Online Appendix for "Community College Program Choices in the Wake of Local Job Losses"

A Additional Figures & Tables

Figure A.1: Average Layoffs in Michigan Counties, 2001-2017

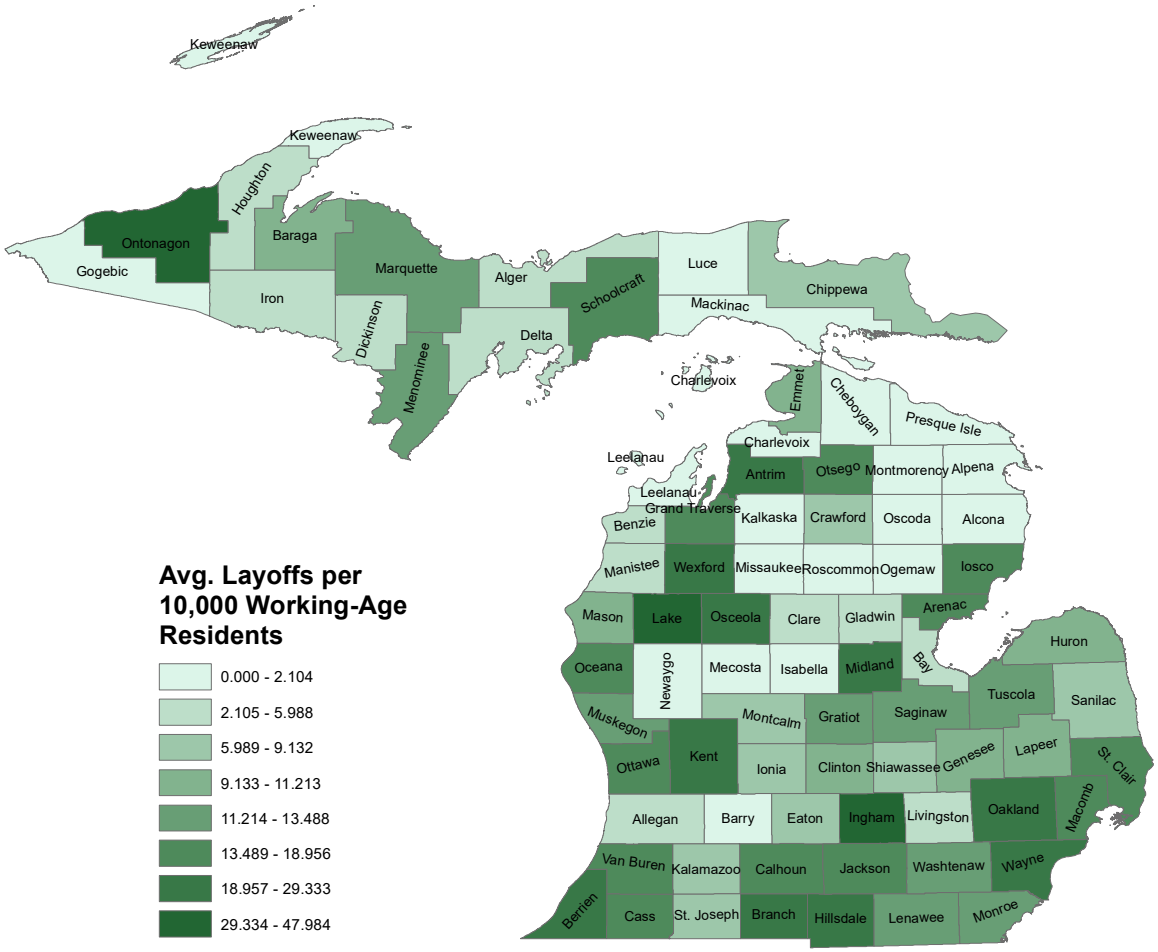
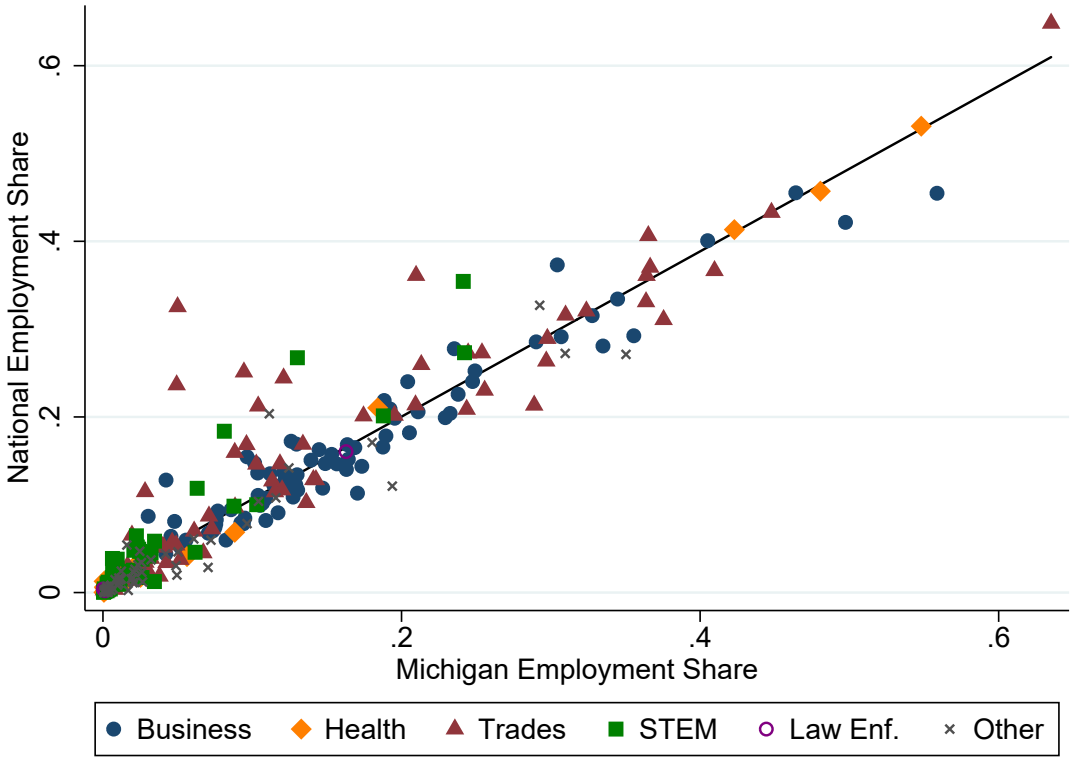


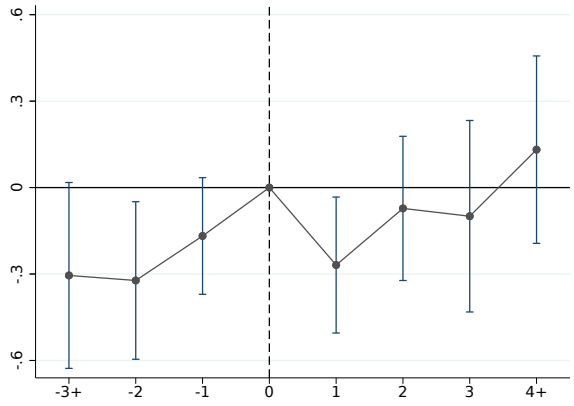
Figure A.2: Correlation Between National and State-Specific Industry Employment Shares, 2016



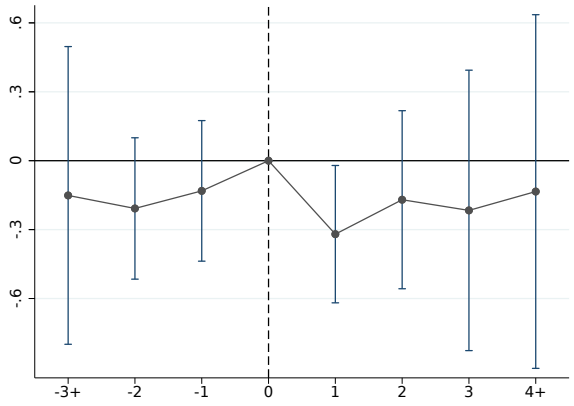
Note: Each marker represents a NAICS three-digit industry with non-zero employment in a given community college program/occupation group. The national employment share is calculated from the 2016 BLS Occupational Employment Series national estimates. The Michigan employment share is calculated from the 2016 BLS Occupational Employment Series state-specific estimate.

Figure A.3: Enrollment Trends Surrounding Large Layoff Events

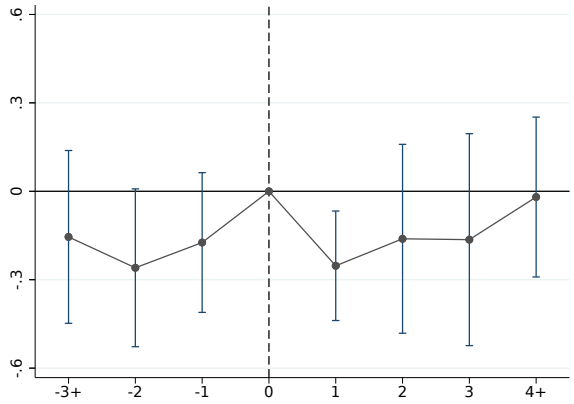
(a) Main Specification



(b) Including County-by-Program Linear Time Trends

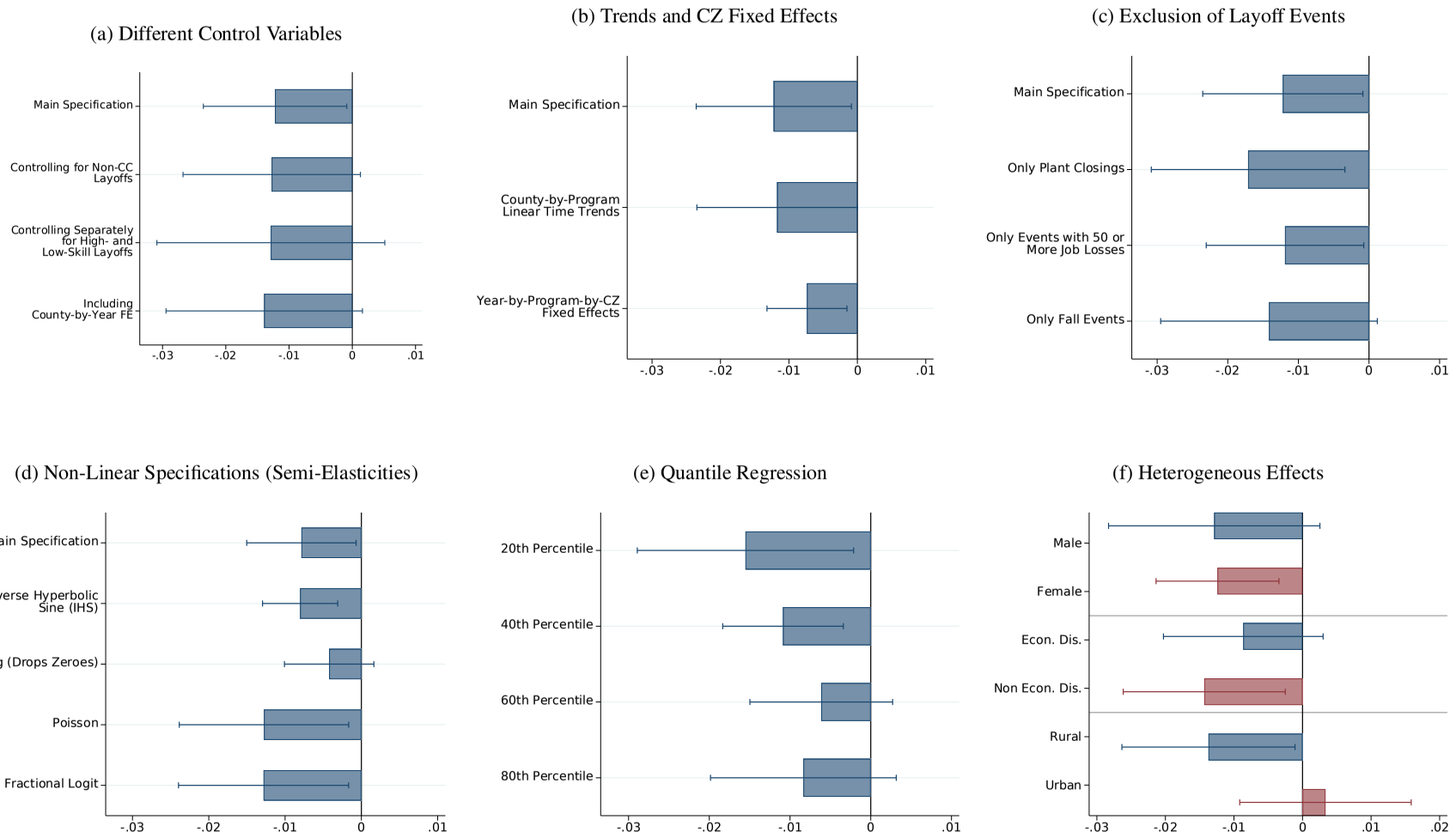


(c) Including Program-by-Year-by-CZ Fixed Effects



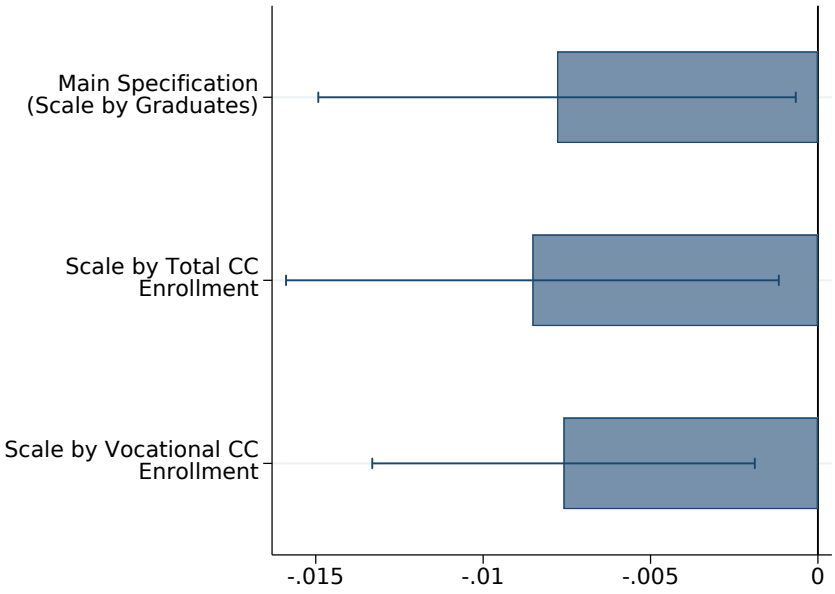
Note: Each figure plots the β_k estimates from equation (4) in the main text, indicating the change in program enrollment surrounding a large layoff event in corresponding occupations. All specifications include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate and logged size of the labor force. Panel B additionally includes county-by-program linear time trends, while Panel C includes program-by-year-by-CZ (commuting zone) fixed effects. All standard errors are clustered at the county level.

Figure A.4: Robustness & Heterogeneity



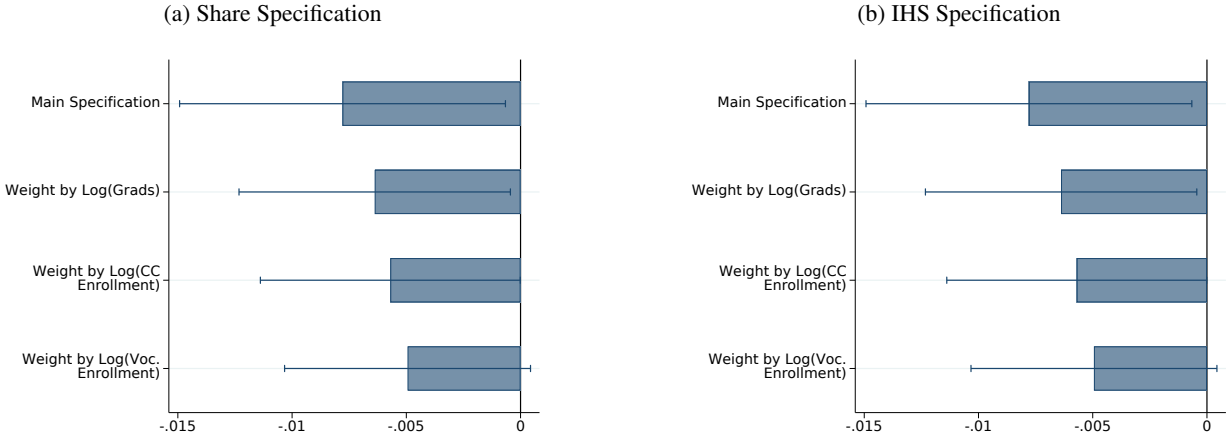
Note: Each figure presents estimates of β from equation (3) in the main text under different specifications. Unless otherwise indicated, all regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level.

Figure A.5: Semi-Elasticities with Different Denominators



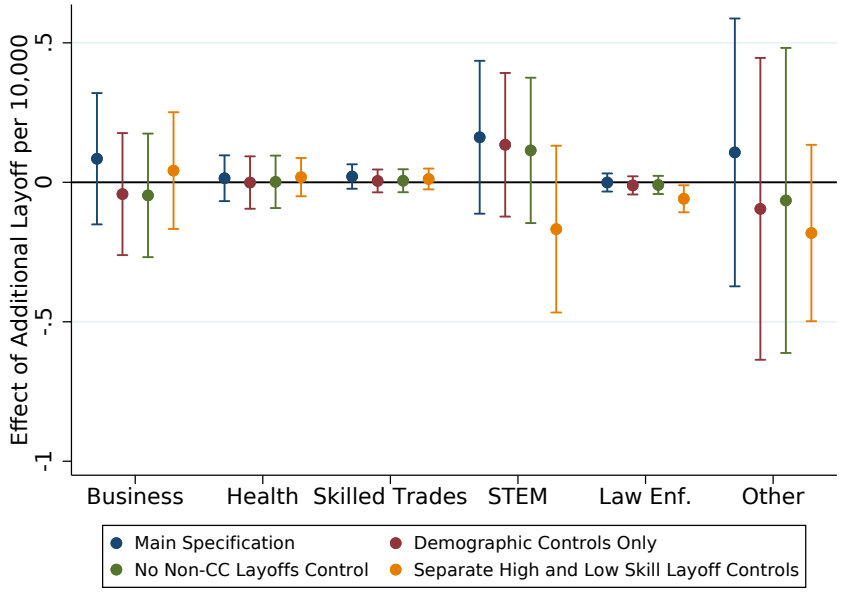
Note: Each bar provides the estimated semi-elasticity from equation (3) in the main text, i.e. the percent change in enrollment in a given vocational community college program due to an additional layoff in related occupations per 10,000 working-age residents in the county. The top bar scales the dependent variable by the number of graduates in the county, the middle bar scales by the total enrollment in community college programs, and the bottom bar scales by enrollment in vocational community college programs. Standard errors are clustered at the county level and 95% confidence intervals are shown.

Figure A.6: Semi-Elasticities with County-Level Weights



Note: Each bar in each panel provides the estimated semi-elasticity from equation (3) in the main text, i.e. the percent change in enrollment in a given vocational community college program due to an additional layoff in related occupations per 10,000 working-age residents in the county. The top bar does not include weights, the second bar weights by the log of the average number of graduates in a county between 2009 and 2016, the third bar weights by the log of the average community college enrollment, and the bottom bar weights by the log of the average enrollment in vocational community college programs (the weight is equal to 0 if a county's average vocational enrollment is less than 1). Panel A uses the full sample of counties and main specification, while Panel B uses an inverse hyperbolic sine transformation of the dependent variable. Standard errors are clustered at the county level and 95% confidence intervals are shown.

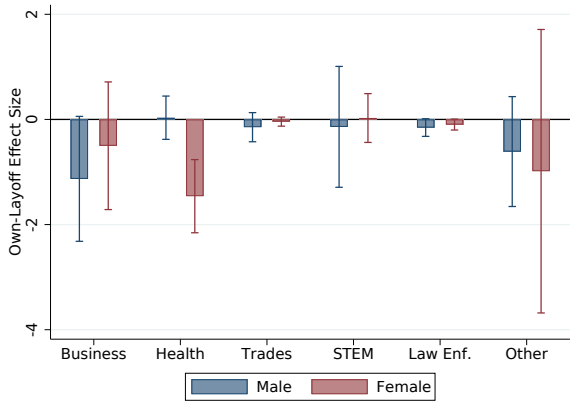
Figure A.7: Overall Enrollment in Vocational Programs, Different Control Variables



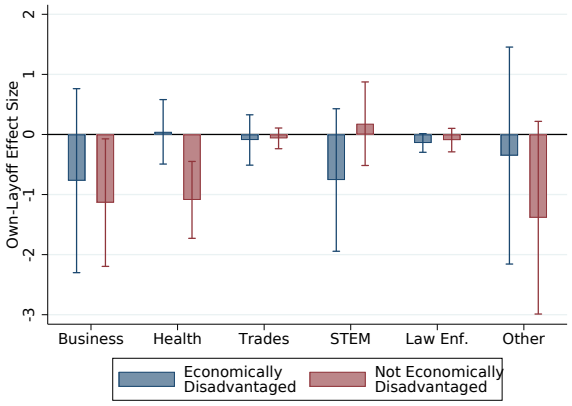
Note: Each plotted coefficient represents one of the β parameters in equation (5) in the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on overall enrollment in vocational programs, when including different control variables. The "Main Specification" controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. The "Demographic Controls Only" specification controls for the share of graduates that are white, male, and categorized as economically disadvantaged, as well as average 11th grade math and reading test scores. The "No Non-CC Layoffs Control" specification includes all the variables in the "Demographic Controls Only" specification, plus the county unemployment rate and logged size of the labor force. The "Separate High and Low Skill Layoff Controls" duplicates the main specification, but separates the number of layoffs per 10,000 working-age residents in non community college occupations into those occurring in low-skill and high-skill occupations. In all specifications, standard errors are clustered at the county level.

Figure A.8: Heterogeneous Own-Layoff Effects

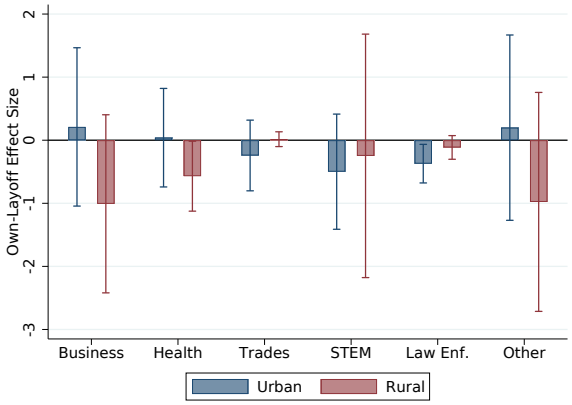
(a) Heterogeneity by Gender



(b) Heterogeneity by Economic Disadvantage Status



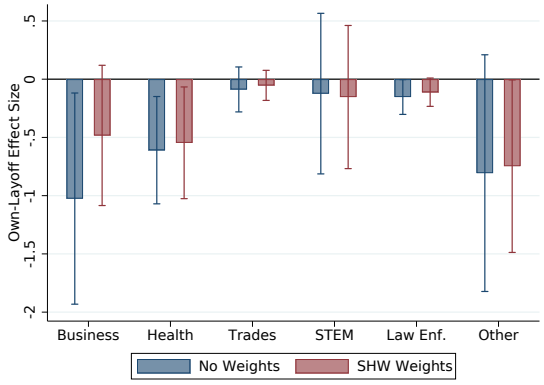
(c) Heterogeneity by County Urbanicity



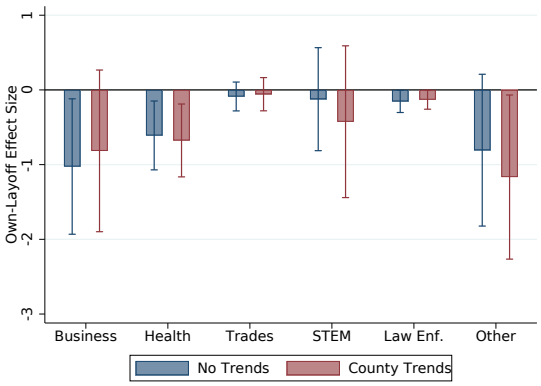
Note: Each figure presents estimates of the "own-layoff" effects in Table 5 of the main text for different subgroups of students. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level.

Figure A.9: Robustness Checks for Own-Layoff Effects

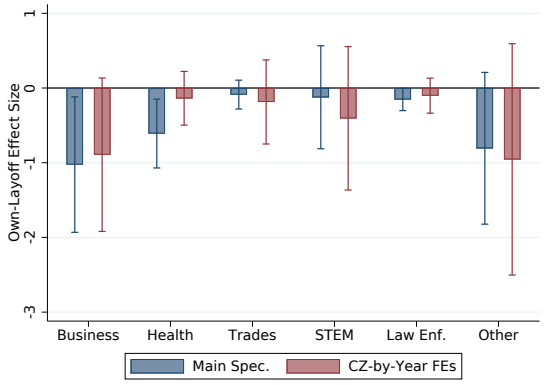
(a) Weighting for Heteroskedasticity



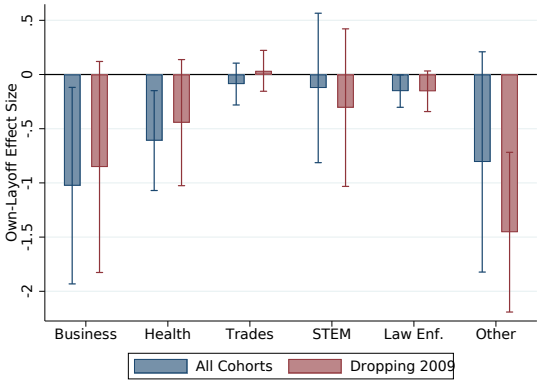
(b) County-Specific Time Trends



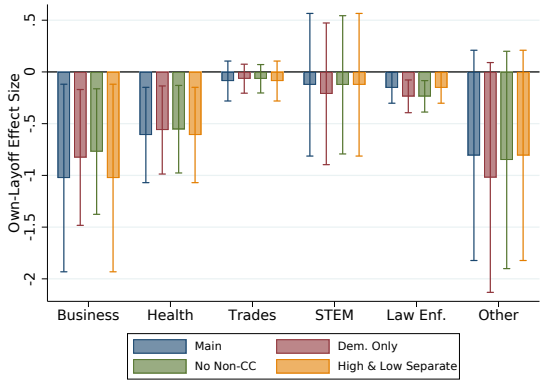
(c) Cohort-by-Commuting Zone Fixed Effects



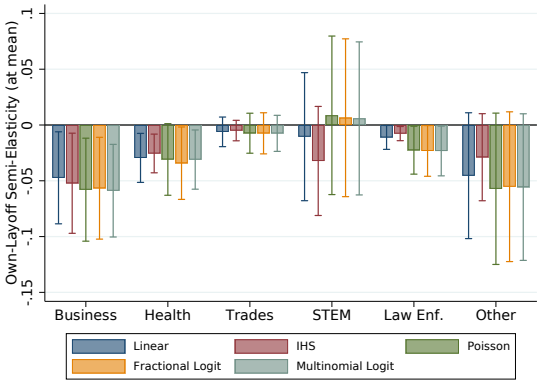
(d) Dropping 2009 Cohort



(e) Different Control Variables

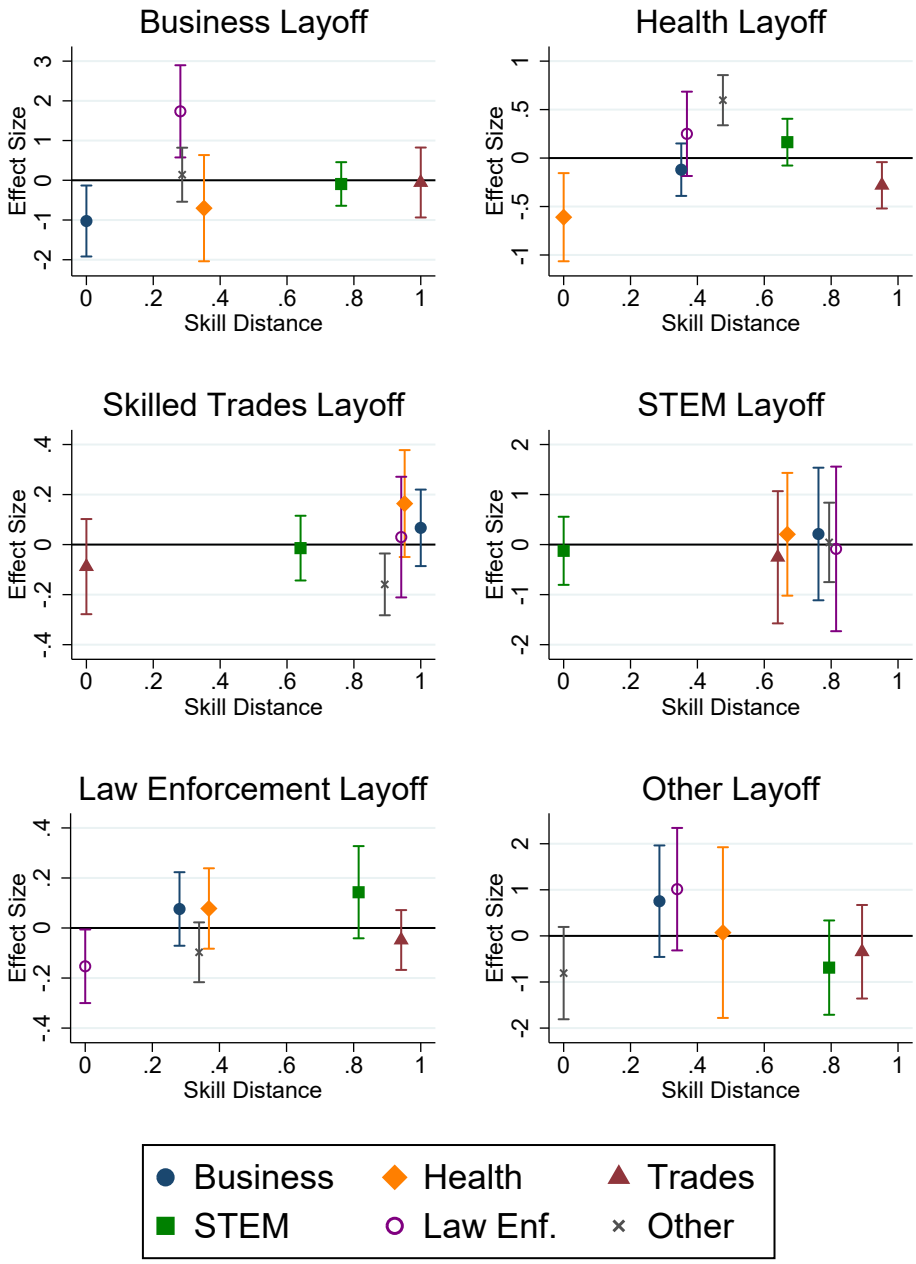


(f) Non-Linear Specifications (Semi-Elasticites)



Note: Each figure presents estimates of the "own-layoff" effects in Table 5 in the main text under alternative specifications. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level.

Figure A.10: Substitution into Program Groups Requiring Similar Skills



Note: Each panel plots the coefficients from a single row of Table 5 of the main text against the skill distance metric that uses all 27 skill measures from the O*NET database. The coefficient at the skill distance of 0 is the "own-layoff" effect, while all other coefficients are the substitution effects. All standard errors are clustered at the county level.

Table A.1: Programs Offered by Michigan's Community Colleges, 2011

Variable:	**Mean (1)**	**S.D. (2)**	**Min. (3)**	**Max. (4)**
Panel A. All Programs				
Total Programs	116.54	67.18	41.00	319.00
Vocational Programs	95.29	59.00	33.00	280.00
Non-Vocational Programs	21.25	13.03	5.00	51.00
Share Vocational	0.81	0.10	0.56	0.94
Panel B. Associate Programs				
Total Programs	59.75	30.11	10.00	142.00
Vocational Programs	45.07	24.42	5.00	124.00
Non-Vocational Programs	14.68	9.94	2.00	37.00
Share Vocational	0.75	0.12	0.49	0.92
Panel C. Certificate Programs				
Total Programs	56.79	40.52	17.00	177.00
Vocational Programs	50.21	36.47	13.00	158.00
Non-Vocational Programs	6.57	5.45	0.00	21.00
Share Vocational	0.88	0.08	0.67	1.00

Note: The sample consists of Michigan's 28 community colleges during the academic year 2011-2012. Vocational programs are defined as those which can be matched to an occupation that is attainable by community college graduates. Non-vocational programs are all other programs offered by Michigan's community colleges. See Section 3.1 of the main text for more details.

Table A.2: Program Groups and Associated Occupation Codes

Program Group	**SOC**	**SOC Title**
Business	11	Management
	13	Business and Financial
	23	Legal
	41	Sales and Related
	43	Office and Administrative Support
Health	29	Healthcare Practitioners and Technical
	31	Healthcare Support
Trades	37	Building and Grounds Cleaning and Maintenance
	45	Farming, Fishing, and Forestry
	47	Construction and Extraction
	49	Installation, Maintenance, and Repair
	51	Production*
	53	Transportation and Material Moving**
STEM	15	Computer and Mathematical
	17	Architecture and Engineering
	19	Life, Physical, and Social Science
Law Enf.	33	Protective Service
Other	21	Community and Social Service
	25	Education, Training, and Library
	27	Arts, Design, Entertainment, Sports, and Media
	35	Food Preparation and Serving Related
	39	Personal Care and Service

Note: * Programs matched to the 3-digit code 51-3 (Food Processing Workers) are included in the "Other" group because they are generally part of Culinary Arts programs that are mostly matched to the 2-digit code 35 (Food Preparation and Serving Related).

** Programs matched to the 6-digit code 53-3011 (Ambulance Drivers and Attendants) are included in the "Health" group because they are generally part of Emergency Medical Services programs that are mostly matched to the 2-digit code 29 (Healthcare Practitioners and Technical).

Table A.3: Industries with Highest Employment Shares of Community College Occupations

NAICS	**Industry Title**	**Share** (α)
Business		
524	Insurance Carriers and Related Activities	0.429
522	Credit Intermediation and Related Activities	0.443
425	Wholesale Electronic Markets and Agents and Brokers	0.470
Health		
621	Ambulatory Health Care Services	0.414
623	Nursing and Residential Care Facilities	0.508
622	Hospitals	0.544
Trades		
212	Mining (except Oil and Gas)	0.386
811	Repair and Maintenance	0.449
484	Truck Transportation	0.623
STEM		
511	Publishing Industries (except Internet)	0.187
516	Internet Publishing and Broadcasting	0.216
518	Data Processing, Hosting, and Related Services	0.300
Law Enforcement		
482	Rail Transportation	0.005
921	Executive, Legislative, and Other General Government Support	0.010
922	Justice, Public Order, and Safety Activities	0.411
Other		
515	Broadcasting (except Internet)	0.228
812	Personal and Laundry Services	0.313
624	Social Assistance	0.369

Note: Employment shares (α) are calculated as outlined in Section 4.1 of the main text and averaged over all years 2001-2016.

Table A.4: Correlation Between Occupation Composition Across Industries

	Business	**Health**	**Trades**	**STEM**	**Law Enf.**	**Other**
Business	1.000					
Health	-0.133	1.000				
Trades	-0.258	-0.212	1.000			
STEM	0.328	-0.106	-0.190	1.000		
Law Enf.	-0.106	-0.002	-0.098	-0.051	1.000	
Other	-0.138	0.071	-0.360	-0.011	-0.026	1.000

Note: Each cell displays a pairwise correlation between the industry employment shares for the occupation groups of interest. See Section 4.1 of the main text for more information.

Table A.5: Largest Layoffs by Occupation Group, 2001-2017

County	**Year**	**Size**	**Largest Related Layoff (Jobs Lost)**
Business			
Lake	2005	27.88	Michigan Youth Correctional Facility (204)
Iosco	2008	29.02	Kalitta Air (219)
Ontonagon	2009	45.75	SmurfitStone Container Corp. (150)
Health			
Midland	2015	13.95	MidMichigan Health - Stratford Village (143)
Gladwin	2015	29.72	MidMichigan Health - Gladwin Pines (85)
Ontonagon	2009	88.23	Maple Manor Nursing Home (62)
Trades			
Antrim	2007	61.18	Dura Automotive Systems (300)
Ontonagon	2009	69.30	SmurfitStone Container Corp. (150)
Wexford	2010	95.56	AAR Mobility Systems (282)
STEM			
Antrim	2007	61.18	Dura Automotive Systems (300)
Ingham	2004	9.987	General Motors (3,975)
Midland	2015	14.98	Dow Chemical Company (700)
Law Enforcement			
Lake	2011	87.01	Northlake Correctional Facility (146)
Arenac	2009	131.2	Standish Maximum Facility (281)
Lake	2005	138.9	Michigan Youth Correctional Facility (204)
Other			
Oceana	2008	6.03	Double JJ Resort (150)
Hillsdale	2012	7.45	The Manor Residential Treatment Facility (140)
Ontonagon	2009	14.10	SmurfitStone Container Corp. (150)

Note: Size is measured as the estimated number of layoffs per 10,000 working-age residents in the county.

Table A.6: Summary Statistics of Vocational Students by Program

Variable:	**Business (1)**	**Health (2)**	**Trades (3)**	**STEM (4)**	**Law Enf. (5)**	**Other (6)**
White	0.747	0.705	0.837	0.759	0.750	0.704
Black	0.169	0.203	0.088	0.146	0.171	0.213
Hispanic	0.041	0.051	0.045	0.042	0.049	0.046
Male	0.588	0.216	0.943	0.855	0.653	0.396
Economically Disadvantaged	0.329	0.415	0.348	0.338	0.389	0.366
English Language Learner	0.044	0.053	0.034	0.048	0.031	0.019
Standardized Math Score	-0.056	-0.260	-0.193	0.069	-0.306	-0.242
Standardized Reading Score	-0.162	-0.231	-0.398	-0.072	-0.316	-0.162
On-Time Graduation	0.987	0.984	0.978	0.984	0.984	0.984
Students	16,082	15,080	5,387	8,476	8,288	12,979
Share of Vocational Students	0.243	0.227	0.081	0.128	0.125	0.196

Note: The sample consists of all graduates of Michigan public high schools from 2009 to 2016 who have non-missing demographic and geographic information and enroll in a vocational program at one of the state's community colleges within 6 months of high school graduation.

Table A.7: Effect of Layoffs on College Enrollment Outcomes

	Enrollment per 100 Graduates in:			
Layoffs per 10,000 in:	**No Formal College (1)**	**CC Vocational Programs (2)**	**CC Non-Voc. Programs (3)**	**Four-Year Colleges (4)**
Panel A. Total layoffs				
All occupations, t-1	-0.013**	-0.004*	0.005	0.012**
	(0.006)	(0.002)	(0.005)	(0.005)
Outcome Mean	39.60	9.40	12.56	38.44
County-Year Obs.	664	664	664	664
R-Squared	0.787	0.670	0.731	0.865
Panel B. Layoffs by skill group				
Low-skill	-0.004	-0.012	0.019	-0.002
occupations, t-1	(0.020)	(0.013)	(0.016)	(0.022)
Community college	-0.041	0.004	0.011	0.026
occupations, t-1	(0.035)	(0.017)	(0.021)	(0.027)
High-skill	0.058	-0.002	-0.069	0.012
occupations, t-1	(0.077)	(0.037)	(0.052)	(0.053)
Outcome Mean	39.60	9.40	12.56	38.44
County-Year Obs.	664	664	664	664
R-Squared	0.788	0.670	0.732	0.865

Note: The unit of observation is a county-cohort pair. Outcomes are measured as the number of students who enroll in vocational community college programs within 6 months of high school graduation, per 100 high school graduates in the county and cohort. The coefficients in each column are estimated from a separate regression and represent the β parameters in equation (6) in the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on the outcome of interest. The numbers in brackets below the estimates are the estimated elasticities at the mean dependent and independent variable values. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate and logged size of the labor force during a cohort's senior year of high school. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.8: Effect of Layoffs on Composition of Vocational Students

Layoffs per 10,000 in:	% White (1)	% Male (2)	% Econ. Dis. (3)	Avg. Math Score (4)	Avg. Read Score (5)
Business, t-1	0.007	-0.005	-0.005	0.011	-0.003
	(0.004)	(0.009)	(0.008)	(0.008)	(0.008)
Health, t-1	0.004	0.005	-0.002	0.002	-0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Skilled Trades, t-1	-0.000	0.001	-0.000	-0.002	-0.000
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
STEM, t-1	0.008	-0.003	-0.007	-0.009	-0.005
	(0.006)	(0.009)	(0.008)	(0.008)	(0.010)
Law Enforcement, t-1	0.000	0.002	0.001	-0.001	-0.003
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Other, t-1	-0.016	-0.001	-0.009	-0.010	0.010
	(0.012)	(0.011)	(0.006)	(0.014)	(0.011)
P-Value for Joint Test	0.456	0.638	0.217	0.217	0.827
Outcome Mean	0.870	0.531	0.393	-0.067	-0.144
County-Year Obs.	657	657	657	657	657
R-Squared	0.728	0.220	0.528	0.474	0.389

Note: The unit of observation is a county-cohort pair. Outcomes are measured as the mean characteristic across all students who enroll in vocational programs. The coefficients in each column are estimated from a separate regression and represent the β parameters in equation (6) of the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on the outcome of interest. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.9: Effect of Layoffs on First-Year Course-Taking

Layoffs per 10,000 in:	**Total Credits (1)**	**Vocational Credits (2)**	**Non-Voc. Credits (3)**
Business, t-1	0.007	-0.082	0.089
	(0.216)	(0.108)	(0.152)
Health, t-1	0.019	0.029	-0.010
	(0.086)	(0.050)	(0.049)
Skilled Trades, t-1	0.019	0.000	0.019
	(0.036)	(0.018)	(0.025)
STEM, t-1	0.044	0.006	0.039
	(0.346)	(0.143)	(0.233)
Law Enforcement, t-1	0.034	0.009	0.025
	(0.034)	(0.018)	(0.021)
Other, t-1	0.140	-0.150	0.290
	(0.705)	(0.329)	(0.397)
P-Value for Joint Test	0.952	0.920	0.669
Outcome Mean	17.34	6.46	10.88
County-Year Obs.	657	657	657
R-Squared	0.471	0.482	0.505

Note: The unit of observation is a county-cohort pair. Outcomes are measured as the mean number of credits completed in the first year of community college enrollment across all students who enroll in vocational programs. The coefficients in each column are estimated from a separate regression and represent the β parameters in equation (6) of the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on the outcome of interest. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.10: Effect of Industry-Level Layoffs on Substitution Between Community College Programs

	Enrollment in:					
Layoffs per 10,000 in:	**Business (1)**	**Health (2)**	**Trades (3)**	**STEM (4)**	**Law Enf. (5)**	**Other (6)**
Panel A. Share Specification						
Retail Trade, t-1	-0.241*	0.318***	0.052	0.005	-0.257	0.123
	(0.131)	(0.115)	(0.075)	(0.086)	(0.180)	(0.283)
Health Care & Social Assistance, t-1	-0.017	-0.322**	-0.089	0.042	0.129	0.257***
	(0.059)	(0.152)	(0.083)	(0.045)	(0.112)	(0.077)
Manufacturing, t-1	-0.049**	0.089*	-0.026	-0.019	0.028	-0.023
	(0.023)	(0.046)	(0.030)	(0.020)	(0.043)	(0.020)
Public Administration, t-1	0.015	0.057**	-0.016	0.041	-0.058***	-0.039*
	(0.023)	(0.025)	(0.019)	(0.040)	(0.019)	(0.020)
All Other Industries, t-1	0.026	0.046	0.024	-0.025	0.002	-0.073**
	(0.044)	(0.039)	(0.018)	(0.029)	(0.047)	(0.028)
Panel B. Inverse Hyperbolic Sine Specification						
Retail Trade, t-1	-0.005	0.014***	0.001	0.010	-0.003	0.006
	(0.004)	(0.005)	(0.005)	(0.007)	(0.004)	(0.012)
Health Care & Social Assistance, t-1	0.002	-0.011**	0.001	-0.000	0.003	0.010***
	(0.002)	(0.005)	(0.004)	(0.003)	(0.006)	(0.003)
Manufacturing, t-1	-0.002**	0.003**	-0.002	0.000	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Public Administration, t-1	0.001	0.002***	-0.000	0.002	-0.002**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
All Other Industries, t-1	0.001	0.004***	0.002	0.000	0.002	-0.002
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Outcome Mean (Share)	21.66	20.67	14.33	11.84	13.74	17.75
Observations	657	657	657	657	657	657

Note: The unit of observation is a county-cohort pair. Outcomes in Panel A are measured as the number of students who enroll in a given program within 6 months of high school graduation per 100 students who in the county and cohort enroll in vocational programs. Outcomes in Panel B are measured as the inverse hyperbolic sine of the number of students who enroll in a given program within 6 months of high school graduation. The coefficients in each column are estimated from a separate regression and represent the β_j terms in equation (6) of the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on the outcome of interest. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. Regressions in Panel B further control for logged total enrollment in vocational programs. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.11: Substitution Between Narrower Community College Programs

	Enrollment per 100 Vocational Students in:							
Layoffs per 10,000 in:	**Business** (1)	**Health** (2)	**Trades** (3)	**STEM** (4)	**Law Enf.** (5)	**Arts & Media** (6)	**Personal & Culinary** (7)	**Social Services** (8)
Business, t-1	**-1.025****	-0.702	-0.056	-0.093	1.736***	-0.303	0.004	0.440**
	(0.456)	(0.682)	(0.449)	(0.280)	(0.592)	(0.227)	(0.201)	(0.184)
Health, t-1	-0.120	**-0.610****	-0.281**	0.164	0.250	0.107	0.144*	0.346***
	(0.138)	**(0.232)**	(0.122)	(0.123)	(0.222)	(0.084)	(0.083)	(0.073)
Skilled Trades, t-1	0.067	0.164	**-0.088**	-0.014	0.030	-0.124***	-0.027	-0.008
	(0.078)	(0.109)	**(0.097)**	(0.066)	(0.123)	(0.039)	(0.057)	(0.031)
STEM, t-1	0.212	0.206	-0.253	**-0.124**	-0.086	0.383	-0.535**	0.196
	(0.676)	(0.626)	(0.674)	**(0.347)**	(0.839)	(0.316)	(0.268)	(0.195)
Law Enforcement, t-1	0.076	0.078	-0.048	0.143	**-0.153****	-0.077***	-0.088**	0.068
	(0.075)	(0.082)	(0.061)	(0.094)	**(0.075)**	(0.027)	(0.043)	(0.053)
Other, t-1	0.753	0.072	-0.344	-0.688	1.014	-0.652	-0.123	-0.031
	(0.617)	(0.945)	(0.518)	(0.522)	(0.678)	(0.404)	(0.302)	(0.371)
Outcome Mean	21.66	20.67	14.33	11.84	13.74	9.11	3.39	5.26
Observations	657	657	657	657	657	657	657	657
R-squared	0.190	0.506	0.344	0.266	0.258	0.542	0.313	0.322

Note: The unit of observation is a county-cohort pair. Outcomes are measured as the number of students who enroll in a given program within 6 months of high school graduation per 100 students who in the county and cohort enroll in vocational programs. I define social service programs as those with 2-digit occupation codes of 21 (Community and Social Service) and 25 (Education, Training, and Library), plus childcare programs (SOC 39-9011); arts and media programs as those with the 2-digit occupation code 27 (Arts, Design, Entertainment, Sports, and Media); and personal care and culinary programs as those with the 2-digit codes 35 (Food Preparation and Serving) and 39 (Personal Care and Service), other than childcare, plus baking programs (SOC 51-3011). The coefficients in each column are estimated from a separate regression and represent the β_j terms in equation (6) of the main text, the effect of an additional layoff per 10,000 working age residents in a given occupation group on the outcome of interest. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.12: O*NET Skill Measures by Community College Program Group

	Business (1)	**Health (2)**	**Trades (3)**	**STEM (4)**	**Law Enf. (5)**	**Other (6)**
Panel A. Cognitive Skills						
Active Learning	50.61	53.41	40.38	50.28	46.30	45.95
Active Listening	56.56	57.35	42.20	52.62	56.24	50.80
Critical Thinking	55.74	55.93	45.29	54.42	56.08	49.52
Learning Strategies	44.15	49.52	34.37	43.75	44.33	42.49
Mathematics	38.88	38.10	29.99	49.88	27.84	26.22
Monitoring	54.40	55.40	43.85	51.09	51.35	49.64
Reading Comprehension	56.53	58.77	40.82	56.96	55.13	50.11
Science	14.83	40.91	17.69	37.79	12.74	8.08
Speaking	55.62	55.60	39.90	50.65	55.34	49.99
Writing	53.57	52.42	35.61	50.03	47.75	46.35
Panel B. Technical Skills						
Equipment Maintenance	0.68	2.81	42.18	25.62	2.71	3.55
Equipment Selection	0.65	9.89	35.51	31.48	3.17	9.37
Installation	0.02	0.84	24.59	18.04	0.06	0.99
Operation Monitoring	31.92	37.73	45.75	43.63	35.22	25.75
Operation and Control	19.67	28.87	44.56	32.11	35.80	15.78
Operations Analysis	38.59	28.07	21.45	39.92	23.85	27.87
Programming	9.27	8.26	8.82	35.41	6.41	7.51
Quality Control Analysis	25.96	33.23	46.35	46.77	26.46	25.56
Repairing	0.58	1.92	44.14	24.73	2.77	2.40
Technology Design	13.70	13.28	16.40	34.38	9.07	14.09
Troubleshooting	15.54	20.18	45.15	41.87	16.98	12.17
Panel C. Social Skills						
Coordination	52.39	53.69	40.98	46.16	53.92	48.79
Instructing	44.73	50.93	37.71	46.18	45.92	42.62
Negotiation	49.13	43.26	28.95	36.90	54.33	41.17
Persuasion	47.81	46.54	33.12	40.66	53.32	43.38
Service Orientation	44.96	53.92	38.23	40.39	51.46	42.38
Social Perceptiveness	53.89	59.11	35.68	42.02	55.99	47.75

Note: Each column shows the average skill levels of occupations associated with a given program group, weighted by total program enrollments from 2009-2016. A higher skill level indicates that the skill is more likely to be required for the occupations associated with the program group.

Table A.13: Skill Distance Metrics Using All O*NET Skill Measures

	Business	**Health**	**Trades**	**STEM**	**Law Enf.**	**Other**
Business	0.000					
Health	0.352	0.000				
Trades	1.000	0.952	0.000			
STEM	0.762	0.669	0.640	0.000		
Law Enf.	0.339	0.369	0.942	0.815	0.000	
Other	0.286	0.476	0.892	0.794	0.339	0.000

Note: Each cell displays the skill distance metric between two program/occupation groups, when using all skill measures available in O*NET. See Section 6.3 in the main text for more information.

B Comparing Layoffs to Other Employment Data Sources

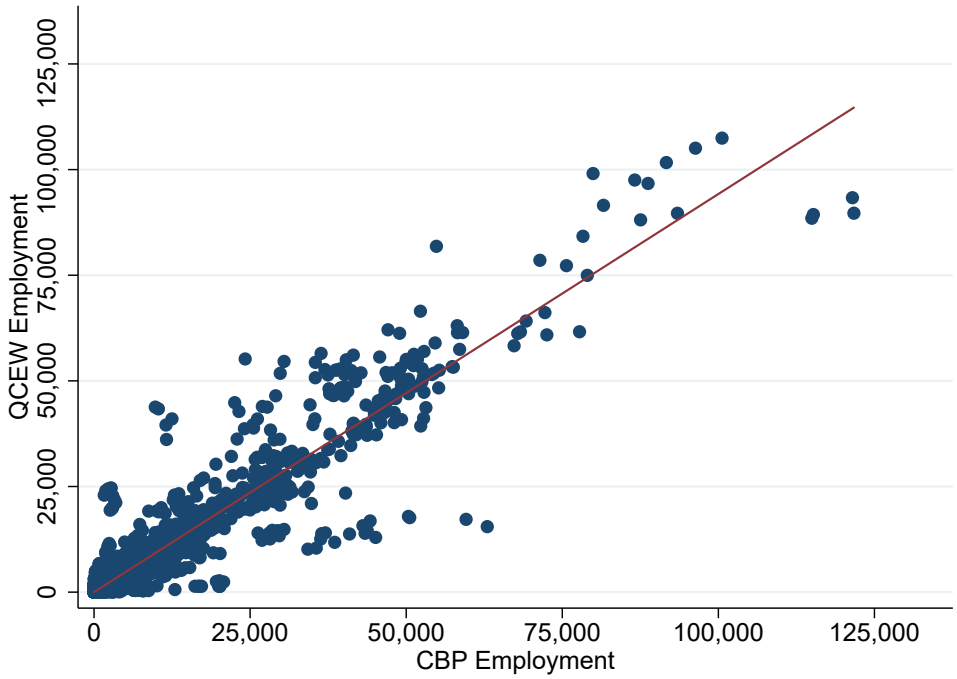
The estimated layoff measures used throughout the analysis are designed to capture changes in local labor demand in a given county and group of occupations. These measures should not, however, be treated as the exact number of job losses in an occupation group and county because not all layoff events are required to be reported under the WARN Act and, among events that are required to be reported, there is non-compliance in reporting. For example, in 2001, the federal government estimated that only about one quarter of events were required to be reported under the WARN Act and that, of those that were required to be reported, only one-third of were reported to the correct government agencies (United States General Accounting Office, 2003).

To verify that these proxy measurements capture true changes in employment over time and across counties, I compare county-by-industry layoffs to analogous employment data from two commonly used employment datasets: the Quarterly Census of Employment and Wages (QCEW) and the County Business Patterns (CBP). The QCEW is published quarterly by the Bureau of Labor Statistics and captures employment in more than 95% of U.S. jobs. However, a large share of its data at the county-by-industry level is suppressed due to privacy concerns. The CBP is released annually by the U.S. Census Bureau and captures the number of establishments and total employment during the week of March 12. Like the QCEW, many county-by-industry cells in the CBP are suppressed to prevent users from inferring information about individual firms. But in contrast to the QCEW, employment counts for some cells in the CBP can be imputed from establishment counts and higher-level geographic and industrial classifications. In the analyses that follow, I use the imputed data provided by Eckert et al., 2020 to maximize the coverage of Michigan's counties.

I begin by comparing the county-by-industry employment counts provided by both the QCEW and CBP. Because the CBP data does not contain information on government employment, I restrict the sample to all non-government NAICS 3-digit sectors. I further restrict the sample to county-by-industry pairs that have non-zero employment counts in all years 2001-2016 in at least one of the datasets. Figure B.1, below, provides a simple scatterplot of employment counts in the

two datasets for the 73% of observations (3,630 county-industry pairs) that contain employment information in both datasets. The two measures of employment are highly correlated, with a Pearson's coefficient of 0.95.

Figure B.1: Comparison of Employment Counts in QCEW & CBP



Then, with each dataset, I estimate regressions of the following form:

$$\Delta\text{Employment}_{kct} = \alpha + \beta\text{Layoffs}_{kc,t-1} + \varepsilon_{kct} \tag{1}$$

where $\Delta\text{Employment}_{kct}$ is the change in employment in industry k in county c between March of year $t-1$ and March of year t, and $\text{Layoffs}_{kc,t-1}$ is the number of layoffs in industry k in county c between March of year $t-1$ and March of year t.[1] The parameter of interest, β, captures the relationship between layoffs and year-over-year employment change in a given county and industry. If β is equal to -1, then, on average, an additional layoff is associated with an employment reduction of exactly one worker. If $|\beta|$ is less than 1, then an additional layoff reduces employment

[1] The CBP provides employment counts as of March 12. To track corresponding employment changes in the QCEW, I use the first quarter, third month employment counts.

by less than one worker on average, presumably because some laid-off workers find work at other firms in the same county and industry or other firms are increasing employment at the same time as the layoff. Alternatively, if $|\beta|$ is greater than 1, then an additional layoff reduces employment by more than one worker on average, indicating that there are additional employment reductions, including changes in labor supply, that are not captured in the WARN data. Table B.1 presents the results of this specification using each dataset.

Table B.1: Relationship Between Estimated Layoffs & Employment Change

Layoff measure:	**(1)**	**(2)**	**(3)**
Panel A. Quarterly Census of Employment & Wages (QCEW)			
Layoffs in county and industry, t-1	-1.236***	-1.139***	-0.749***
	(0.322)	(0.312)	(0.266)
County, industry, and year FEs		X	X
Interacted FEs			X
County-Year-Industry Obs.	47,399	47,398	47,254
Panel B. County Business Patterns (CBP)			
Layoffs in county and industry, t-1	-0.942***	-0.914***	-0.803***
	(0.196)	(0.196)	(0.202)
County, industry, and year FEs		X	X
Interacted FEs			X
County-Year-Industry Obs.	58,202	58,202	58,186

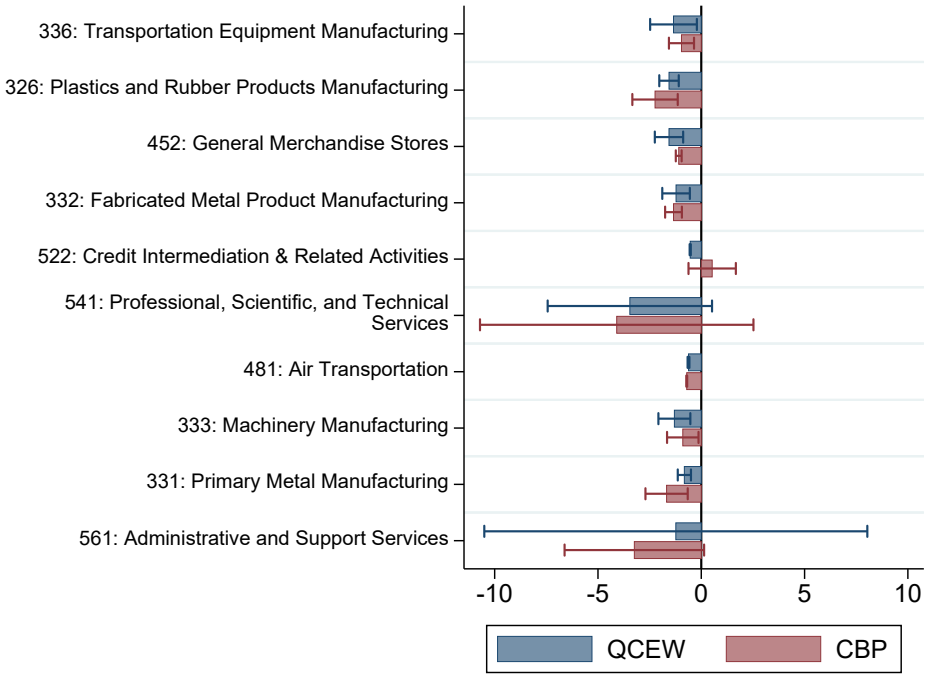
Note: The sample consists of all county-by-industry pairs that have non-zero employment between 2001 and 2016 in either the QCEW or CBP dataset. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Column (1) shows that an additional layoff is associated with an employment reduction of 1.2 workers in the QCEW and of 0.94 workers in the CBP data. Column (2) then adds county, industry, and year fixed effects to assess whether the negative relationship continues to hold after controlling for factors that may induce layoffs (e.g., overall economic downturns or industry-specific turnover patterns). When using either dataset, the estimated change in employment due to an additional layoff remains negative, statistically significant and close to -1 when including these fixed effects. Finally, column (3) interacts these fixed effects to mimick the interacted fixed effects in equation (6) in the main text. When controlling for county-by-year, county-by-sector, and sector-by-year

effects, an additional layoff reduces employment by 0.75 workers (QCEW) to 0.8 workers (CBP). The estimates remain statistically significant, indicating that the layoff measures are indeed capturing changes in local employment counts.

Finally, to ensure that the relationship between is not driven by select industries, I estimate equation (1) separately for the ten NAICS 3-digit subsectors with the most layoffs in the WARN data. Figure B.2 presents these results. The estimated coefficients are overwhelmingly negative and do not vary substantially by dataset, again indicating that the layoff measures used throughout the paper capture true changes in local employment conditions.

Figure B.2: Relationship between Layoffs and Employment Changes, by Sector



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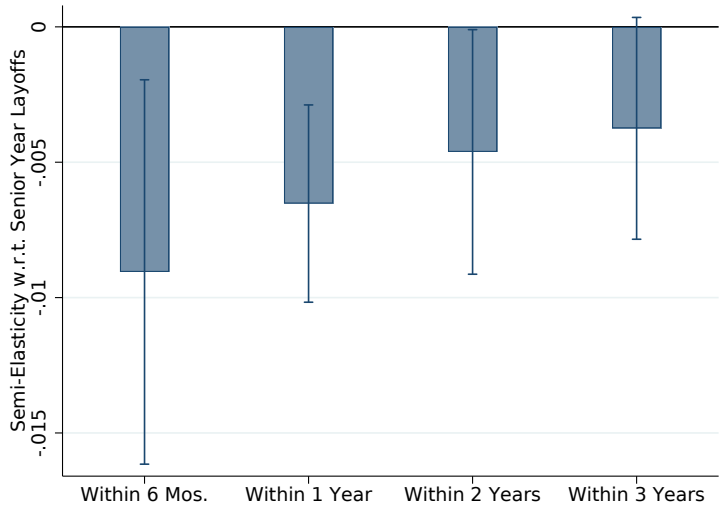
United States General Accounting Office. 2003. The Worker Adjustment and Retraining Notification Act: Revising the Act Could Clarify Employer Responsibilities and Employee Rights. `https://www.gao.gov/new.items/d031003.pdf`.

C Effect of Layoffs on Other Educational Outcomes

To supplement the main analysis, I also analyze how layoffs affect two other educational outcomes of interest: (1) the enrollment choices of students beyond the first six months of high school graduation and (2) the retention rates of students already enrolled in vocational community college programs. For the first outcome, I restrict the sample to students who graduate from high school between 2009 and 2013 and re-estimate equation (3) in the main text for different enrollment time frames. Figure C.1 below presents these results.

Figure C.1: Effect of Layoffs on Later Program Choices



Note: The presents estimates of β from equation (3) of the main text where the outcome variable is measured over different time frames. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's senior year of high school. All standard errors are clustered at the county level.

As in the main results that include all cohorts, an additional layoff per 10,000 county residents in the senior year of high school reduces enrollment in related programs within six months of high school graduation by about 1%. This estimate becomes smaller, but remains negative and statistically significant at the 10% level, as I expand the time frame of enrollment to one year, two year, or three years following high school graduation. The attenuation of the results is consistent with students moving across counties or gaining new information about the labor market as they

age, and therefore, being less influenced by shocks that occurred during high school.

Next, I consider how layoffs affect vocational program retention rates. I include all cohorts and estimate equations of the following form:

$$\text{Retention}_{gct} = \alpha + \mathbf{Layoffs}_{gct}\beta + \mathbf{X}_{ct}\Gamma + \lambda_{gc} + \delta_{gt} + \varepsilon_{gct} \tag{1}$$

where Retention_{gct} is a measure of the year-over-year retention of students from county c enrolled in program group g in year t, Layoffs_{gct} is a measure of analogous layoffs, and all other terms are defined as in previous equations in the main text. My main measure of retention is the number of students from county c who were enrolled in program group g in year $t-1$ and remain enrolled in the same program and community college in year t, per 100 students initially enrolled.[1] I also calculate measures of students switching between programs and between colleges, graduating from programs, and not being observed in the data the following year. I measure layoffs as those that occur between July 1st of year $t-1$ and June 30th of year t to capture layoffs that students observe throughout the year in which they are enrolled in a program.

Table C.1 presents these results. Column (1) indicates that an additional layoff per 10,000 working-age residents reduces program retention by 0.26pp, or about 0.6%. This estimate is smaller than the decrease in initial program enrollment documented in my earlier results, which is consistent with the fact that students already enrolled in a program likely face a lower marginal cost to finishing. For example, they have likely already completed some of the coursework needed to earn a degree in the subject. I also estimate the effects of layoffs on retention separately for each program group using a modified version of the systems of equations setup.[2] Table C.2 presents these results, which indicate that the largest elasticities come from students' responses to layoffs in STEM and other programs.

Columns (2) through (5) of Table C.1 document what choices students make when layoffs deter them from continuing in vocational programs. While the estimates are imprecise, the largest coefficient appears in Column (5), which measures the share of students who were enrolled in a program

[1] In these calculations, I only consider enrollment in the college at which students earn the most credits during a given year. That is, if a student enrolls in two colleges within one year, she is assigned to enrollment only at the college in which she earns more credits.

[2] Specifically, I regress a program's retention rate on the vector of layoffs occurring in each occupation group, county control variables, county fixed effects, and cohort fixed effects.

in the prior year but are no longer formally enrolled in postsecondary education. In most cases, this means that a student has dropped out of her community college program without earning a degree.[3] Given the large labor market returns to degree completion, this type of substitution effect may negatively impact students' longer-run outcomes and suggests that policies that assist students in switching between programs after local labor market shocks could improve student outcomes.

Table C.1: Effect of Layoffs on Retention in Related Programs

	Number per 100 Prior-Year Vocational Students:				
Layoff measure:	**Same Program (1)**	**Different Program (2)**	**Different College (3)**	**Earned Degree (4)**	**Not Observed (5)**
Layoffs per 10,000 in occupation group	-0.264**	-0.034	-0.008	0.027	0.279**
	(0.128)	(0.027)	(0.043)	(0.052)	(0.129)
Outcome Mean	43.48	11.92	10.62	8.54	25.44
County-Program-Year Obs.	3,364	3,364	3,364	3,364	3,364
R-Squared	0.246	0.300	0.270	0.374	0.276

Note: The unit of observation is a county-year-program triad. Each coefficient is estimated from a separate regression and represents β in equation (1), the effect of an additional layoff per 10,000 working age residents in a given occupation group on retention in related programs. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's first year of college. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C.2: Own-Layoff Effects on Program Retention Rates

	Retention per 100 Students in:					
Layoff measure:	**Business (1)**	**Health (2)**	**Trades (3)**	**STEM (4)**	**Law Enf. (5)**	**Other (6)**
Layoffs per 10,000 in own occupation group	-0.250	-0.082	-0.364	-1.307	-0.226	-3.600***
	(0.546)	(0.275)	(0.246)	(0.951)	(0.204)	(1.358)
Outcome Mean	41.41	43.93	43.98	45.25	41.97	44.37
County-Year Obs.	566	566	560	554	560	558
R-Squared	0.353	0.291	0.253	0.245	0.285	0.233

Note: The unit of observation is a county-cohort pair. Each coefficient is estimated from a separate regression and represents the effect of an additional layoff per 10,000 working age residents in a given occupation group on retention in related programs. All regressions include controls for the share of graduates that are white, male, and categorized as economically disadvantaged; average 11th grade math and reading test scores; and the county unemployment rate, logged size of the labor force, and the number of layoffs per 10,000 working-age residents in non community college occupations during a cohort's first year of college. All standard errors are clustered at the county level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

[3]Students could also be enrolled in colleges not covered by the NSC data. However, these types of colleges make up less than 1% of U.S. postsecondary institutions overall.