, pre-2005 cohorts)	0.031	0.035	0.036	0.036	0.037	0.037	0.037	0.037	0.037
<i>E. Accounting master's degree</i>									
Constrained x treated cohort	0.0003 (0.001)	0.0002 (0.001)	-0.001 (0.002)	-0.0001 (0.001)	-0.0004 (0.001)	-0.0002 (0.001)	-0.0002 (0.001)	0.0001 (0.001)	0.00003 (0.002)
Dep var mean (cons, pre-2005 cohorts)	0.027	0.028	0.028	0.029	0.029	0.029	0.029	0.029	0.029
<i>F. Chiropractic degree</i>									
Constrained x treated cohort	-0.002 (0.001)	0.001 (0.001)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)
Dep var mean (cons, pre-2005 cohorts)	0.012	0.025	0.026	0.026	0.027	0.027	0.027	0.027	0.027
<i>G. Nursing</i>									
Constrained x treated cohort	0.002 (0.002)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)
Dep var mean (cons, pre-2005 cohorts)	0.021	0.023	0.024	0.024	0.024	0.024	0.024	0.024	0.025
<i>H. Medical degree (MD or DO)</i>									
Constrained x treated cohort	‡ ‡	‡ ‡	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.0004 (0.001)	-0.0004 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	‡	0.013	0.013	0.014	0.014	0.014	0.015	0.015
<i>I. Master's in Social Work</i>									
Constrained x treated cohort	0.002 (0.001)+	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*	0.003 (0.001)*
Dep var mean (cons, pre-2005 cohorts)	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
<i>J. Other business master's degree (excl. MBA and accounting)</i>									
Constrained x treated cohort	‡ ‡	-0.0003 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.012
<i>K. Engineering master's degree</i>									
Constrained x treated cohort	‡ ‡	-0.001 (0.001)	-0.001 (0.001)	-0.0002 (0.001)	0.0002 (0.001)	0.0002 (0.001)	0.0002 (0.001)	0.0003 (0.001)	0.0004 (0.001)
Dep var mean (cons, pre-2005 cohorts)	‡	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of the probability of the type of degree received (indicated in the panel heading) by the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for belonging to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$, + $p < 0.1$.

‡ results suppressed

Table A.8: Effects of Grad PLUS on constrained students' receipt of academic master's degrees

Years since entry =	2	3	4	5	6	7	8	9	10
<i>A. Arts or humanities master's degree</i>									
Constrained x treated cohort	0.002 (0.005)	0.003 (0.005)	0.003 (0.006)	0.004 (0.006)	0.004 (0.006)	0.004 (0.006)	0.005 (0.006)	0.004 (0.006)	0.004 (0.006)
Dep var mean (cons, pre-2005 cohorts)	0.020	0.025	0.027	0.028	0.029	0.029	0.029	0.030	0.030
<i>B. Social science master's degree</i>									
Constrained x treated cohort	‡	0.002 (0.002)	0.0004 (0.002)	0.0002 (0.003)	0.0002 (0.003)	0.0004 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)
Dep var mean (cons, pre-2005 cohorts)	‡	0.013	0.015	0.016	0.016	0.017	0.017	0.017	0.017
<i>C. Math or science master's degree</i>									
Constrained x treated cohort	‡	0.002 (0.002)	0.002 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)
Dep var mean (cons, pre-2005 cohorts)	‡	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment. Point estimates from regressions of the probability of the type of degree received (indicated in the panel heading) by the specified number of years since entry on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for belonging to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses.

‡ results suppressed

Table A.9: Effects of Grad PLUS on constrained students' time to degree

	(1) Time to degree
Constrained x treated cohort	0.03 (0.03)
Observations	95,480
Dep var mean (const, pre-period)	2.06

Notes: The sample includes first-time graduate students in the 2002 through 2008 entry cohorts who borrowed in their first year of enrollment and received a graduate degree within 10 years of entry. Point estimates from regressions of the number of years to degree receipt on an interaction between an indicator for being constrained (borrowing at the federal Stafford Loan limit) and an indicator for belonging to a treated cohort (academic year 2005 and later). Regressions also include entry cohort and entry program fixed effects and age, indicators for race/ethnicity, gender, college educated parents and enrollment in fall and spring, and constrained. Robust standard errors, clustered at the program level, in parentheses.

Table A.10: Graduate program prices and characteristics before and after Grad PLUS

	(1) Pre	(2) Post
Average enrollment		
All	937	918
FAFSA filers	427	522
Percent of students who are:		
Asian	0.07	0.06
Black	0.10	0.10
Hispanic	0.15	0.17
White	0.58	0.53
First gen	0.37	0.38
Average age	30.2	29.9
Average EFC	\$6,431	\$7,080
COA	\$28,030	\$30,695
FTFY COA	\$21,303	\$26,125
Net price	\$26,644	\$28,418
Percent with any loans	0.49	0.54
Average loans		
PLUS	\$38	\$987
Stafford	\$10,754	\$11,534
State or private	\$515	\$515
Total	\$11,673	\$13,166
Average grants	\$1,214	\$1,857
Average tuition waiver	\$172	\$420
Observations	1,168	1,168

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Pre is 2003-2006, post is 2007-2010. All dollar amounts adjusted for inflation using CPI-U and reported in 2018\$.

Table A.11: Robustness of estimated effects on program-level loans and prices

	(1) Grad PLUS loans	(2) Total Fed. loans	(3) COA	(4) FTFY COA	(5) Grants	(6) Net price
<i>A. Minimum program enrollment = 10</i>						
% constrained*Post	79.3 (16.5)**	54.5 (28.7)+	60.0 (21.1)**	63.4 (18.9)**	23.0 (13.6)+	35.2 (30.1)
Observations	3,104	3,104	3,104	3,104	3,104	3,104
<i>B. Minimum program enrollment = 30</i>						
% constrained*Post	79.4 (16.6)**	54.5 (28.9)+	59.3 (21.2)**	62.4 (19.0)**	23.0 (13.7)	34.5 (30.3)
Observations	1,992	1,992	1,992	1,992	1,992	1,992
<i>C. Percent constrained based on 2006 only</i>						
% constrained*Post	69.6 (15.3)**	50.9 (24.0)*	52.7 (20.2)*	53.7 (19.7)**	19.5 (11.6)+	31.8 (26.6)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>D. Constrained def does not account for partial year enrollment</i>						
% constrained*Post	75.6 (15.9)**	53.1 (27.0)+	58.1 (19.7)**	62.2 (17.7)**	22.3 (12.8)+	34.2 (28.0)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>E. Constrained def based on all loans, accounts for partial year enrollment</i>						
% constrained*Post	84.7 (18.0)**	56.7 (31.9)+	65.5 (23.2)**	68.1 (20.2)**	25.5 (14.8)+	37.5 (33.2)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>F. Constrained def based on all loans, not accounting for partial year enrollment</i>						
% constrained*Post	82.1 (17.1)**	56.4 (30.1)+	64.4 (21.9)**	67.0 (19.1)**	24.5 (14.0)+	37.5 (31.3)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>G. Discrete treatment (above median % constrained)</i>						
Abv med*Post	1761.2 (494.9)**	1097.3 (742.6)	938.7 (912.3)	1362.3 (808.2)+	368.2 (265.0)	337.5 (905.6)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>H. Unweighted</i>						
% constrained*Post	57.3 (13.1)**	22.1 (21.0)	49.3 (19.3)*	59.8 (17.5)**	13.0 (11.4)	34.1 (24.7)
Observations	2,336	2,336	2,336	2,336	2,336	2,336

Notes: Unless otherwise noted, the sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Each panel contains point estimates from separate regressions of the outcome indicated in the column heading on an interaction between post-Grad PLUS academic year and exposure to Grad PLUS. Regressions also include academic year and program fixed effects. In panels A, B, and H, exposure is measured as the percent of students with Stafford Loans at or above the Stafford maximum (adjusted for part-year enrollment), on average, between 2004 and 2006. In Panel C, the same measure of percent constrained is used but only measured in 2006. In Panel D, the same measure of percent constrained is used but not adjusted for part-year enrollment. In Panel E (F), percent constrained is measured using total borrowing and does (not) account for part-year enrollment. In Panel G, exposure is measured by a binary variable indicating that the program had above median baseline percent constrained. Observations are weighted by baseline program size except where indicated. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table A.12: Estimated effects on program-level loans and prices, simulated instrument treatment

	(1) Grad PLUS loans	(2) Total Fed. loans	(3) COA	(4) FTFY COA	(5) Grants	(6) Net price
% constrained×Limit increase×Post	338 (55)**	217 (118)+	185 (89)*	210 (63)**	100 (59)+	78 (120)
Observations	2,336	2,336	2,336	2,336	2,336	2,336

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates from regressions of average loans per student from the specified source on the triple interaction between the percent of students who were constrained at baseline, the projected limit increases, and post-Grad PLUS (see text for definitions). Regressions also include academic year and program fixed effects. COA = cost of attendance. Net price equals COA minus grants and tuition waivers. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table A.13: IV estimates of the effect of federal loans on program price using simulated instrument

	(1) COA	(2) FTFY COA	(3) Net price
Federal loans	0.852 (0.482)+	0.970 (0.470)*	0.359 (0.404)
Observations	2,336	2,336	2,336

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Point estimates from instrumental variables models in which average federal student loans per student is the endogenous regressor and the triple interaction between the percent of students who were constrained at baseline, the projected limit increase, and post-Grad PLUS (see text for definition) is the excluded instrument. Regressions also include academic year and program fixed effects. COA = cost of attendance. Net price equals COA minus grants and tuition waivers. Robust standard errors, clustered at the program level, in parentheses; * $p < 0.05$, + $p < 0.1$.

Appendix B: Defining Programs of Study

This appendix provides additional information on program of study construction. As discussed in Section 3, in some cases, students entering a doctoral program are classified as master's degree seeking, even if they are pursuing a PhD. Because not all doctoral degree-seeking students complete their program, we cannot use the degree received to assign students to programs. Instead, we focus on the set of students who do receive a degree from the program and calculate the percent of such students who receive a terminal master's degree. We classify a student as receiving a terminal master's degree if they receive a master's degree but no additional degrees in that CIP by institution combination. For each 4-digit CIP code, we then calculate the percentage of degrees received that were terminal master's degrees. We then define a program as a professional (i.e., nonacademic) degree program if more than 85 percent of degrees granted were terminal master's degrees. Otherwise, a program is classified as academic.

To provide an example, if over 85 percent of degrees awarded to graduates with a CIP code of 4506 (Economics) at the University of Texas at Austin were master's degrees (not followed by any subsequent doctoral degree in the same CIP code), this would be classified as a professional master's degree in economics, but if less than 85 percent of degrees awarded were terminal masters, all students would be classified as academic doctoral students (even if their highest degree obtained was a master's degree). Students in a program with a 2-digit CIP code of 51 (Health Professions) or 13 (education) are considered to be in a professional degree program even if most of the degrees granted are doctoral in the data. All health and education programs are classified as non-academic.

In most cases, programs are defined by 4-digit CIP but because the level of disaggregation is not constant across CIP codes (i.e., economics is defined at the 4-digit CIP-level but psychology is defined at the 2-digit CIP-level), we deviate from this approach in a handful of cases. We combine 2-digit CIP codes 14 and 15 into a single category of engineering. All programs with a 2-digit CIP code of 13 are combined into a single category of education. All institution by 4-digit CIP code combinations that do not meet the 85 percent terminal master's degree cut-off are combined into a single category of academic programs.

A small number of CIP codes are added, deleted, or combined every decade. We use crosswalks provided by the National Center for Education Statistics (NCES) to adjust observed CIP codes to ensure that fields of study are measured consistently over the years our data span.¹ Specifically, we map all earlier CIP codes to the 2010 code. If a CIP code did not appear in 2010 but did appear in 1990 and 2000, we used the codes from 1990 and 2000. In one instance, (14.17) the 1990 code was more aggregated than subsequent codes and so we kept those codes aggregated. The 1990 4-digit CIP codes of 26.06 and 51.13

¹ See <https://nces.ed.gov/pubs2002/cip2000/crosswalk.ASP> and <https://nces.ed.gov/ipeds/cipcode/crosswalk.aspx>.

mapped into a number of 2000 CIPs. To handle these, we recoded all underlying 6-digit CIPs into their 2000 6-digit CIP, before re-applying general aggregation methods as above.

The Texas Higher Education Coordinating Board requires different information from private nonprofit universities (which they call “Independent Colleges and Universities”) than from public universities. In many cases, we do not observe CIP codes for enrolled students and can only identify programs with separate tuition classifications: theology, education, law, and chiropractic programs. Graduates from these programs made up 22 percent of all graduate degrees granted by nonprofit institutions in 2006 and overall, we can identify programs for 82 percent of all graduate student degree recipients in 2006 (authors’ calculations using IPEDS completions data). Table B.1 shows average characteristics of programs by field of study, for the top 50 fields in terms of average annual enrollment. Programs denoted with a single asterisk are those in which students were eligible to borrow an additional \$12,500 in Stafford Loans in the pre-period and students in programs denoted with a double asterisk could borrow an additional \$20,000.

Our main program-level estimates are robust to using alternative terminal master’s degree cut-offs in our classification of academic and professional programs. Table B.2 compares estimated effects on program access using our main definition (Panel A, replicating estimates in Panel A of Table 3) and the samples that result when academic programs are defined using an 80 percent terminal master’s degree cut-off (Panel B) and a 75 percent threshold (Panel C). Likewise, Table B.3 shows that estimated effects of exposure to Grad PLUS (i.e., percent of students constrained at baseline) are robust to these alternate definitions.

Table B.1 Characteristics of programs (top 50 fields of study, by average enrollment)

	Average annual enrollment:		Percent of students who are:					Degree receipt within:			Unique programs		
	All	Fin. aid recipcs	Male	API	Black	Hispanic	White	Intl.	2 years	4 years		6 years	
Education	347	121	0.26	0.02	0.13	0.25	0.56	0.02	0.37	0.48	0.50	328	
Law J.D.	318	241	0.53	0.06	0.10	0.12	0.60	0.01	0.55	0.66	0.67	71	
Chiropractic (DC).	209	187	0.62	0.08	0.08	0.08	0.59	0.01	0.16	0.38	0.38	14	
Academic	193	78	0.45	0.04	0.09	0.17	0.53	0.15	0.28	0.39	0.45	373	
Medicine (MD).**	188	154	0.52	0.23	0.05	0.13	0.55	0.01	0.03	0.91	0.93	63	
Engineering	161	30	0.77	0.06	0.05	0.12	0.30	0.43	0.39	0.49	0.53	196	
Library Science/Librarianship.	151	51	0.10	0.02	0.06	0.14	0.74	0.01	0.51	0.67	0.69	54	
Osteopathic Medicine/Osteopathy (DO).**	149	133	0.50	0.28	0.02	0.08	0.59	0.00	0.02	0.93	0.95	9	
Business Administration, Management and Operations.	149	52	0.56	0.05	0.12	0.19	0.50	0.12	0.45	0.55	0.58	297	
Veterinary Medicine (DVM).**	132	104	0.25	0.03	0.01	0.08	0.87		0.01	0.95	0.95	9	
Pharmacy, Pharmaceutical Sciences, and Administration.*	128	90	0.39	0.22	0.13	0.16	0.35	0.12	0.07	0.70	0.74	43	
Social Work.	105	63	0.11	0.02	0.17	0.32	0.46	0.01	0.63	0.73	0.74	76	
Optometry (OD).**	104	90	0.34	0.36	0.03	0.10	0.42	0.05	0.01	0.88	0.90	9	
Dentistry (DDS, DMD).**	90	78	0.51	0.20	0.05	0.15	0.56	0.01	0.03	0.88	0.89	27	
Public Health.*	77	24	0.35	0.09	0.08	0.17	0.49	0.11	0.37	0.55	0.59	52	
Registered Nursing, Nursing Administration, Nursing Research Rehabilitation and Therapeutic Professions.	75	21	0.16	0.05	0.10	0.21	0.60	0.01	0.38	0.56	0.59	175	
Accounting and Related Services.	71	37	0.26	0.04	0.07	0.26	0.59	0.01	0.50	0.80	0.81	99	
Theological and Ministerial Studies	60	27	0.39	0.07	0.07	0.22	0.54	0.09	0.53	0.58	0.59	208	
Clinical, Counseling and Applied Psychology.*	57	28	0.74	0.02	0.07	0.08	0.58	0.04	0.10	0.31	0.35	50	
Public Policy Analysis.	57	31	0.20	0.02	0.11	0.16	0.65	0.03	0.28	0.48	0.55	222	
Liberal Arts/General Studies	50	23	0.41	0.07	0.09	0.08	0.51	0.22	0.32	0.52	0.63	27	
Architecture.	50	19	0.39	0.02	0.11	0.27	0.54	0.03	0.13	0.18	0.20	61	
Area Studies.	48	24	0.60	0.04	0.12	0.13	0.54	0.14	0.56	0.72	0.75	62	
Information Science/Studies.	46	21	0.39	0.02	0.01	0.40	0.48	0.05	0.62	0.70	0.72	15	
Legal Support Services.	46	12	0.67	0.05	0.13	0.21	0.30	0.29	0.36	0.44	0.45	68	
Health and Medical Administrative Services.*	46	26	0.28	0.02	0.11	0.23	0.60	0.02	0.38	0.45	0.47	9	
Legal Research and Advanced Professional Studies (Post-LLB/JI	43	17	0.38	0.12	0.19	0.08	0.46	0.10	0.35	0.47	0.50	96	
Computer and Information Sciences, General .	43	18	0.47	0.07	0.12	0.09	0.55	0.04	0.68	0.80	0.82	7	
Computer Science.	42	8	0.74	0.07	0.04	0.08	0.23	0.56	0.44	0.51	0.54	170	
Communication Disorders Sciences and Services.	41	7	0.77	0.07	0.03	0.14	0.19	0.55	0.28	0.37	0.45	43	
Criminology.	37	21	0.05	0.02	0.04	0.27	0.63	0.02	0.71	0.80	0.81	122	
Public Relations, Advertising, and Applied Communication.	37	13	0.45	0.02	0.26	0.13	0.58		0.38	0.46	0.47	11	
International Relations and Affairs.	37	18	0.22	0.03	0.11	0.08	0.51	0.26	0.62	0.72	0.75	24	
Finance and Financial Management Services.	35	20	0.55	0.02	0.03	0.08	0.77	0.08	0.92	0.92	0.93	9	
Work and Family Studies.	35	10	0.63	0.09	0.04	0.11	0.49	0.25	0.49	0.57	0.61	90	
Management Information Systems and Services.	34	22	0.60		0.06	0.10	0.71	0.05	0.47	0.48	0.48	6	
Public Administration.	33	7	0.71	0.07	0.03	0.09	0.35	0.45	0.44	0.53	0.55	78	
Real Estate.	32	16	0.47	0.02	0.15	0.29	0.48	0.03	0.38	0.50	0.53	186	
Intercultural/Multicultural and Diversity Studies.	31	12	0.73	0.04	0.05	0.06	0.70	0.11	0.63	0.65	0.66	27	
Veterinary Biomedical and Clinical Sciences (Cert., MS, PhD)	30	17	0.19	0.04	0.09	0.54	0.30	0.02	0.27	0.43	0.46	14	
Allied Health Diagnostic, Intervention, and Treatment Professi	29	8	0.39		0.05	0.05	0.18	0.63	0.34	0.25	0.36	0.42	9
City/Urban, Community and Regional Planning.	29	16	0.25	0.05	0.05	0.18	0.63	0.01	0.59	0.75	0.75	87	
Nutrition Sciences.	29	15	0.55	0.03	0.37	0.06	0.33	0.19	0.49	0.58	0.62	45	
Journalism.	29	10	0.14	0.04	0.03	0.07	0.57	0.28	0.33	0.55	0.65	27	
Multi/Interdisciplinary Studies, Other.	28	13	0.35	0.02	0.11	0.09	0.63	0.09	0.47	0.54	0.56	36	
Advanced/graduate dentistry	27	11	0.44	0.03	0.09	0.23	0.52	0.11	0.32	0.39	0.41	169	
Architectural History/Criticisms.	27	9	0.57	0.13	0.05	0.11	0.50	0.12	0.32	0.47	0.47	21	
Radio, Television, and Digital Communication.	25	13	0.29			0.05	0.82	0.06	0.37	0.46	0.46	7	
Mental and Social Health Services and Allied Professions.	25	16	0.49	0.05	0.06	0.09	0.64	0.09	0.45	0.70	0.74	18	
	24	10	0.21	0.06	0.11	0.08	0.68	0.05	0.29	0.53	0.58	45	

Table B.2: Robustness of estimated effects on program enrollment and composition

	(1)	Percent (0-100%) of entering students who are:					
	Enrollment	(2) Black	(3) Hispanic	(4) API	(5) White	(6) Internl	(7) Men
<i>A. 85% terminal MA cut-off for nonacademic (main estimates)</i>							
Projected limit increase (\$1k) x Post	-1.2	-0.04	-0.03	0.05	0.39	-0.15	0.03
	(1.5)	(0.05)	(0.05)	(0.04)	(0.144)**	(0.159)	(0.074)
Observations	2,345	2,345	2,345	2,345	2,345	2,345	2,345
<i>B. 80% terminal MA cut-off for nonacademic</i>							
Projected limit increase (\$1k) x Post	-1.4	-0.04	-0.03	0.05	0.39	-0.15	0.04
	(1.5)	(0.05)	(0.05)	(0.04)	(0.15)**	(0.16)	(0.07)
Observations	2,541	2,541	2,541	2,541	2,541	2,541	2,541
<i>C. 75% terminal MA cut-off for nonacademic</i>							
Projected limit increase (\$1k) x Post	-1.4	-0.04	-0.04	0.06	0.37	-0.14	0.01
	(1.4)	(0.05)	(0.05)	(0.04)	(0.13)**	(0.15)	(0.10)
Observations	2,744	2,744	2,744	2,744	2,744	2,744	2,744

Notes: The sample includes graduate programs that had entering students in each of the 2004 through 2010 academic years and had at least 20 entering students who filed a FAFSA in 2004 through 2006. Each panel contains point estimates from separate regressions of first-year enrollment or percentage of entering students (0-100) with the given demographic characteristic on an interaction between post-Grad PLUS entry cohort and the projected federal loan limit increase based on the program's 2006 average cost of attendance (COA). All specifications also include entry cohort and program fixed effects. Columns (2) through (7) estimates weighted by the size of the entering cohort. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table B.3: Robustness of estimated effects on borrowing and prices

	(1) Grad PLUS loans	(2) Total Fed. loans	(3) COA	(4) FTFY COA	(5) Grants	(6) Net price
<i>A. 85% terminal MA cut-off for academic program def (main estimates)</i>						
% constrained*Post	79.3 (16.6)**	54.3 (28.8)+	59.6 (21.1)**	62.7 (18.9)**	23.0 (13.7)+	34.8 (30.2)
Observations	2,336	2,336	2,336	2,336	2,336	2,336
<i>B. 80% terminal MA cut-off for academic program def</i>						
% constrained*Post	79.3 (16.6)**	54.1 (28.9)+	59.0 (21.1)**	62.1 (19.0)**	23.1 (13.7)+	34.1 (30.2)
Observations	2,576	2,576	2,576	2,576	2,576	2,576
<i>C. 75% terminal MA cut-off for academic program def</i>						
% constrained*Post	79.4 (16.6)**	54.0 (28.9)+	58.2 (21.1)**	61.7 (19.0)**	23.1 (13.7)+	33.4 (30.2)
Observations	2,728	2,728	2,728	2,728	2,728	2,728

Notes: The sample includes a balanced panel graduate programs with enrollment in the 2003 through 2010 academic years and at least 20 federal aid recipients enrolled per year, on average, between 2003 and 2006. Each panel contains point estimates from separate regressions of the outcome indicated in the column heading on an interaction between post-Grad PLUS academic year and exposure to Grad PLUS (the percent of students with Stafford Loans at or above the Stafford maximum (adjusted for part-year enrollment), on average, between 2004 and 2006). Observations are weighted by baseline program size except where indicated. Robust standard errors, clustered at the program level, in parentheses; ** $p < 0.01$, + $p < 0.1$.