SHEEO

A DREAM DERAILED?

INVESTIGATING THE CAUSAL EFFECTS OF COLLEGE CLOSURES ON STUDENT OUTCOMES

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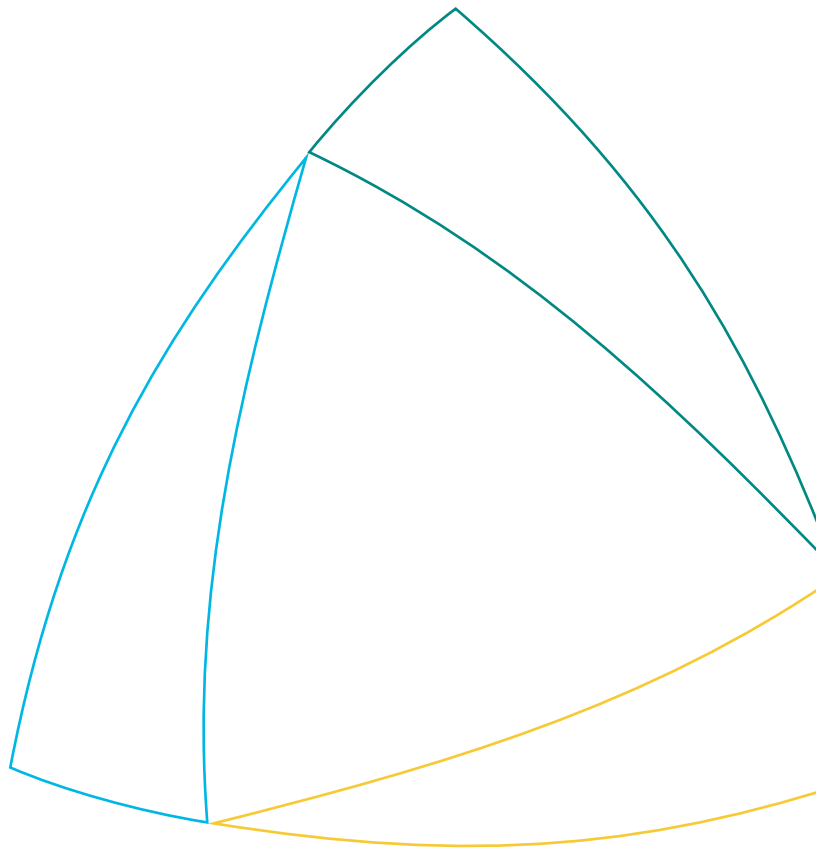DUSTIN WEEDEN

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ACKNOWLEDGEMENTS

An interactive and customizable visualization that summarizes outcomes for students who experienced closure and a closed institution data download capturing details to assist in determining abrupt and orderly closures are available on the project website (sheeo.org/project/college-closures).

SUGGESTED CITATION:

The State Higher Education Executive Officers Association (SHEEO) serves the executives of statewide governing, policy, and coordinating boards of postsecondary education and their staffs. Founded in 1954, SHEEO promotes an environment that values higher education and its role in ensuring the equitable education of all Americans, regardless of race/ethnicity, gender, or socioeconomic factors. Together with its members, SHEEO aims to achieve this vision by equipping state higher education executive officers and their staffs with the tools to effectively advance the value of higher education, promoting public policies and academic practices that enable all Americans to achieve success in the 21st century, and serving as an advocate for state higher education leadership. For more information, visit sheeo.org.

EXECUTIVE SUMMARY

A Dream Derailed? Investigating the Causal Effects of College Closure on Student Outcomes is the second of three planned novel reports from a collaborative research team of SHEEO and the National Student Clearinghouse (NSC) Research Center, seeking to quantify the impacts of college closures on students' subsequent postsecondary enrollment and completion outcomes and to identify the policy levers states may have to support students who experience a closure. The first report in this series provided a descriptive analysis of the students who experienced a closure and their longitudinal enrollment and credential attainment outcomes after closure. Using an original panel dataset constructed with student-level data from the Clearinghouse, the first report traced if, when, and through which education pathways affected students reenrolled to continue their education and whether they were successful in earning a credential. This second report builds on the foundation established by the first report to provide estimates of the impacts of closures on student outcomes. It includes a matched sample of students who did not experience a closure as a comparison group for determining the direction and strength of the associations between closure and student outcomes such as enrollment, persistence, and completion. A forthcoming third report will incorporate the state authorization policy context to ascertain if policy interventions can ameliorate the negative impacts of closures on students.

Additional data resources and visualizations are available on the project website (sheeo.org/project/college-closures), including an interactive data visualization summarizing student outcomes.

The correlation between college closure and student outcomes is overwhelmingly negative: Students who experience a closure are less likely to reenroll, more likely to switch to a shorter-term credential than the one they were pursuing at time of closure, less likely to earn any credential post-closure, and take longer to complete a credential compared to students who did not experience a closure. These negative associations are most pronounced for students of color, students enrolled in certificate programs, and students enrolled in the for-profit sector. These students are also the most likely to experience an institutional closure, particularly abrupt closures that occur with little warning or time for students to prepare.[1]

ENROLLMENT OUTCOME FINDINGS

College closure is negatively correlated with a student's ability to reenroll after experiencing a closure. Whether measured one month or three years after closure, students who experienced a closure are significantly less likely than control students to be enrolled post-closure.

- The largest gap in predicted enrollment between students who experienced a closure (treatment students) and students who did not experience a closure (control students) occurs exactly one month post-closure, when treatment students are 71.3% less likely than control students to be enrolled.

- At exactly four months, treatment students are still 63.3% less likely to be enrolled, but are only 5.0% less likely to be enrolled after exactly one year.

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1. Burns, R., Brown, L., Heckert, K., & Weeden, D., Kim, H., Randolph, B., Pevitz, A., Karamarkovich, S., & Causey, J., (2022). *A dream derailed? Investigating the impact of college closures on student outcomes.* State Higher Education Executive Officers Association and National Student Clearinghouse Research Center. www.sheeo.org/wp-content/uploads/2022/11/SHEEO_NSCRC_College Closures_Report1.pdf

- At two and three years post-closure, treatment students are 17.3% and 39.0% less likely to be enrolled than control students.

Reenrollment likelihood for treatment and control students varies by student demographic and academic characteristics.

- Students of color are between 4.9% and 26.3% less likely than white students, and male students are between 3.0% and 14.1% less likely than female students, to be enrolled post-closure.

- Students pursuing associate and bachelor's degrees at the time of closure are between 29.8% and 161.6% more likely to be enrolled at all exact follow-up dates than students in certificate programs.

- Compared to students in public two-year institutions, students enrolled in private nonprofit two-year and four-year, public four-year, and for-profit four-year institutions are more likely to be enrolled, while students in for-profit two-year institutions are less likely.

Students who experienced a closure were more likely to transfer into an institution of the same type post-closure than students in the control group who chose to transfer for reasons unrelated to closure, particularly within the first year.

- At exactly one month after closure, treatment students are 121.8% more likely than control students to be enrolled in an institution in the same sector.

- This gap increases to 179.3% more likely at four months and 145.8% more likely at one year, then drops to 89.2% and 43.3% at two and three years, respectively.

The likelihood of enrolling in an institution of the same sector does not vary for most student demographics but does vary by academic and institutional characteristics.

- Black students are between 21.1% and 29.1% more likely than white students to transfer to an institution of the same sector across all follow-up dates.

- Within the first year of closure, students in bachelor's degree programs are between 14.1% and 60.8% more likely than students in certificate programs to remain in the same sector, but are less likely to remain in the same sector at two and three years post-closure.

- Conversely, associate degree students are less likely than certificate students to remain in the same sector at one month, one year, two years, and three years post-closure, but are 12.9% more likely to remain in the same sector at four months post-closure.

- Students enrolled in private nonprofit and for-profit two-year institutions are consistently between 75.9% and 95.5% more likely than students in public two-year institutions to change sectors.

- Students enrolled in public four-year institutions are between 32.7% and 78.5% more likely to change sectors at one month, four months, and one year post-closure, but are between 40.8% and 51.9% less likely to change sectors at two and three years post-closure when compared to community college students.

COMPLETION OUTCOME FINDINGS

Students who experienced a closure were equally likely to earn a credential at some time prior to institution closure—either at a previous postsecondary institution or at the closed institution—but were less likely to earn a credential after experiencing a closure than control students. For students with no prior credential, closure is significantly negatively correlated with credential completion, reducing the likelihood of completion by almost half.

- Compared to control students, students who experienced a closure were 6.1% more likely to ever earn a credential after controlling for student demographic and academic characteristics.

- When only considering post-closure outcomes for students who had not earned a prior credential, students who experienced a closure were 50.1% less likely to earn a credential than control students.

Credential completion after closure for students with no prior credential varies by student demographics and academic characteristics.

- Among students with no prior credential, students of color are between 19.5% and 28.2% less likely than white students to earn a post-closure credential, with the exception of Asian students, who are 29.7% more likely.

- Male students are 9.1% less likely than female students to earn a post-closure credential.

- Students age 21 and older are between 37.8% and 43.9% less likely to complete post-closure than students aged 18-20.

- Compared to students in certificate programs at the time of closure, students in associate and bachelor's programs are 14.3% and 50.1% more likely to complete a credential, respectively.

- Students enrolled in private for-profit two-year institutions at closure are 46.2% less likely to complete than students at public two-year institutions, while students in all other sectors are between 16.2% and 216.2% more likely to complete.

For both first-time completers and students with prior credentials, college closure is significantly negatively correlated with completing a credential of the same or higher type that a student was pursuing at the time of closure. Students who experienced a closure are more likely to complete a shorter-term credential (e.g., a certificate instead of an associate degree) as their highest credential earned.

- Students who experienced a closure are 7.7% less likely than control students to earn the same credential or higher after closure that they were pursuing at the time of closure.

- Among students with no prior credential, the difference is even larger: Treatment students are 19.9% less likely than control students to earn a credential of the same or higher that they were pursuing at the time of closure.

Among students who earned their first credential after closure, completion of the same or higher credential pursued at closure varies by student characteristics.

- Asian students are 58.1% more likely to earn a higher credential than white students, while Black students are 17.6% less likely.

- Compared to students enrolled in health sciences majors, students enrolled in all other major fields of study are between 11.3% and 185.4% more likely to complete a credential of the same or higher level after closure.

- Students enrolled in private for-profit, private nonprofit four-year, and public four-year institutions at closure are between 19.5% and 72.7% less likely to earn a credential of the same or higher level compared to students in public two-year institutions.

College closure is significantly negatively correlated with both overall time to completion and time to completion after closure for students who reenrolled and earned a credential. However, the magnitude of this difference is not large.

- Students who experienced a closure take, on average, 2.4 years from closure to first credential, compared to 2.2 years for control students. Treatment students take 7.6 years in total time to completion (from first postsecondary enrollment), compared to 8 years for control students.

- Among students who earned their first credential after closure, the time from closure to first credential is 82 days (2.7 months) longer for treatment students, while the time from first postsecondary enrollment to first credential is 56 days (1.8 months) longer.

The time from first postsecondary enrollment to first credential does not vary consistently by student demographics but does differ by academic characteristics.

- Compared to students in certificate programs, students in associate, bachelor's, and graduate degree programs take 102, 259, and 323 days (3.4 months, 8.5 months, and 10.6 months) longer to complete a credential.

- Students enrolled part time or a mix of part time and full time take 163 and 355 days (5.4 months and 11.7 months) longer to complete than students enrolled exclusively full time.

- Students enrolled in private nonprofit and for-profit two-year institutions at closure take 427 and 441 fewer days (1 year 2 months and 1 year 2.5 months) to complete than students in public two-year institutions, while students at public four-year institutions take an additional 114 days (3.7 months).

POLICY IMPLICATIONS

State agencies of higher education are an essential component of the regulatory triad[2] and can ensure institutions take actions to prevent closures or provide accommodations for students in the event of closure. Recommended actions for states and institutions include:

1. State agencies and institutions should simplify the transfer process for students affected by closure, allowing them to quickly reenroll and continue their postsecondary education with minimal interruptions.

2. State agencies and institutions should provide additional student support (e.g., transfer counseling and orientation, academic advising, tutoring services) for students who reenroll after experiencing a closure.

2.   The regulatory triad includes accreditors, state higher education agencies, and the U.S. Department of Education.

3. States and institutions should consider the effects of closure from an equity perspective that accounts for the persistently worse outcomes for students of color, older students, and students in subbaccalaureate degree programs.

4. State authorization policies should require institutions to submit and implement contingency plans in the event of college closure.

5. States should ensure authorization offices have the capacity, resources, and authority needed to serve students in the event of a closure.

6. States and institutions should scrutinize branch-to-branch transfer after closure and should provide pathways for students to reenroll at financially stable, accredited institutions.

7. State agencies should ensure that institutions receiving transfer students after closure meet certain quality criteria, including financial stability and a robust history of accreditation.

For additional data resources and to access the interactive data visualization, visit the project website (sheeo.org/project/college-closures).

STUDY BACKGROUND AND MOTIVATION

With the onset of the COVID-19 pandemic in early 2020, higher education researchers predicted that more institutions would permanently close their doors in response to financial challenges and enrollment declines.[3,4,5] Despite temporary in-person shutdowns, steadily declining enrollment,[6] and financial difficulties, institutions have largely defied these expectations, with only 758 branch campuses closing between July 2020 and December 2022.[7] This rate is far below the average closure rate of 800 to 1,200 branch closures per year between 2012 and 2019, which were precipitated by the increased regulation of the for-profit sector in the mid-2010s. The ability of many institutions to remain in operation during the height of the pandemic was due in part to federal funding disbursed through the Higher Education Emergency Relief Fund (HEERF), which provided direct emergency relief to institutions of higher education between 2020 and 2022. As this funding expires and institutions deplete their appropriations, institutions again confront the conundrum of rising instructional and operational costs[8] coupled with nationwide decreasing student enrollments, leading to further speculation regarding the acceleration of institutional closures in the coming years.[9,10] While closures are themselves frequently unavoidable once institutions are in dire financial situations, the regulatory triad of accreditors, state higher education agencies, and the U.S. Department of Education is responsible for ensuring that institutions have implemented safeguards to protect students during and immediately after closure.

The high-profile closures of several institutions in recent years due to challenges exacerbated by the pandemic (e.g., Mills College in Oakland, Concordia College in Manhattan, and Cazenovia College in New York) have refocused attention on predicting, preventing, and responding to institutional closures. Some closures cannot be avoided and may in fact serve as the best course of action for a struggling institution by allowing students to continue their education at financially stable, accredited alternatives. The deliberate management of closure and the provision of post-closure alternatives is an important determinant in the subsequent success of affected students. Importantly, ensuring that students have sufficient notice of an impending closure and clear alternatives for continuing their education is a key determinant in predicting post-closure reenrollment and completion.[11] Researchers and policymakers are particularly concerned

3. Doyle, W. (2020, October 12). Higher education's nightmare scenario. *Chronicle of Higher Education.* www.chronicle.com/article/higher-educations-nightmare-scenario

4. Aborn, M., & Megan, K. (2020). *College closures in the wake of COVID-19: A need for forward-looking accountability.* Bipartisan Policy Center. bipartisanpolicy.org/blog/college-closures-in-the-wake-of-covid-19-a-need-for-forward-looking-accountability/

5. Korn, M., Belkin, D., & Chung, J. (2020, April 30). Coronavirus pushes colleges to the breaking point, forcing 'hard choices' about education. *Wall Street Journal.* www.wsj.com/articles/coronavirus-pushes-colleges-to-the-breaking-point-forcing-hard-choices-about-education-11588256157

6. National Student Clearinghouse Research Center. (2023). *Current term enrollment estimates: Fall 2022 expanded edition.* nscresearchcenter.org/current-term-enrollment-estimates/

7. Postsecondary Education Participants System. Federal Student Aid.

8. Commonfund Institute. (2022). *Commonfund higher education price index 2022 update.* www.commonfund.org/hubfs/04%20Institute/HEPI/Reports/Commonfund-Higher-Education-Price-Index.pdf

9. Sanchez, O. (2023, January 13). With student pool shrinking, some predict a grim year of college closings. *Hechinger Report.* hechingerreport.org/with-student-pool-shrinking-some-predict-a-grim-year-of-college-closings/

10. Moody, J. (2023, January 19). A harbinger for 2023? Presentation college to close. *Inside Higher Ed.* https://www.insidehighered.com/news/2023/01/19/more-colleges-will-likely-face-closure-2023-experts-say

11. Burns, R., Brown, L., Heckert, K., & Weeden, D., Kim, H., Randolph, B., Pevitz, A., Karamarkovich, S., & Causey, J., (2022). *A dream derailed? Investigating the impact of college closures on student outcomes.* State Higher Education Executive Officers Association and National Student Clearinghouse Research Center. www.sheeo.org/wp-content/uploads/2022/11/SHEEO_NSCRC_College Closures_Report1.pdf

with the impact of closures on students' educational trajectories and debt accumulation,[12] including whether they are able to continue their studies at another postsecondary institution and ultimately earn a credential. After closure, students must consider whether and how to reenroll, means for financing their continued education, and whether they are responsible for loans incurred in the process of seeking an unearned credential. Some students who experience a closure and do not complete a credential or reenroll may be eligible for federal student loan discharge, but not all students are eligible for or take advantage of this financial relief. While the regulatory triad cannot entirely preclude imminent institutional closures, it can ensure that institutions have teach-out agreements, tuition refund policies, credit transfer agreements, loan discharge opportunities, and transcription retention plans to ameliorate any potential negative impacts on students.

EXISTING RESEARCH

Existing research on college closures has primarily served to establish metrics for predicting closures,[13] estimate the impacts of federal sanctions on enrollment rates,[14] understand the impact of federal policies on closures,[15] or analyze the uptake of loan discharge.[16] Qualitative research on institutional closure has focused on students' perceptions and experiences of closure, including initial shock and confusion followed by anger and financial difficulties.[17] The first report in this series, *A Dream Derailed? Investigating the Impacts of College Closures on Student Outcomes* (referred to as *Impacts* throughout this paper), published by SHEEO and the NSC Research Center, was the first report to empirically investigate the longitudinal outcomes of a large sample of students who experienced college closures between 2004 and 2020. The study confirmed that less than half (47.1%) of students reenrolled in postsecondary education after experiencing a closure, and of those who did reenroll, only 36.8% earned a postsecondary credential. As a purely descriptive study, the first report in this series did not provide a comparison group of similar students who did not experience a closure and thus could not provide causal estimates of the impact of closure.

Anecdotal and descriptive evidence of the impacts of closure on individual students, while impactful, does not paint the full empirical picture of the negative outcomes associated with a college closure. For instance, it may be that the student populations more likely to attend colleges that ultimately close are populations that have lower retention and completion rates even in the absence of closure. Moreover, the institutions that are more likely to close (private for-profit institutions) may also have lower persistence and completion rates than institutions that are less likely to close. Disentangling the impacts of a closure on student outcomes thus requires a methodology that accounts and controls for variables such as student academic characteristics and institution type. As a follow-up to the first report in this series, this second report provides a fuller understanding of the effects of closure on student outcomes by constructing a sample of students who did not experience a closure, and comparing the enrollment and completion outcomes of students who experienced a closure with those who did not.

12. Government Accountability Office. (2022). *College closures: Education should improve outreach to borrowers about loan discharges.* www.gao.gov/assets/gao-22-104403.pdf

13. Kelchen, R. (2020). *Examining the feasibility of empirically predicting college closures.* Working paper. www.brookings.edu/wp-content/uploads/2020/09/ES-Kelchen-09.08.20-1.pdf

14. Cellini, S., Darolia, R., & Turner, L. (2020). Where do students go when for-profit colleges lose federal aid? *American Economic Journal: Economic Policy 12*(2): 46-83.

15. Kelchen, R., & Lui, Z. (2022). Did gainful employment regulations result in college and program closures? *Education Finance and Policy, 17*(3): 454-478. doi.org/10.1162/edfp_a_00340

16. Emry-Arras, M. (2021). *College closures: Many impacted borrowers struggled financially despite being eligible for loan discharges.* United States Government Accountability Office (GAO). www.gao.gov/assets/gao-21-105373.pdf

17. Caldwell, J. (2013). *The impact and lasting effects on students involved in a campus closing.* Master of Arts in Higher Education (MAHE) Theses. 53.

RESEARCH QUESTIONS

This report expands on previous research and the first report in this series by providing estimates of the impacts of college closures on student outcomes. The research questions include:

RQ1. How does the persistence rate of students who experienced a closure differ from the persistence rate of students who did not experience a closure? Persistence rates are measured at one month, four months, one year, two years, and three years after closure.

RQ2. How does the institution sector at closure and after closure differ for students who experienced a closure and students who did not experience a closure? Institution type is measured at one month, four months, one year, two years, and three years after closure.

RQ3. How does the overall completion rate of students who experienced a closure differ from the overall completion rate of students who did not experience a closure? How does the credential completion rate post-closure of students who experienced a closure differ from the completion rate of students who did not experience a closure?

RQ4. How does the type of credential earned compare to the type of credential pursued at time of closure differ for students who experienced a closure and students who did not experience a closure?

RQ5. How does the time to completion differ for students who experienced a closure and students who did not experience a closure? Time to completion is measured from first postsecondary enrollment to first post-closure credential and from time of closure to first post-closure credential.

FORTHCOMING REPORTS

To further explore the policy levers available to states, the third and final report in this series will examine how state authorization policies affect student outcomes post-closure, comparing students who experienced a closure in states with stringent protections with those who experienced a closure in states with lenient student protections.

METHODOLOGICAL NOTES

This report uses an original panel dataset constructed with student-level data from the Clearinghouse, federal data sources for institutional and student demographic information, and an original institutional data source containing contextual college closure information. The dataset for this report builds on the first report in this series by incorporating matched institution and student samples to identify a control group of students who did not experience a closure. The combined dataset includes enrollment and credential completion records for 143,215 treatment students who experienced a closure at 467 institutions of higher education between July 1, 2004, and June 30, 2020, and 1,295,773 matched control students enrolled in 467 matched institutions who did not experience a closure.

INSTITUTIONAL AND STUDENT DATA COLLECTION

Institutional data were sourced from the Integrated Postsecondary Education Data System (IPEDS), the College Scorecard, the Postsecondary Education Participants System (PEPS), and the Federal Student Aid (FSA) Data Center. After data cleaning and elimination of non-Clearinghouse reporting institutions, the final sample included 934 unique 8-digit OPEIDs at the campus level, including 467 institutions that closed between July 1, 2004, and June 30, 2020, and 467 matched institutions that did not close.[18]

This study includes 143,215 treatment students who (1) had an eligible enrollment (full- or part-time enrollment of 21 days or longer) at one of the 467 closed degree-granting institutions within 120 days prior to the date of closure; or (2) had a valid enrollment for the term during which the closure occurred. Enrollment and credential records prior to, during, and after a closure experience were tracked to capture academic trajectories over a student's full postsecondary career. For students with multiple closure experiences, analyses are based on their first closure experience unless otherwise noted. An additional 1,517,775 students were identified as a control group of students who were enrolled in one of the 467 open institutions during the same time period that closure occurred in the matched closed institution and fit the same enrollment criteria described above for treatment students. This control sample was reduced to 1,295,773 students by the matching procedures described below.

For additional details on institutional and student data collection procedures, see the first report in this series (sheeo.org/wp-content/uploads/2022/11/SHEEO_NSCRC_CollegeClosures_ Report1.pdf).

MATCHING PROCEDURES

Matching occurred in two steps. First, a matched sample of open institutions was selected based on their similarity to the institutions that closed. An institution-level match was necessary to limit the number of possible comparison students in the Clearinghouse database to a manageable number of observations. Open institutions were sampled from the universe of 3,299 open institutions identified in the *Impacts* paper, then reduced to the 816 institutions that matched to the Clearinghouse database. To retain sufficient sample size for comparisons, a one-to-one

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18. The 8-digit OPEID is a distinct campus-level institution identifier. Branch campuses in a multi-campus system have the same first six digits of the 8-digit OPEID.

match per closed OPEID was implemented using coarsened exact matching (CEM). CEM is an algorithm for matching treatment and control groups by reducing the monotonic imbalance between groups.[19] The advantage of CEM over other matching approaches is the elimination of the need for perfect balance on all units in all dimensions. The algorithm instead coarsens values of specified variables using automatic binning of values, then generates strata for each unique observation. These strata are used to identify matches between the treatment and control groups.

One drawback of CEM is the inability to match all treatment cases when a large number of matching variables is used. The design of this study required retention of all treatment institutions while also matching on as many variables as possible. Several approaches to CEM were considered to achieve these ends, including matching on smaller numbers of variables. Post-matching comparisons revealed that a match on less than three variables was not sufficient for generating a comparable control sample. Thus, to generate the most precise matches, matching was conducted using a novel approach: CEM was run in 12 steps, with progressively smaller numbers of matching variables in each step to identify matches for any institutions not matched in the prior step. Observations matched in one step were dropped from the next step, then merged at the conclusion of the matching process. Because CEM was run using a one-to-one match, the CEM weight for each institution is equal to 1. Each of the 12 steps of the matching process is equally weighted.

After the first matching process, some institutions were eliminated due to insufficient reporting to the Clearinghouse (e.g., missing reporting years). The match was rerun on a case-by-case basis to replace institutions without full enrollment and completion data. Several approaches to constructing the control group through matching were explored, including a one-to-one match by collapsing all years into an average for each observation, weighted matching for all rounds of imputation with multiple control observations per treatment observation, and weighted matching using only the final round of imputation. Comparisons of imbalance across the four approaches confirmed that the one-to-one match per closed OPEID yielded the best results when comparing post-matching covariate balance. The variables used in each step of the matching process and the number of observations matched appear in *Table 1*. The measures of imbalance between the treatment and control groups on key variables of interest prior to and after matching appear in *Appendix B, Table B1.*

19. Blackwell, M., Iacus, S., King, G., & Porro, G., (2010). cem: *Coarsened exact matching in Stata.* gking.harvard.edu/files/cem-stata.pdf

TABLE 1
VARIABLES FOR INSTITUTION-LEVEL STEP-BY-STEP COARSENED EXACT MATCHING

MATCHING VARIABLE	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7	STEP 8	STEP 9	STEP 10	STEP 11	STEP 12
UNDERGRAD FTE	X	X	X	X	X		X					X
PERCENTAGE AGE 24+	X	X	X									
PERCENTAGE FEMALE	X	X	X	X								
PERCENTAGE STUDENTS OF COLOR	X	X	X	X	X	X						
PERCENTAGE PART TIME	X											
PERCENTAGE WITH PELL	X											
AVERAGE LOANS	X											
TUITION REVENUE	X											
PERCENTAGE DIST ED	X											
GRADUATION RATE	X	X										
RETENTION RATE		X										
SECTOR		X	X	X	X	X	X	X	X			
CONTROL		X								X		
HIGHEST LEVEL		X	X	X	X	X	X	X			X	
MATCHES	10	16	120	152	214	54	56	136	4	28	92	52

Following matching of the treatment and control institutions, an artificial matched closure date was assigned to each control institution and student based on the closure date of the corresponding treatment institution.[20] Control students were selected at the control institutions if they (1) had an eligible enrollment (full- or part-time enrollment of 21 days or longer) at one of the 467 control institutions within 120 days prior to the matched artificial date of closure; or (2) had a valid enrollment for the term of the matched artificial date of closure.

The next matching step identified an appropriate group of control students from the 1,517,775 students enrolled in the 467 matched control institutions. The aims of the matching procedure were (1) to achieve better balance across the treatment and control groups; (2) to keep as many treatment observations as possible; and (3) to slightly reduce the number of control observations while still maintaining a healthy pool to use as a weighted control group. This avoids forcing a one-to-one match which can result in a biased sample, especially when treatment and control groups are vastly different in size.[21]

Several matching procedures at the student level were explored, including kernel propensity score matching, propensity score weighting, coarsened exact matching, one-to-one caliper matching, and Mahalanobis distance matching with variable ratios with and without a caliper. See *Appendix B*

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20. For example, if a control student attended an open institution that was matched to a closed institution that closed on April 1, 2006, the artificial matched institution closure date for the control student is April 1, 2006.

21. Ming, K., & Rosenbaum, P. R. (2001). A note on optimal matching with variable controls using the assignment algorithm. *Journal of Computational and Graphical Statistics, 10*(3), 455–463. doi.org/10.1198/106186001317114938

for further discussion of these approaches. Given the goals for identifying a matching procedure, Mahalanobis distance matching was selected and implemented using the *ultimatch* package in Stata 17.[22] As opposed to the more common propensity score matching, Mahalanobis distance matching facilitates the identification of the closest neighbors to each treated observation based on covariate proximity as opposed to probability of treatment group assignment.[23]

This approach defines strata for exact matches on race, gender, and age group, requiring that counterfactual (control) cases be in the same stratum as corresponding treated observations. This method also minimizes the distance between the selected counterfactual cases and the treated cases based on other key covariates: credential level at the time of closure; whether the respondent had earned a credential prior to enrolling in the closed institution (or matched open institution, for control students); respondent's highest credential earned prior to enrolling in the closed institution (or matched open institution, for control students); whether the respondent had a prior postsecondary enrollment at another institution prior to enrolling in the closed institution (or matched open institution, for control students); and enrollment intensity while enrolled at the closed institution (or matched open institution, for control students). The variables used in the matching process appear in *Table 2*.

TABLE 2
VARIABLES FOR STUDENT-LEVEL MAHALANOBIS MATCH

MATCHING VARIABLE	VARIABLE DESCRIPTION
RACE/ETHNICITY	STUDENT RACE/ETHNICITY DURING ANY ENROLLMENT TERM
GENDER	STUDENT GENDER DURING ANY ENROLLMENT TERM
AGE CATEGORY	STUDENT AGE CATEGORY AT TIME OF INSTITUTION CLOSURE OR MATCHED ARTIFICIAL CLOSURE DATE
CREDENTIAL LEVEL	STUDENT CREDENTIAL LEVEL AT TIME OF INSTITUTION CLOSURE OR MATCHED ARTIFICIAL CLOSURE DATE
PRIOR CREDENTIAL	BINARY INDICATOR OF STUDENT'S CREDENTIAL ATTAINMENT PRIOR TO ENROLLING AT CLOSED OR MATCHED OPEN INSTITUTION
HIGHEST CREDENTIAL	STUDENT'S HIGHEST CREDENTIAL ATTAINED PRIOR TO ENROLLING AT CLOSED OR MATCHED OPEN INSTITUTION
PRIOR ENROLLMENT	BINARY INDICATOR OF STUDENT'S ENROLLMENT PRIOR TO ENROLLING AT CLOSED OR MATCHED OPEN INSTITUTION
ENROLLMENT INTENSITY	INDICATOR OF STUDENT'S ENROLLMENT INTENSITY ACROSS ALL TERMS ENROLLED AT CLOSED OR MATCHED OPEN INSTITUTION

After implementing this matching procedure, all students in the treatment group (n=143,215) are retained. The number of students in the control group (i.e., students enrolled at one of the 467 control institutions around the time of closure of the matched treatment) is reduced by about 15% (n=1,295,773). The resulting weights facilitate a near-perfect balance on key covariates (see *Appendix B, Table B2*). The remainder of this report will focus on the post-closure time frame, which is defined as the time after institution closure (for treatment students) and after the artificial matched institution closure date (for control students). For additional details on institution and student matching procedures, see *Appendix B*.

22. Doherr, T. (2019). *ULTIMATCH: Stata module to implement nearest neighbor, radius, coarsened exact, percentile rank and Mahalanobis distance matching.* Boston College Department of Economics. ideas.repec.org/c/boc/bocode/s458632.html

23. King, G., & Nielsen, R. (2019). Why propensity scores should not be used for matching. *Political Analysis, 27*(4), 435–454. doi.org/10.1017/pan.2019.11

REGRESSION ANALYSIS

Student outcomes for treatment and control groups are analyzed using logistic and linear regression models. All treatment students (n=143,215) and all matched control students (n=1,295,773) are included in the regression models, although some models are further subset to narrow the analysis to specific populations of interest (e.g., first-time completers). Weights from the *ultimatch* matching process described above are used in all models to create a balanced comparison of the two student groups.

Logistic regression models estimate the probability of a binary outcome (e.g., whether a student completed a credential) given a set of independent covariates. The logistic regression model is bounded by the values of the binary outcome (0 and 1) and assumes that the data follow a sigmoid, or s-shaped, function. The outcome of a logistic regression model is the log-odds of an event, which can be converted to a likelihood ratio that describes the likelihood of an event occurring conditional on receiving the treatment (i.e., institution closure). Likelihood ratios are equivalent to the exponential of the log odds coefficient and can be interpreted as the increased or decreased likelihood of an event occurring relative to the reference condition. The generalized model of the logistic regression is the form:

$$p(x) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x)}}$$

Where β_0 is the y-intercept, and β_1 is the slope of the log-odds as a function of x (the covariate of interest).

Logistic regressions are used to model the following enrollment and completion outcomes:

RQ1: Enrolled in postsecondary education one month, four months, one year, two years, and three years following closure (for treatment students) or the matched closure date (for control students).[24]

RQ2: Enrolled in a postsecondary institution in the same sector at one month, four months, one year, two years, and three years following closure (for treatment students) or the matched closure date (for control students).[25]

RQ3.1: Earned a credential at any time during postsecondary education.

RQ3.2: Earned a first postsecondary credential after closure (for treatment students) or the matched closure date (for control students).[26]

RQ4: Earned a credential of the same or higher type after closure (for treatment students) or the matched closure date (for control students) that student was pursuing at time of closure or the matched closure date.[27]

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24. Students who had earned a credential after closure but prior to the respective follow-up dates are excluded from these models.

25. These models are limited to treatment students who reenrolled after closure and control students who transferred institutions as of the respective follow-up dates.

26. Students who earned a credential prior to enrolling at the closed institution or the matched institution are excluded from these models. Students who were still enrolled as of February 2022 are also excluded.

27. These models are limited to students who earned a credential after closure or the matched closure date. Students with unknown credential types and non-credit credentials and students who were still enrolled as of February 2022 are excluded.

Ordinary least squares (OLS) regression models estimate the linear relationship between a continuous outcome (e.g., time to completion) and a set of independent covariates. The OLS regression model minimizes the sum of the squares of the differences between the values of the observed outcome variable and the estimated values of the linear function. The outcome of a linear regression is a beta coefficient that measures the value of a one-unit change in the independent variable (e.g., treatment) on the dependent (outcome) variable. The generalized model of the OLS regression is the form:

$$y = \alpha + \beta x$$

Where β is the slope and α is the y-intercept of the function, y is the value of the dependent variable, and x is the value of the covariate of interest.

Linear OLS regressions are used to model the following completion outcomes:[28]

> **RQ5.1:** Total time elapsed from first postsecondary enrollment to first postsecondary credential earned after closure (for treatment students) or the matched closure date (for control students).
>
> **RQ5.2:** Time elapsed from closure or the matched closure date to first postsecondary credential.

For both logistic and OLS regression models, independent covariates include race/ethnicity, sex, age category, major field of study, prior enrollment, degree program, enrollment intensity, institution sector, and institution region. Student race/ethnicity, sex, and age category are included due to differences by demographics in post-closure outcomes identified in the first report in this series. *Impacts* found that students of color, male students, and students older than 24 years had the worst reenrollment and completion outcomes. Student academic characteristics (i.e., major, prior enrollment, program, enrollment intensity) are included to account for differences that could arise from the availability of similar programs and the number of credits a student had incurred prior to closure. Institution sector is included due to results from *Impacts* that found that students in for-profit institutions had worse reenrollment and completion outcomes than students in other sectors. Institution region accounts for the variation in institutional density across regions, which could limit students' options for alternative opportunities post-closure.

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28. Students who earned a credential prior to enrolling at the closed institution or the matched institution are excluded from both of these models.

INSTITUTION SAMPLE CHARACTERISTICS

Treatment students experienced a closure at 467 campuses that closed between 2004 and 2020, while control students attended 467 matched institutions that did not close. The treatment group of institutions included a larger proportion of private for-profit two-year institutions (49.9% compared to 7.3%) and private for-profit four-year institutions (28.1% compared to 6.0%) than the control group of institutions (*Figure 1*). The treatment group included a smaller proportion of public two-year institutions (0% compared to 29.8%) and private nonprofit four-year institutions (17.8% compared to 46.5%) than the control group.

FIGURE 1
TREATMENT (N=467) AND CONTROL (N=467) INSTITUTIONS BY SECTOR
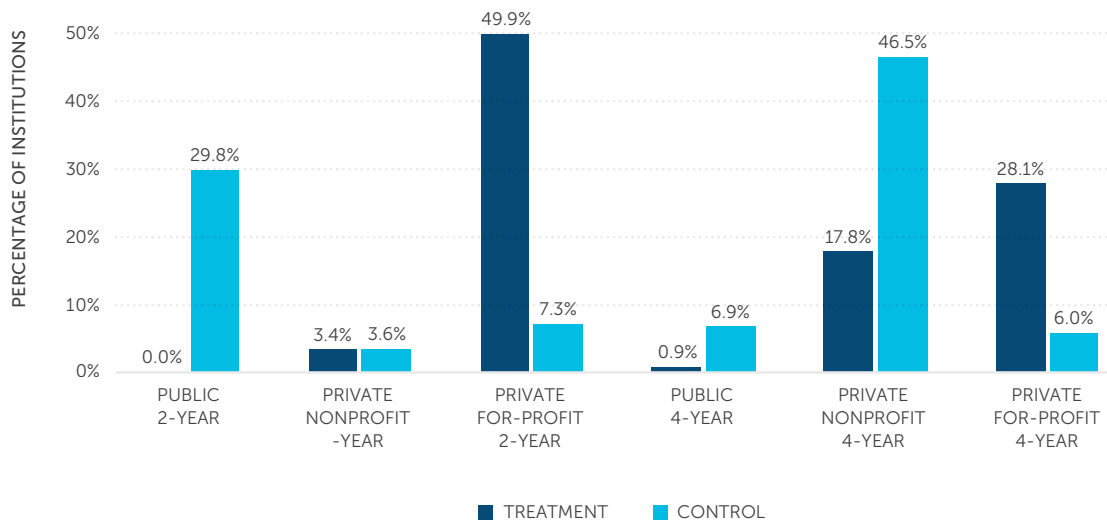
There were no stark differences in the regional distribution of treatment and control institutions. Slightly more treatment institutions were in the Great Lakes region (18.0% compared to 11.6%) and the Plains region (12.6% compared to 7.9%), while slightly fewer treatment institutions were in the Mid-Atlantic (10.5% compared to 19.5%) and Far West (16.3% compared to 20.3%) regions (*Figure 2*).

FIGURE 2

TREATMENT (N=467) AND CONTROL (N=467) INSTITUTIONS BY REGION
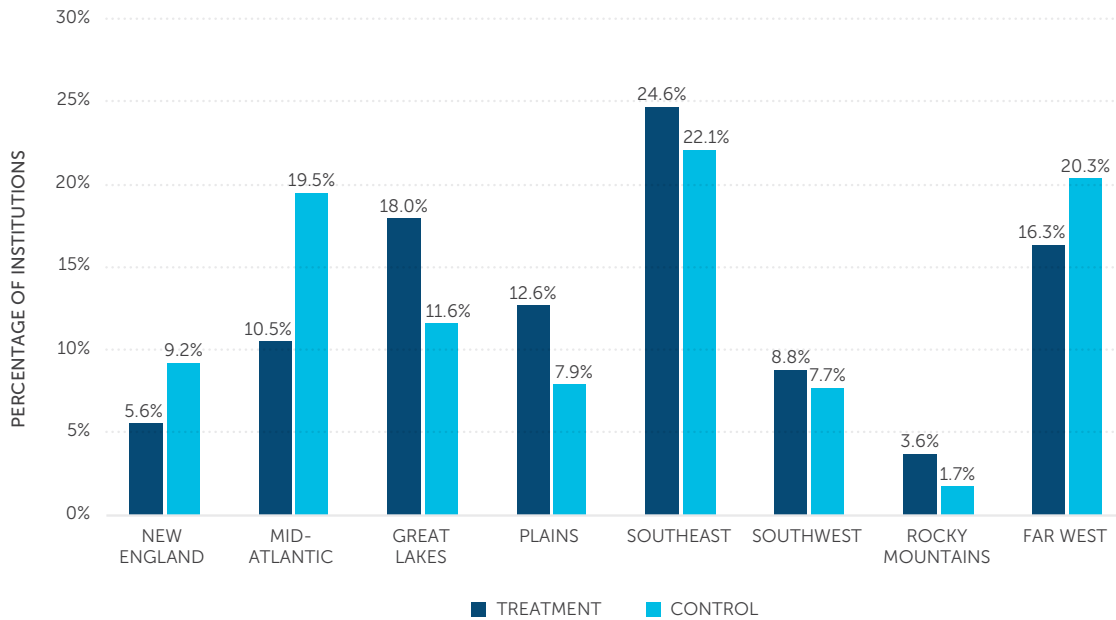
NOTE:

1. Institution region is determined by the location of the branch campus that closed. Some institutions may operate predominantly or entirely online, which is not reported in Clearinghouse data.

SOURCE: Integrated Postsecondary Education Data System (IPEDS), 2004-2020

After performing matching procedures that accounted for institution characteristics, the student demographics of treatment and control institutions were relatively similar. Treatment institutions had a higher percentage of Black students (23.0% compared to 14.6%) and lower percentage of white students (45.0% compared to 55.5%) (*Figure 3*). Treatment institutions enrolled more female students (69.5% compared to 60.7%), fewer part-time students (22.7% compared to 28.1%), and more Pell recipients (54.7% compared to 39.1%).

FIGURE 3

TREATMENT (N=467) AND CONTROL (N=467) INSTITUTION CHARACTERISTICS

Category	Treatment	Control
AMERICAN INDIAN/NATIVE ALASKAN	0.7%	1.6%
ASIAN	2.9%	4.8%
BLACK	23.0%	14.6%
HISPANIC	13.1%	12.7%
OTHER RACE	15.0%	10.8%
WHITE	45.0%	55.5%
FEMALE	69.5%	60.7%
MALE	30.5%	39.3%
UNDER 24	83.7%	83.9%
24 AND OLDER	16.3%	16.1%
FULL-TIME	77.3%	71.9%
PART-TIME	22.7%	28.1%
PELL RECIPIENT	54.7%	39.1%
NON-PELL RECIPIENT	45.3%	60.9%

PERCENTAGE OF STUDENT BODY
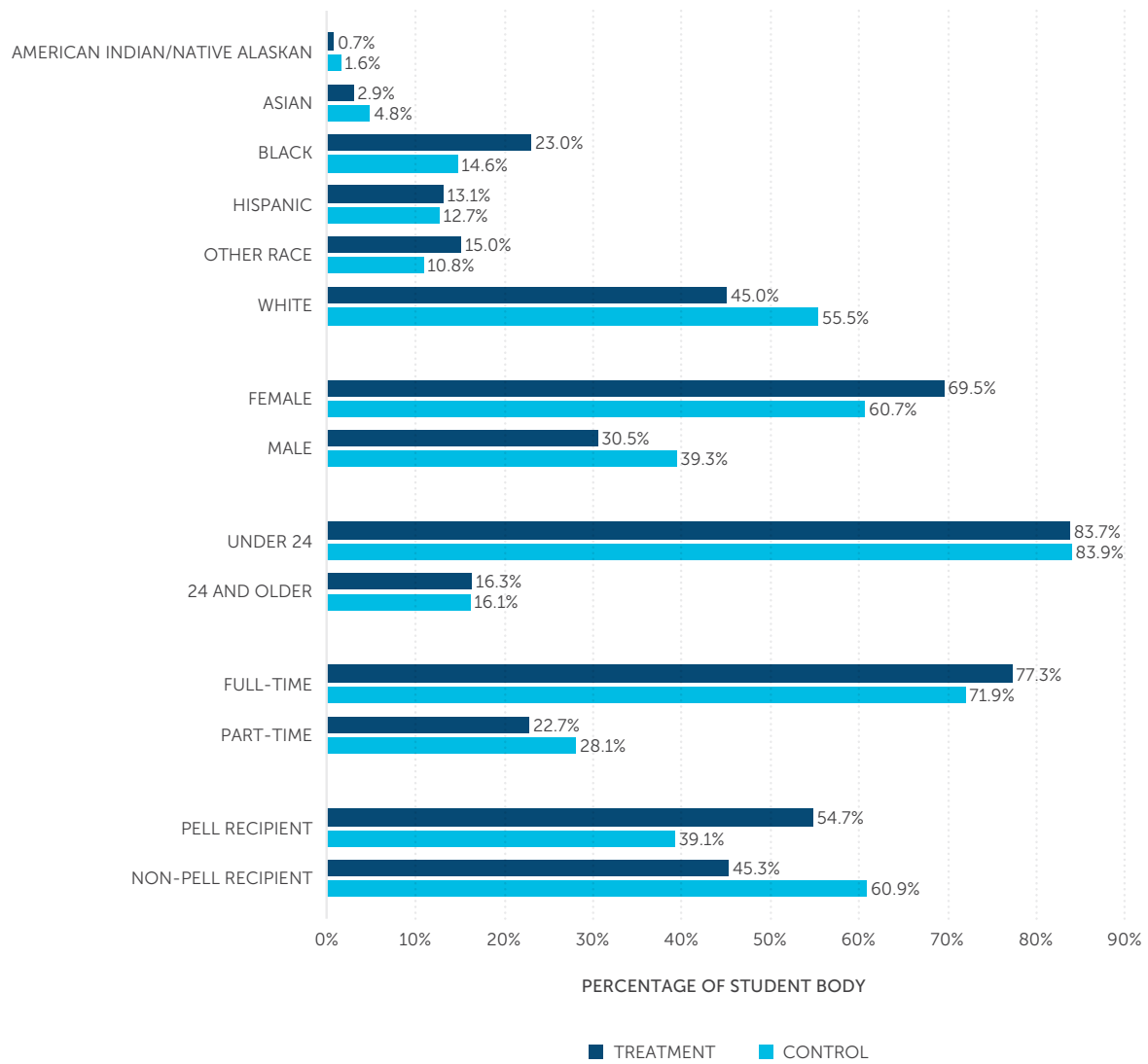
■ TREATMENT ■ CONTROL

SOURCE: Integrated Postsecondary Education Data System (IPEDS), 2004-2020

STUDENT SAMPLE CHARACTERISTICS

The 143,215 treatment students in our sample were matched with 1,295,773 control students on various student demographics. The following data points are reported on the raw student sample, without accounting for the weights generated during the student matching process. For weighted frequencies, see *Appendix B.* Treatment and control students included roughly equivalent proportions of male and female students (54.6% female among treatment students compared to 56.0% of control students) (*Table 3*). Treatment students comprised smaller percentages of white students (25.0% compared to 38.1%) and Hispanic students (12.2% compared to 19.7%), and a larger percentage of Black students than control students (17.3% compared to 12.2%). Students in the treatment group were generally older than students in the control group, with 59.3% aged 25 and older, compared to 38.6% of control students. A larger percentage of control students were traditionally college-aged students between 18 and 24 years (57.4% of control students compared to 39.9% of treatment students).

TABLE 3
DEMOGRAPHICS OF TREATMENT (N=143,215) AND CONTROL (N=1,295,773) STUDENTS (UNWEIGHTED)

STUDENT DEMOGRAPHICS	TREATMENT STUDENT COUNT	TREATMENT PERCENTAGE	CONTROL STUDENT COUNT	CONTROL PERCENTAGE
GENDER				
FEMALE	78,179	54.6%	725,300	56.0%
MALE	63,419	44.3%	542,785	41.9%
MISSING	1,617	1.1%	27,688	2.1%
RACE/ETHNICITY				
AMERICAN INDIAN/ NATIVE ALASKAN	936	0.7%	4,842	0.4%
ASIAN	3,569	2.5%	57,848	4.5%
BLACK	24,761	17.3%	157,486	12.2%
HISPANIC	17,517	12.2%	254,897	19.7%
NATIVE HAWAIIAN/ PACIFIC ISLANDER	856	0.6%	2,316	0.2%
NON-RESIDENT	363	0.3%	6,388	0.5%
TWO OR MORE RACES	6,538	4.6%	36,064	2.8%
WHITE	35,818	25.0%	493,785	38.1%
MISSING	52,857	36.9%	282,147	21.8%
AGE CATEGORY				
17 OR YOUNGER OR MISSING	1,179	0.8%	51,748	4.0%
18-20	25,206	17.6%	434,286	33.5%
21-24	31,926	22.3%	309,181	23.9%
25-29	29,083	20.3%	167,717	12.9%
30 OR OLDER	55,821	39.0%	332,841	25.7%

NOTE:

1. Reported frequencies are unweighted. Matching procedures reduced the observed differences in unweighted student characteristics (see *Appendix B, Table B2*).

SOURCE: National Student Clearinghouse (NSC)

Among both treatment and control students, the most common credential level at time of closure was associate degrees (42.0% of treatment and 35.0% of control students) (*Table 4*). Treatment students included a larger percentage of certificate students (21.2% compared to 6.0%) and a slightly smaller percentage of bachelor's degree students (18.0% compared to 20.1%). Students in the treatment group were more likely to attend exclusively full time (51.5% compared to 21.3%), while control students were more likely to attend exclusively part time (28.6%) or a mix of full- and part-time (48.2%). Compared to control students, a larger percentage of treatment students were studying health professions and clinical sciences (28.5% compared to 10.0%) and computer/information science (15.5% compared to 2.4%). A higher percentage of control students were enrolled in liberal arts and sciences programs (13.7% compared to 1.4%). Treatment and control students were equally likely to have earned a credential prior to enrolling in the closed institution (or the matched open institution, for control students) (approximately 89% for both). The majority of treatment students had enrolled in another postsecondary institution prior to enrolling in the closed institution (60.8%), while only 40.5% of control students had attended a previous postsecondary institution.

TABLE 4

ACADEMIC CHARACTERISTICS OF TREATMENT (N=143,215) AND CONTROL (N=1,295,773) STUDENTS (UNWEIGHTED)

STUDENT DEMOGRAPHICS	TREATMENT STUDENT COUNT	TREATMENT PERCENTAGE	CONTROL STUDENT COUNT	CONTROL PERCENTAGE
PROGRAM LEVEL				
MISSING	17,432	12.2%	412,611	31.8%
NON-CREDIT	2,113	1.5%	8,318	0.6%
CERTIFICATE	30,427	21.2%	78,299	6.0%
ASSOCIATE	60,109	42.0%	453,536	35.0%
BACHELOR'S	25,748	18.0%	260,283	20.1%
GRADUATE	7,386	5.2%	82,726	6.4%
ENROLLMENT INTENSITY				
MISSING	17,149	12.0%	25,084	1.9%
EXCLUSIVELY FULL-TIME	73,734	51.5%	275,502	21.3%
EXCLUSIVELY PART-TIME	10,707	7.5%	370,856	28.6%
MIX FULL- AND PART-TIME	41,625	29.1%	624,331	48.2%
MAJOR				
ENGINEERING TECHNOLOGIES/ TECHNICIAN	16,446	11.5%	14,729	1.1%
BUSINESS, MANAGEMENT, MARKETING	19,457	13.6%	128,655	9.9%
COMPUTER/INFORMATION SCIENCE	22,160	15.5%	31,197	2.4%
HEALTH PROFESSIONS AND CLINICAL SCIENCES	40,835	28.5%	129,919	10.0%
LIBERAL ARTS AND SCIENCES	2,047	1.4%	177,799	13.7%
SECURITY/PROTECTIVE SERVICES	3,958	2.8%	45,331	3.5%
OTHER MAJORS OR MISSING	38,312	26.8%	768,143	59.3%

STUDENT DEMOGRAPHICS	TREATMENT STUDENT COUNT	TREATMENT PERCENTAGE	CONTROL STUDENT COUNT	CONTROL PERCENTAGE
PRIOR ENROLLMENT				
NO	56,099	39.2%	770,986	59.5%
YES	87,116	60.8%	524,787	40.5%
PRIOR CREDENTIAL				
NO	127,224	88.8%	1,154,764	89.1%
YES	15,991	11.2%	141,009	10.9%

NOTE:

1. Reported frequencies are unweighted. Matching procedures reduced the observed differences in unweighted student characteristics (see *Appendix B, Table B2*).

SOURCE: National Student Clearinghouse (NSC)

Consistent with the differences in institution type reported in the Institution Sample Characteristics section above, a much larger percentage of students in the control group were in the public two-year sector (53.2% compared to 0%), while a larger percentage of treatment students attended private for-profit two- and four-year institutions (36.5% and 46.4% compared to 1.1% and 12.6%, respectively) (*Table 5*). A much larger percentage of treatment students than control students were enrolled in institutions in the Great Lakes region (37.9% compared to 6.8%), and a smaller percentage were enrolled in institutions in the Far West region (24.4% compared to 40.2%).

TABLE 5

INSTITUTIONAL CHARACTERISTICS OF TREATMENT (N=143,215) AND CONTROL (N=1,295,773) STUDENTS (UNWEIGHTED)

STUDENT ACADEMIC CHARACTERISTICS	TREATMENT STUDENT COUNT	TREATMENT PERCENTAGE	CONTROL STUDENT COUNT	CONTROL PERCENTAGE
CONTROL & LEVEL				
PUBLIC 2-YEAR	0	0.0%	689,752	53.2%
PRIVATE NONPROFIT 2-YEAR	1,256	0.9%	5,623	0.4%
PRIVATE FOR-PROFIT 2-YEAR	52,223	36.5%	14,436	1.1%
PUBLIC 4-YEAR	766	0.5%	162,822	12.6%
PRIVATE NONPROFIT 4-YEAR	22,467	15.7%	259,489	20.0%
PRIVATE FOR-PROFIT 4-YEAR	66,503	46.4%	163,651	12.6%
REGION				
NEW ENGLAND	7,581	5.3%	67,932	5.2%
MID-ATLANTIC	7,492	5.2%	229,104	17.7%
GREAT LAKES	54,284	37.9%	87,478	6.8%
PLAINS	10,610	7.4%	79,039	6.1%
SOUTHEAST	18,752	13.1%	247,093	19.1%
SOUTHWEST	8,593	6.0%	51,933	4.0%
ROCKY MOUNTAINS	957	0.7%	12,120	0.9%
FAR WEST	34,946	24.4%	521,074	40.2%

NOTE:

1. Reported frequencies are unweighted. Matching procedures reduced the observed differences in unweighted student characteristics (see *Appendix B, Table B2*). Students' region is determined by the location of the branch campus they attended. Some students may have been enrolled in predominantly or entirely online courses, which is not reported in Clearinghouse data.

SOURCE: National Student Clearinghouse (NSC)

ENROLLMENT OUTCOMES

Weighted results for the logistic regressions measuring student enrollment outcomes are reported for five separate follow-up dates: one month, four months, one year, two years, and three years after closure (or the matched closure date, for control students).[29] Students who earned a credential after closure but before each follow-up date are excluded from the analyses. Persistence is broadly defined as enrollment after a closure (or the matched closure date, for control students). For treatment students, enrollment at each follow-up date is necessarily reenrollment after closure. For control students, enrollment can be continued enrollment at the same institution or reenrollment at another institution. For additional details on the timing and flow of reenrollment among treatment students, including an interactive data visualization, visit the project website (sheeo.org/project/college-closures/).

RESULTS FOR RQ1. PERSISTENCE RATES

Closure is negatively correlated with a student's ability to reenroll after experiencing a closure, regardless of the time frame for measuring enrollment. Across all enrollment time frames, students who experienced a closure are significantly less likely than control students to be enrolled post-closure (*Figure 4*). Excluding students who earned a post-closure credential within the time frames of interest, the largest gap in predicted enrollment between treatment and control students occurs exactly one month post-closure, when treatment students are 71.3% less likely than control students to be enrolled (*Figure 5*). At exactly four months, treatment students are still 63.3% less likely to be enrolled, but are only 5.0% less likely to be enrolled after exactly one year. At three years post-closure, treatment students are 39.0% less likely to be enrolled than control students. Even when accounting for whether a student had been enrolled at any point between closure and the follow-up date (even if not necessarily on the exact follow-up date), treatment students are consistently between 40.0% and 69.5% less likely than control students to have enrolled post-closure.

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29. Results are measured at exact time points (i.e., exactly one month, four months, one year, two years, and three years after closure or the matched closure date) as well as for any time between closure and the follow-up date or between two follow-up dates (i.e., between closure and one month post-closure, between one month and four months post-closure, etc.).

FIGURE 4

POST-CLOSURE PERSISTENCE RATES OF TREATMENT AND CONTROL STUDENTS
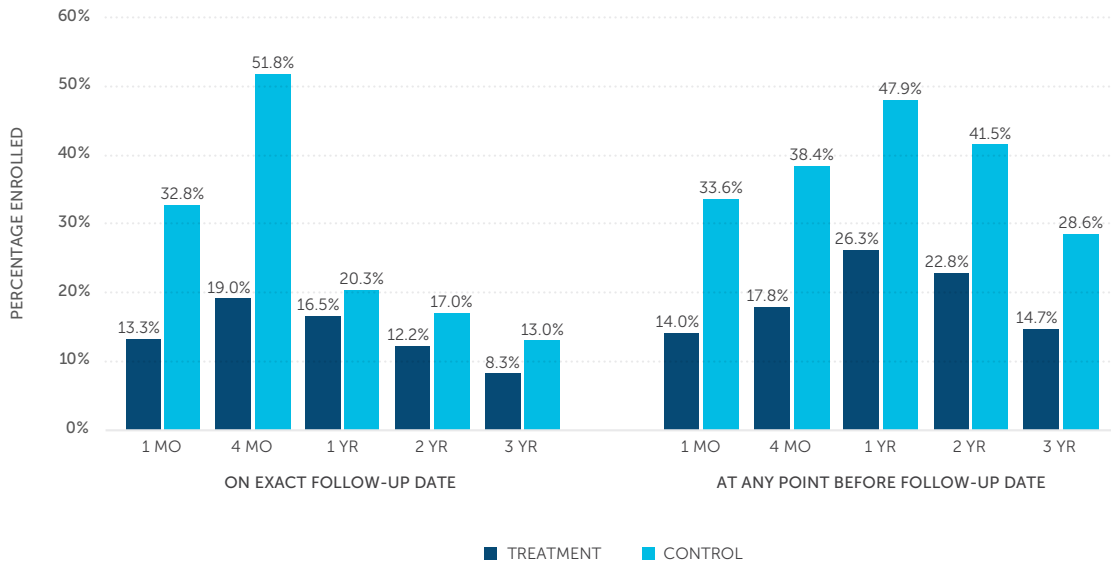
■ TREATMENT ■ CONTROL

SOURCE: National Student Clearinghouse (NSC)

FIGURE 5

POST-CLOSURE PERSISTENCE RATES LIKELIHOOD RATIOS: TREATMENT COMPARED TO CONTROL STUDENTS
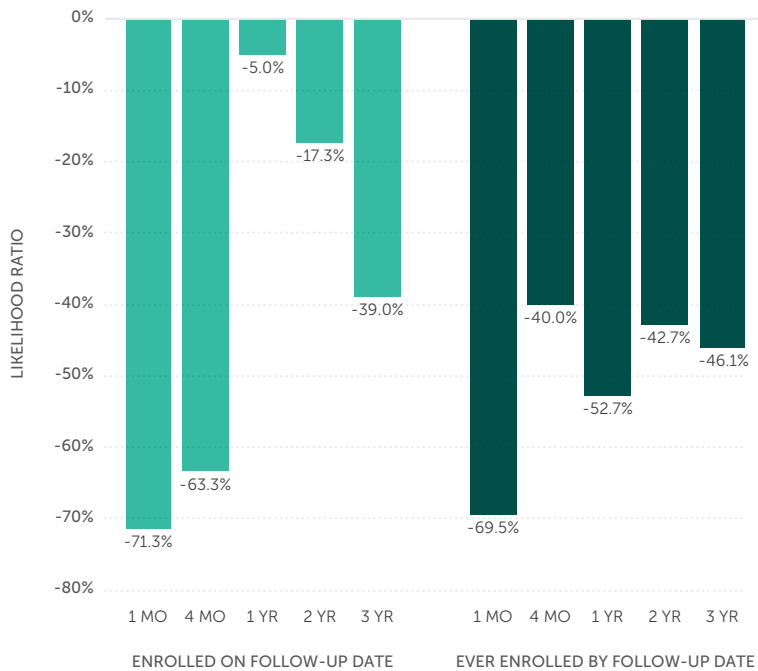
NOTE:

1. The negative values of the likelihood ratios in this figure indicate that treatment students are less likely than control students to be enrolled. Covariates included in these regression models appear in *Appendix C, Table C1 to C10.*

SOURCE: National Student Clearinghouse (NSC)

Among both treatment and control students and across all exact enrollment follow-up dates, students of color are between 4.9% and 26.3% less likely than white students, and male students are between 2.9% and 14.1% less likely than female students, to be enrolled post-closure (*Table 6*). Students pursuing associate and bachelor's degrees at the time of closure are between 29.8% and 161.6% more likely to be enrolled at all exact follow-up dates than students in certificate programs. Across most follow-up dates, students in private nonprofit two-year and four-year, public four-year, and for-profit four-year institutions are more likely to be enrolled than students in public two-year institutions, while students in for-profit two-year institutions are less likely.

TABLE 6
LIKELIHOOD RATIOS FOR POST-CLOSURE PERSISTENCE RATES AT EXACT FOLLOW-UP DATE

	ENROLLED AT 1 MONTH	ENROLLED AT 4 MONTHS	ENROLLED AT 1 YEAR	ENROLLED AT 2 YEARS	ENROLLED AT 3 YEARS
TREATMENT	-71.3%***	-63.3%***	-5.0%**	-17.3%***	-39.0%***
RACE					
AMERICAN INDIAN/ NATIVE ALASKAN	-3.8%	-23.6%***	5.9%***	5.9%***	-4.8%***
ASIAN	-14.2%***	0.6%	25.1%***	36.5%***	33.2%***
BLACK	-21.1%***	-17.1%***	-6.7%***	-4.9%***	-2.7%
HISPANIC	-23.2%***	-21.4%***	3.9%***	2.8%**	12.2%***
NATIVE HAWAIIAN/ PACIFIC ISLANDER	-24.0%***	-26.3%***	-16.9%***	-17.5%***	-16.7%***
NON-RESIDENT	-17.6%*	-10.8%	14.8%***	-0.7%	-5.8%***
TWO OR MORE RACES	-19.2%***	-17.8%***	-5.6%***	-9.3%***	8.1%***
GENDER					
MALE	-2.9%**	-3.3%**	-1.3%	-6.5%***	-14.1%***
CREDENTIAL LEVEL					
NON-CREDIT	71.7%***	97.3%***	30.2%***	2.4%	3.5%***
ASSOCIATE	30.2%	61.7%***	49.7%***	34.6%***	42.1%***
BACHELOR'S	103.0%***	161.6%***	117.8%***	31.2%***	29.8%***
GRADUATE	224.9%***	166.0%***	70.1%***	-3.4%***	8.4***
SECTOR					
PRIVATE NP 2-YEAR	130.2%***	-3.0%	27.0%***	15.5%***	39.0%***
PRIVATE FP 2-YEAR	-33.6%***	-78.9%***	-42.4%***	-39.0%***	-6.0%***
PUBLIC 4-YEAR	-19.5%***	-2.4%	44.0%***	74.2%***	66.8%***
PRIVATE NP 4-YEAR	4.0%*	26.4%***	53.1%***	88.9%***	61.1%***
PRIVATE FP 4-YEAR	60.1%*	-51.6%***	24.4%***	17.7%***	38.8%***

NOTE:

1. Students who earned a credential prior to the follow-up date are omitted. Reference categories include White, Female, Certificate, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C1 to C5*. * p<0.05; ** p<0.01; ***p<0.001.

SOURCE: National Student Clearinghouse (NSC)

Results are similar when assessing whether a student was ever enrolled at any time between closure and the follow-up time point, or between follow-up time points. Across most enrollment follow-up time frames, students of color are between 2.3% and 25.1% less likely than white students, and male students are between 2.1% and 14.4% less likely than female students, to have enrolled post-closure (*Table 7*). Students pursuing associate, bachelor's and graduate degrees are between 24.3% and 207.1% more likely to have been enrolled between closure and the follow-up date or between follow-up dates than students in certificate programs. Across most follow-up time frames, students in private nonprofit two- and four-year and public four-year institutions are more likely to have been enrolled post-closure than students in public two-year institutions, while students in for-profit two-year institutions are less likely.

TABLE 7
LIKELIHOOD RATIOS FOR POST-CLOSURE PERSISTENCE RATES BETWEEN CLOSURE AND FOLLOW-UP DATES

	ENROLLED BETWEEN CLOSURE & 1 MONTH	ENROLLED BETWEEN 1 & 4 MONTHS	ENROLLED BETWEEN 4 MONTHS & 1 YEAR	ENROLLED BETWEEN 1 & 2 YEARS	ENROLLED BETWEEN 2 & 3 YEARS
TREATMENT	-69.5%***	-40.0%***	-52.7%***	-42.7%***	-46.1%***
RACE					
AMERICAN INDIAN/ NATIVE ALASKAN	-6.1%	-15.4%***	-5.3%***	-2.3%*	2.0%*
ASIAN	-13.7%***	-3.9%***	15.6%***	23.4%***	31.0%***
BLACK	-20.3%***	-3.7%***	-8.3%***	2.0%*	4.1%***
HISPANIC	-22.3%***	-12.4%***	-8.6%***	-0.5%	5.8%***
NATIVE HAWAIIAN/ PACIFIC ISLANDER	-25.1%***	-24.3%***	-17.6%***	-10.2%***	-15.6%***
NON-RESIDENT	-18.2%*	-9.1%***	11.0%***	7.7%***	9.1%***
TWO OR MORE RACES	-19.9%***	-22.6%***	-7.2%***	-1.0%	3.6%***
GENDER					
MALE	-3.2%**	0.3%	-2.1%*	-6.3%***	-14.4%***
CREDENTIAL LEVEL					
NON-CREDIT	63.2%***	51.6%***	83.6%***	67.4%***	47.8%***
ASSOCIATE	24.3%***	25.8%***	86.0%***	54.4%***	43.7%***
BACHELOR'S	96.3%***	113.2%***	155.2%***	111.0%***	48.4%***
GRADUATE	207.1%***	91.4%***	165.3%***	107.7%***	20.8%***
SECTOR					
PRIVATE NP 2-YEAR	187.6%***	48.8%***	73.4%***	34.4%***	58.4%***
PRIVATE FP 2-YEAR	-35.4%***	-71.8%***	-56.1%***	-59.0%***	-41.9%***
PUBLIC 4-YEAR	-17.7%***	32.0%***	33.8%***	38.5%***	21.5%***
PRIVATE NP 4-YEAR	3.2%**	29.5%***	69.8%***	49.3%***	42.4%***
PRIVATE FP 4-YEAR	49.9%***	-19.9%***	18.3%***	-0.5%	-7.1%***

NOTE:

1. Students who earned a credential prior to the follow-up date are omitted. Reference categories include White, Female, Certificate, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C6 to C10*. * $p<0.05$; ** $p<0.01$; *** $p<0.001$.

SOURCE: National Student Clearinghouse (NSC)

RESULTS FOR RQ2. ENROLLMENT IN SAME INSTITUTION SECTOR

Students who experienced a closure were more likely to transfer into an institution of the same type post-closure than students in the control group who chose to transfer for reasons unrelated to closure, particularly within the first year (*Figure 6*). Regressions measuring the type of institution at each exact follow-up date were limited to all students who were enrolled on the exact follow-up date and who transferred to an institution other than the closure institution (for treatment students) or the matched non-closure institution (for control students).[30] Within this subset, treatment students are significantly more likely than control students to reenroll in an institution of the same control and level. At exactly one month after closure, treatment students are 121.8% more likely than control students to be enrolled in an institution in the same sector (*Figure 7*). This gap increases to 179.3% more likely at four months and 145.8% more likely at one year, then drops to 89.2% and 43.3% at two and three years, respectively.

FIGURE 6
POST-CLOSURE ENROLLMENT IN SAME SECTOR OF TREATMENT AND CONTROL STUDENTS
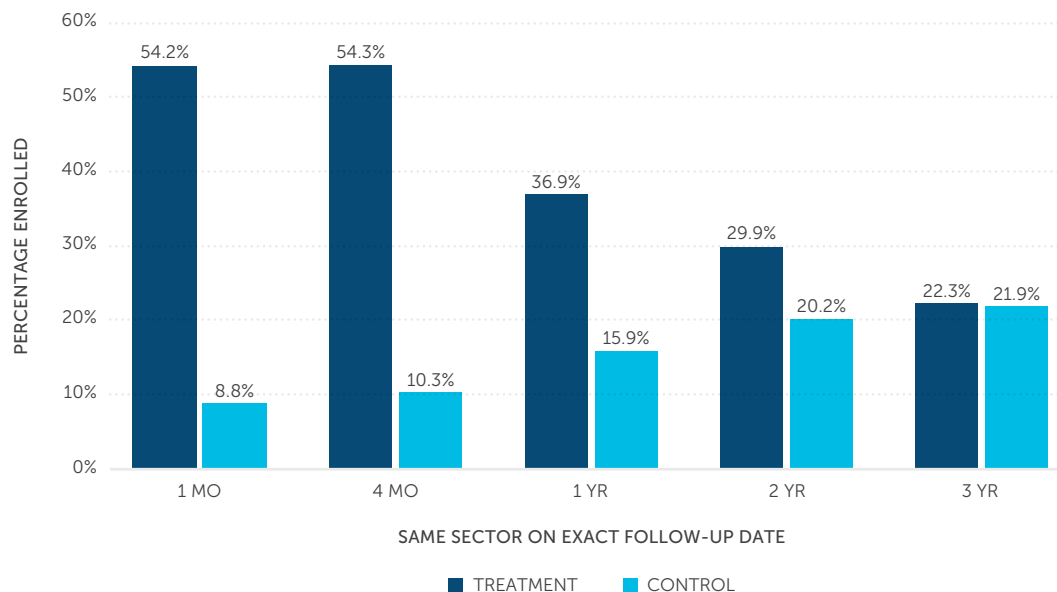
NOTE:

1. Control students who did not transfer to another institution are excluded. Only students who were enrolled on the exact follow-up date are included.

SOURCE: National Student Clearinghouse (NSC)

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30. Students in the control group who did not transfer are excluded from these analyses.

FIGURE 7

POST-CLOSURE ENROLLMENT IN SAME SECTOR LIKELIHOOD RATIOS: TREATMENT COMPARED TO CONTROL STUDENTS

NOTE:

1. Control students who did not transfer are excluded. Only students who were enrolled on the exact follow-up date are included. The positive values of the likelihood ratios in this figure indicate that treatment students are more likely than control students to be enrolled in institutions in the same sector. Covariates included in these regression models appear in *Appendix C, Table C11 to C15*.

SOURCE: National Student Clearinghouse (NSC)

The likelihood of enrolling in an institution of the same sector does not vary for most student demographics. However, Black students are between 21.1% and 29.5% more likely than white students to transfer to an institution of the same sector across all follow-up dates (*Table 8*). Within the first year of closure, students in bachelor's degree programs are between 14.1% and 60.8% more likely than students in certificate programs to remain in the same sector, but are less likely to remain in the same sector at two and three years post-closure. Conversely, associate degree students are less likely than certificate students to remain in the same sector at one month, one year, two years, and three years post-closure, but are 12.9% more likely to remain in the same sector at four months post-closure. Students enrolled in private nonprofit and for-profit two-year institutions are consistently between 75.9% and 95.5% more likely than students in public two-year institutions to change sectors. Students enrolled in public four-year institutions are between 32.7% and 78.5% more likely to change sectors at one month, four months, and one year post-closure, but are 40.8% and 51.9% less likely to change sectors at two and three years post-closure when compared to community college students.

TABLE 8

LIKELIHOOD RATIOS FOR POST-CLOSURE ENROLLMENT IN SAME SECTOR AT EXACT FOLLOW-UP DATES

	SAME SECTOR AT 1 MONTH	SAME SECTOR AT 4 MONTHS	SAME SECTOR AT 1 YEAR	SAME SECTOR AT 2 YEARS	SAME SECTOR AT 3 YEARS
TREATMENT	121.8%***	179.3%***	145.8%***	89.1%***	43.2%***
RACE					
AMERICAN INDIAN/ NATIVE ALASKAN	0.6%	-9.0%	-1.9%	-14.4%	-16.0%
ASIAN	-24.2%***	-8.3%	2.7%	7.0%	14.2%
BLACK	25.3%***	21.6%***	29.1%***	29.5%***	21.1%***
HISPANIC	2.1%	16.1%***	23.4%***	17.3%***	7.3%
NATIVE HAWAIIAN/ PACIFIC ISLANDER	-12.4%	-13.1%	31.0%	73.7%**	19.4%
NON-RESIDENT	-42.0%*	-0.1%	0.8%	23.1%	92.3%**
TWO OR MORE RACES	9.7%	-1.6%	5.9%	-8.4%	3.4%
CREDENTIAL LEVEL					
NON-CREDIT	-23.4%*	68.7%***	67.3%***	-11.0%	-35.0%***
ASSOCIATE	-17.8%**	12.9%**	-13.0%**	-36.1%***	-52.2%***
BACHELOR'S	14.1%*	60.8%***	46.1%***	-5.1%	-35.1%***
GRADUATE	67.7%**	96.0%***	45.3%***	7.0%	-3.1%
SECTOR					
PRIVATE NP 2-YEAR	-88.4%**	-80.6%***	-93.1%***	-95.2%***	-94.1%***
PRIVATE FP 2-YEAR	-75.9%**	-89.4%***	-93.5%***	-95.1%***	-95.5%***
PUBLIC 4-YEAR	-78.5%**	-57.4%***	-32.7%***	40.8%***	51.9%***
PRIVATE NP 4-YEAR	-5.5%	-15.3%**	36.9%***	53.7%***	22.6%**
PRIVATE FP 4-YEAR	12.2%	-17.4%***	-28.0%***	-31.1%***	-36.2%***

NOTE:

1. Students who earned a credential prior to the follow-up date are omitted. Only students who transferred to another institution and were enrolled on the follow-up date are included. Reference categories include White, Certificate, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C11 to C15*. * p<0.05; ** p<0.01; ***p<0.001.

SOURCE: National Student Clearinghouse (NSC)

COMPLETION OUTCOMES

Results for the logistic and linear regressions measuring student completion outcomes are reported for students who were not still enrolled as of February 2022 (n=7,705 treatment and 85,807 control students). Completion is defined as the attainment of any postsecondary credential (including certificates, associate degrees, bachelor's degrees, graduate degrees, non-credit credentials, and unknown credential types). Completion outcomes are reported separately for all students and for students whose first credential was attained after closure (for treatment students) or the matched closure date (for control students). Students with non-credit or unknown credential types are excluded from credential type analyses.

RESULTS FOR RQ3. CREDENTIAL COMPLETION RATES

Students who experienced a closure were equally likely to earn a credential at some time prior to institution closure—either at a previous postsecondary institution or at the closed institution— but were less likely to earn a credential after experiencing a closure than control students (*Figure 8*). For students with no prior credential, closure is significantly negatively correlated with credential completion, reducing the likelihood of completion by almost half. Compared to control students, students who experienced a closure were 6.1% more likely to ever earn a credential after controlling for student demographic and academic characteristics (*Figure 9*). However, when only considering post-closure outcomes for students who had not earned a prior credential, students who experienced a closure were 50.1% less likely to earn a credential than control students.

FIGURE 8

CREDENTIAL COMPLETION RATES OF TREATMENT AND CONTROL STUDENTS
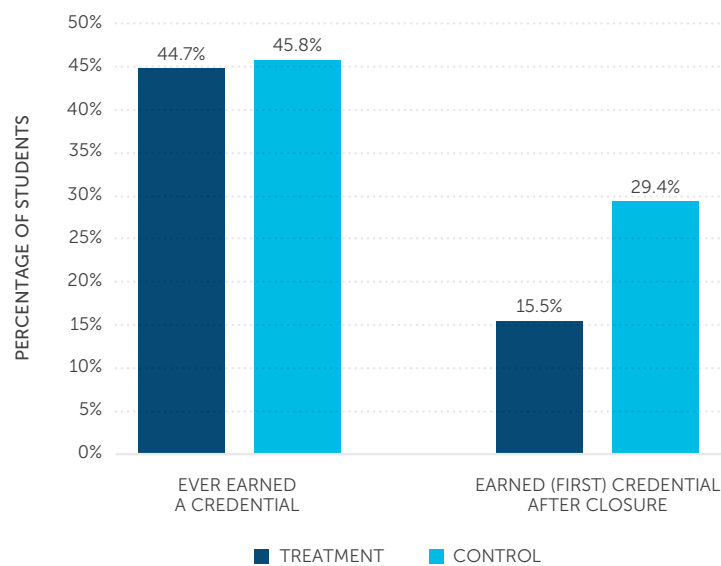
NOTE:

1. All students who were not still enrolled as of February 2022 are included in the denominator for EVER EARNED A CREDENTIAL. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and who were not still enrolled as of February 2022 are included in the denominator for EARNED (FIRST) CREDENTIAL AFTER CLOSURE.

SOURCE: National Student Clearinghouse (NSC)

FIGURE 9

CREDENTIAL COMPLETION LIKELIHOOD RATIOS: TREATMENT COMPARED TO CONTROL STUDENTS

NOTE:

1. All students who were not still enrolled as of February 2022 are included in the denominator for EVER EARNED A CREDENTIAL. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and who were not still enrolled as of February 2022 are included in the denominator for EARNED (FIRST) CREDENTIAL AFTER CLOSURE. Positive likelihood values indicate that treatment students are more likely than control students to ever earn a credential. Negative likelihood values indicate that treatment students are less likely than control students to earn a credential after closure. Covariates included in these regression models appear in *Appendix C, Table C16 and C17.*

SOURCE: National Student Clearinghouse (NSC)

For both treatment and control students, students of color are between 18.0% and 34.3% less likely than white students, and male students are 10.3% less likely than female students to ever earn a credential (*Table 9*). Students over age 20 at the time of closure are between 21.0% and 37.8% more likely than students aged 18-20 to ever earn a credential, with successively higher likelihoods of completion for each older age category. Compared to students seeking a certificate at the time of closure, students in associate programs are 28.7% less likely to complete, while students in bachelor's programs are 73.3% more likely to complete a credential. Students enrolled at private for-profit two-year and four-year institutions at closure are 7.8% and 15.8% less likely to complete than students in public two-year institutions, respectively. Students in private nonprofit two-year and four-year institutions and public four-year institutions are between 27.9% and 192.8% more likely to complete.

TABLE 9

LIKELIHOOD RATIOS FOR CREDENTIAL COMPLETION RATES

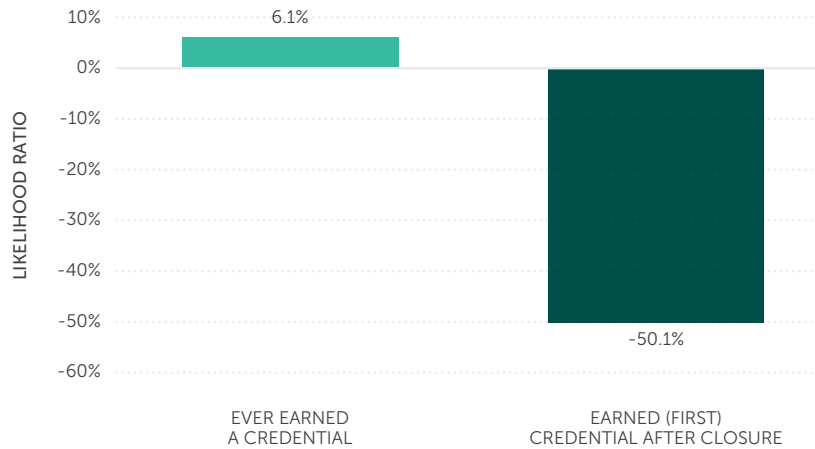|	EVER EARNED A CREDENTIAL	EARNED (FIRST) CREDENTIAL AFTER CLOSURE
TREATMENT	6.1%***	-50.1%***
RACE		
AMERICAN INDIAN/NATIVE ALASKAN	-27.9%***	-19.5%***
ASIAN	2.3%***	29.7%***
BLACK	-27.9%***	-28.2%***
HISPANIC	-18.0%***	-17.5%***
NATIVE HAWAIIAN/PACIFIC ISLANDER	-31.0%***	-24.7%***
NON-RESIDENT	-34.3%***	-7.2%
TWO OR MORE RACES	-33.1%***	-19.2%***
GENDER		
MALE	-10.3%***	-9.1%***
AGE CATEGORY		
UNDER 18	11.9%	17.8%**
21-24	21.0%***	-26.7%***
25-29	31.7%***	-29.7%***
30+	37.8%***	-33.9%***
CREDENTIAL LEVEL		
NON-CREDIT	-31.5%***	23.3%***
ASSOCIATE	-28.7%***	14.3%***
BACHELOR'S	73.3%***	50.1%***
GRADUATE	613.5%***	32.0%***
SECTOR		
PRIVATE NP 2-YEAR	192.8%***	216.2%***
PRIVATE FP 2-YEAR	-7.8%***	-46.2%***
PUBLIC 4-YEAR	27.9%***	52.2%***
PRIVATE NP 4-YEAR	48.1%***	101.7%***
PRIVATE FP 4-YEAR	-15.8%***	16.2%***

NOTE:

1. All students who were not still enrolled as of February 2022 are included in the denominator for EVER EARNED A CREDENTIAL. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and who were not still enrolled as of February 2022 are included in the denominator for EARNED (FIRST) CREDENTIAL AFTER CLOSURE. Reference categories include White, Female, 18-20 Years, Certificate, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C16 and C17.* * p<0.05; ** p<0.01; ***p<0.001.

SOURCE: National Student Clearinghouse (NSC)

Students demonstrate similar patterns for credential completion after closure. Among students with no prior credential, students of color are between 17.5% and 28.2% less likely than white students to earn a post-closure credential, with the exception of Asian students, who are 29.7% more likely. Male students are 9.1% less likely than female students to earn a post-closure

credential. Students over age 20 are between 26.7% and 33.9% less likely to complete post-closure than students aged 18-20. Compared to students in certificate programs at the time of closure, students in associate and bachelor's programs are 14.3% and 50.1% more likely to complete a credential, respectively. Students enrolled in private for-profit two-year institutions at closure are 46.2% less likely to complete than students at public two-year institutions, while students in all other sectors are between 16.2% and 216.2% more likely to complete.

RESULTS FOR RQ4. COMPLETED CREDENTIAL TYPE

For both first-time completers and students with prior credentials, college closure is negatively correlated with completing a credential of the same or higher type that a student was pursuing at the time of closure (*Figure 10*). Students who experienced a closure are more likely to complete a shorter-term credential (e.g., a certificate instead of an associate degree) as their highest credential earned. Students who experienced a closure are 7.7% less likely than control students to earn the same credential or higher after closure that they were pursuing at the time of closure (*Figure 11*). Among students with no prior credential, the difference is even larger: Treatment students are 19.9% less likely than control students to earn a credential of the same or higher type that they were pursuing at the time of closure.[31]

FIGURE 10
COMPLETION RATES OF SAME OR HIGHER CREDENTIAL OF TREATMENT AND CONTROL STUDENTS
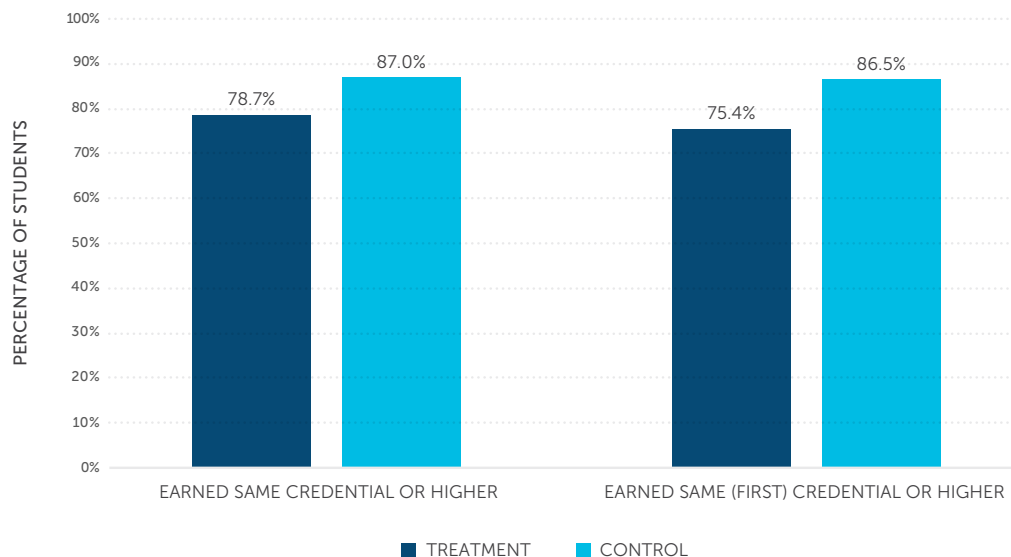
NOTE:

1. All students who earned a post-closure credential are included in the denominator for EARNED SAME CREDENTIAL OR HIGHER. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and earned a post-closure credential are included in the denominator for EARNED SAME (FIRST) CREDENTIAL OR HIGHER. Students with missing or non-credit credential types are excluded.

SOURCE: National Student Clearinghouse (NSC)

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31. Students with missing credential types or non-credit credential types are excluded from the credential type analyses.

FIGURE 11

COMPLETION OF SAME OR HIGHER CREDENTIAL LIKELIHOOD RATIOS: TREATMENT COMPARED TO CONTROL STUDENTS

NOTE:

1. All students who earned a post-closure credential are included in the denominator for EARNED SAME CREDENTIAL OR HIGHER. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and earned a post-closure credential are included in the denominator for EARNED SAME (FIRST) CREDENTIAL OR HIGHER. Students with missing or non-credit credential types are excluded. Negative likelihood values indicate that treatment students are less likely than control students to earn the same or higher credential after closure. Covariates included in these regression models appear in *Appendix C, Table C18 and C19*.

SOURCE: National Student Clearinghouse (NSC)

Among students with no prior credential (students who earned their first credential after closure), Asian students are 58.1% more likely to earn a higher credential than white students, while Black students are 17.6% less likely (*Table 10*). There are no significant differences in likelihood of completing the same or higher credential among male and female students or students of different ages. Compared to students enrolled in health sciences majors, students enrolled in all other major fields of study are between 11.3% and 185.4% more likely to complete a credential of the same or higher level after closure. Students enrolled in private for-profit, private nonprofit four-year, and public four-year institutions at closure are between 19.5% and 72.7% less likely to earn a credential of the same or higher level compared to students in public two-year institutions.

TABLE 10
LIKELIHOOD RATIOS FOR TYPE OF CREDENTIAL COMPLETED

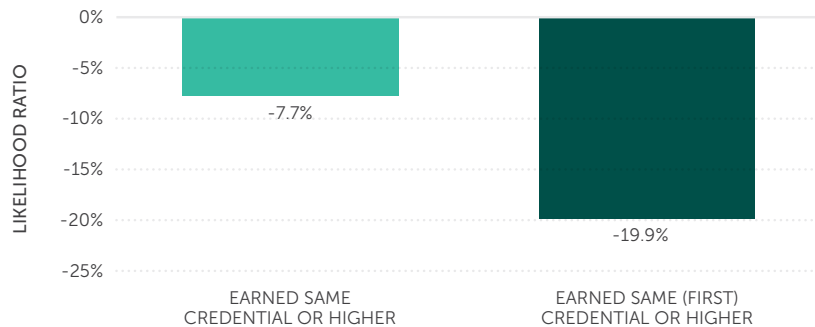|	EARNED SAME CREDENTIAL OR HIGHER	EARNED SAME (FIRST) CREDENTIAL OR HIGHER
TREATMENT	-7.8%*	-19.9%***
RACE		
AMERICAN INDIAN/NATIVE ALASKAN	-17.7%	-15.3%
ASIAN	47.9%***	58.1%***
BLACK	-17.5%***	-17.6%***
HISPANIC	-8.1%*	-6.7%
NATIVE HAWAIIAN/PACIFIC ISLANDER	-12.9%	-12.6%
NON-RESIDENT	-8.9%	1.2%
TWO OR MORE RACES	30.9%***	39.7%***
CIP CATEGORY		
COMPUTER SCIENCE	48.0%***	64.9%***
ENGINEERING	-4.2%	2.6%
BIO & PHYSICAL SCIENCES, MATH, AGRICULTURE	54.7%***	67.2%***
GENERAL STUDIES	127.3%***	152.6%***
SOCIAL SCIENCES	147.1%***	185.4%***
HUMANITIES	78.8%***	97.3%***
BUSINESS	12.9%**	22.4%***
EDUCATION	96.7%***	98.3%***
OTHER	0.7%	11.3%*
SECTOR		
PRIVATE NP 2-YEAR	-17.2%	-11.4%
PRIVATE FP 2-YEAR	-75.9%***	-72.7%***
PUBLIC 4-YEAR	-22.3%***	-23.8%***
PRIVATE NP 4-YEAR	-15.5%**	-19.5%***
PRIVATE FP 4-YEAR	-65.5%***	-65.4%***

NOTE:

1. All students who earned a post-closure credential are included in the denominator for *EARNED SAME CREDENTIAL OR HIGHER*. Only students who had not earned a credential prior to enrolling in the closed institution or matched open institution and earned a post-closure credential are included in the denominator for *EARNED SAME (FIRST) CREDENTIAL OR HIGHER*. Students with missing or non-credit credential types are excluded. Reference categories include White, Health Care, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C18 and C19*. * p<0.05; ** p<0.01; ***p<0.001.

SOURCE: National Student Clearinghouse (NSC)

RESULTS FOR RQ5. TIME TO CREDENTIAL COMPLETION

College closure is significantly negatively correlated with both overall time to completion and time to completion after closure for students who reenrolled and earned a credential after experiencing a closure.[32] However, the effect size of this difference is not large. Students who experienced a closure take, on average, 2.3 years from closure to first credential, compared to 2.2 years for control students from the artificial matched closure date to completion.[33] Treatment students take 7.6 years in total time to completion (from first postsecondary enrollment), compared to eight years for control students (*Figure 12*).[34] Among students who earned their first credential after closure, the time from closure to first credential is 82 days (2.7 months) longer for treatment students, while the time from first postsecondary enrollment to first credential is 56 days (1.8 months) longer (*Figure 13*).

FIGURE 12

TIME TO COMPLETION SUMMARY STATISTICS: TREATMENT STUDENTS COMPARED TO CONTROL STUDENTS
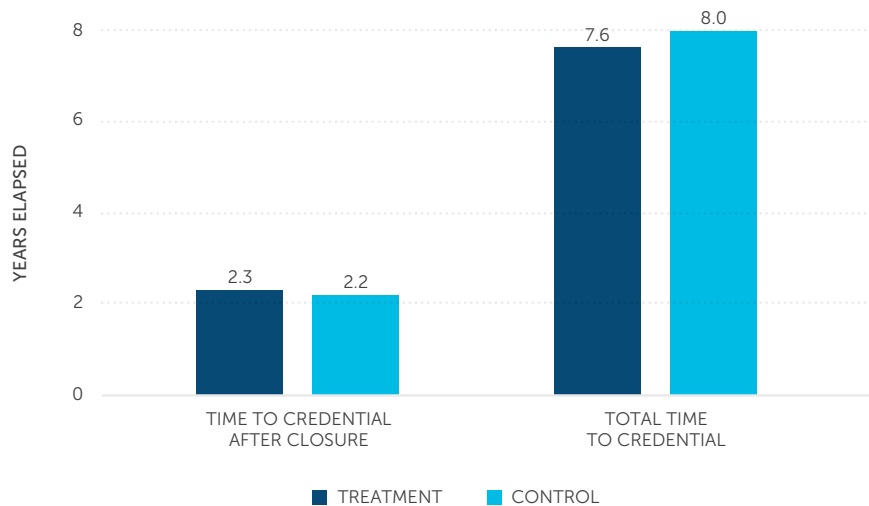
NOTE:

1. Students who earned a credential prior to enrolling in the closed institution or matched open institution are excluded.

SOURCE: National Student Clearinghouse (NSC)

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32. Students who earned a credential prior to the closure date or matched closure date (at any institution) are excluded.

33. At the time of closure or artificial closure date, students have been enrolled and accrued credits at the closure or matched open institution.

34. Time to completion variables measure total time elapsed and do not account for part-time enrollment or semesters enrolled.

FIGURE 13

ADDITIONAL TIME TO COMPLETION COEFFICIENTS: TREATMENT STUDENTS COMPARED TO CONTROL STUDENTS

NOTE:

1. Students who earned a credential prior to enrolling in the closed institution or matched open institution are excluded. Positive coefficient values indicate that treatment students have longer times to completion than control students. Covariates included in these regression models appear in *Appendix C, Table C20 and C21*.

SOURCE: National Student Clearinghouse (NSC)

The time from closure (or matched artificial closure date) to first credential varies by student demographics and academic characteristics. Students of color take between 31 days (1 month) and 83 days (2.7 months) longer than white students to complete a credential after closure (or the matched artificial closure date), while male students take 19 fewer days (0.6 months) than female students (*Table 11*). Students over age 20 at the time of closure take between 179 and 232 fewer days (5.9 months and 7.6, respectively) to complete than students aged 18-20. Compared to students in certificate programs, students in associate, bachelor's, and graduate degree programs take 123, 115, and 105 additional days (4 months, 3.8 months, and 3.4 months) to complete a credential, respectively. Students enrolled in private nonprofit institutions and private for-profit two-year institutions take between 137 and 233 fewer days (4.5 months and 7.6 months) to complete than students in public two-year institutions, while students in public four-year institutions take an additional 124 days (4.1 months).

TABLE 11

ADDITIONAL TIME TO COMPLETION COEFFICIENTS

	TIME TO CREDENTIAL AFTER CLOSURE	TOTAL TIME TO CREDENTIAL
TREATMENT	82.0***	56.0**
RACE		
AMERICAN INDIAN/NATIVE ALASKAN	33.9	-55.7
ASIAN	61.0***	-121.1***
BLACK	54.2***	107.7***
HISPANIC	30.8**	40.6
NATIVE HAWAIIAN/PACIFIC ISLANDER	82.8*	206.8*
NON-RESIDENT	-49.8	-576.3***
TWO OR MORE RACES	58.1***	54.3
GENDER		
MALE	-18.7**	-19.8
AGE CATEGORY		
UNDER 18	226.6***	106.8
21-24	-183.8***	96.8***
25-29	-179.4***	965.8***
30+	-232.2***	1956.1***
ENROLLMENT INTENSITY		
EXCLUSIVELY PART-TIME	59.0***	162.9***
MIXED PART-/FULL-TIME	12.7	355.3***
CREDENTIAL LEVEL		
NON-CREDIT	67.8**	125.2*
ASSOCIATE	122.8***	101.9***
BACHELOR'S	115.2***	258.5***
GRADUATE	105.0***	323.4***
SECTOR		
PRIVATE NP 2-YEAR	-149.5***	-426.9***
PRIVATE FP 2-YEAR	-232.6***	-441.3***
PUBLIC 4-YEAR	123.8***	113.5***
PRIVATE NP 4-YEAR	-137.4***	-45.4
PRIVATE FP 4-YEAR	-21.7	-31.4

NOTE:

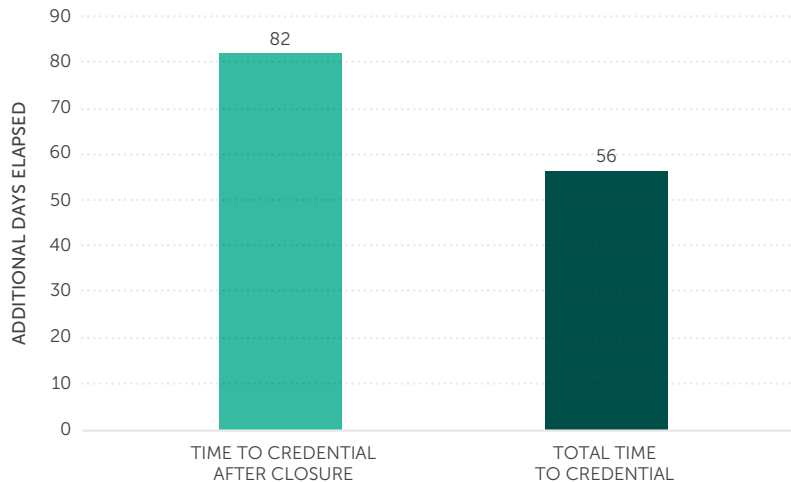1. Students who earned a credential prior to enrolling in the closed institution or matched open institution are excluded. Reference categories include White, Female, 18-20 Years, Full-Time, Certificate, and Public 2-Year. Results for additional covariates appear in *Appendix C, Table C20 and C21*. * p<0.05; ** p<0.01; ***p<0.001.

SOURCE: National Student Clearinghouse (NSC)

In contrast, the time from first postsecondary enrollment to first credential does not vary as consistently by student demographics but does differ by academic characteristics. Compared to students in certificate programs, students in associate, bachelor's, and graduate degree programs take 102, 259, and 323 days (3.4 months, 8.5 months, and 10.6 months) longer to complete a credential (*Table 11*). Students enrolled part time or a mix of part time and full time take 163 and 355 days (5.4 months and 11.7 months) longer to complete than students enrolled exclusively full time. Students enrolled in private nonprofit and for-profit two-year institutions at closure take 427 and 441 fewer days (1 year 2 months and 1 year 2.5 months) to complete than students in public two-year institutions, while students at public four-year institutions take an additional 114 days (3.7 months).

DATA LIMITATIONS

Matching occurred in two separate steps: first for institutions, and second for students. Regression models are not constructed as multi-level models because treatment is applied at the student level in addition to the institution level. The first matching step (for institutions) was necessary to reduce the number of potential student-level observations. Future analyses could consider constructing a multi-level model to account for treatment application at two levels.

The CEM procedure used for the institution-level match was not perfect and had to be run in several steps. This procedure was not performed to generate institution-level weights. Rather, it was chosen to limit the number of open institutions from which to construct the control sample of students. Other institutions may have been considered a better match for the closed institutions. The match was limited to: institutions that reported to the Clearinghouse, institutions that were open when treatment institutions closed, institutions that had sufficient student enrollment, and institutions that shared some institutional characteristics and student demographics with institutions that closed. Matches from the first several steps of CEM are more robust matches than those from later steps. These less-robust institution-level matches are partially remedied by the student-level match.

Even after institution-level matching, treatment and control institutions varied significantly by sector, student gender, and student receipt of Pell Grants. The resulting student samples may therefore be biased by student selection into institutions in a specific sector. The inclusion of student demographic and academic characteristics (e.g., prior enrollment) in the student-level match accounts for some of these unobservable selection biases.

Approximately 30% of students in the treatment sample attended a single, large institution system that closed. The context and circumstances surrounding that institutional closure and the subsequent outcomes of students impacted may bias the overall results.

The timing of institution closure may influence the reenrollment or continued enrollment rates of treatment and control students if institutions closed during summer or winter breaks. This has the potential to affect students measured at exactly one month after closure (or matched closure date). We estimate that up to 16.5% of students may be affected by this. However, many institutions now offer summer enrollment terms or continuous enrollment, allowing students to remain enrolled continuously throughout the calendar year.

Clearinghouse data cannot capture whether students transfer to another non-Clearinghouse-reporting institution. Some students may appear to have dropped out of postsecondary education, when in fact they may have transferred to a non-reporting institution. Measures of transfer that are captured in Clearinghouse data are not classified as objectively positive or negative changes for students, as we do not incorporate a measure of institutional quality.

The small pseudo-R2 values for some regression models suggest that unobserved characteristics may be responsible for a large percentage of the variation between treatment and control students. These unobserved characteristics may include intrinsic student motivation, student social and financial capital, or the existence of institutional or state policies to protect students from closure. Many of these variables cannot be captured in Clearinghouse data and thus cannot be included in regression models. The third and final report in this series will explore the potential impacts of state policies designed to protect students.

DISCUSSION AND IMPLICATIONS

College closure is negatively correlated with enrollment after closure in both the immediate term (within one and four months after closure) and the long term (two to three years after closure). Students who experienced a closure are between 39.0% and 71.3% less likely to be enrolled at various time points than students who did not experience a closure. At the one-year mark, however, the difference between treatment and control students is less pronounced: Treatment students are just 5.0% less likely to enroll than control students. The bell-shaped distribution of this outcome suggests that treatment students may need up to a year to reenroll after closure but are less likely to persist beyond one year. Closure thus affects not only initial reenrollment patterns, but also the ability of students to persist after reenrollment. The challenges of reenrollment (e.g., finding a suitable program, transferring credits, reapplying for programs and aid) may prove to be an additional burden to students, and even those who are able to reenroll may choose to depart prior to completion. In some cases, students may not choose to leave before completion, but may instead experience a second or third institutional closure.[35] **Thus, while reenrollment may be construed as a positive outcome of closure, a longitudinal perspective reveals that even those who do reenroll struggle to complete.**

Across both treatment and control students, continued enrollment after closure (or matched closure date) varies by race/ethnicity, sex, credential level, and institution sector. Students of color and male students are less likely to be enrolled at any post-closure time point than white and female students. The results are most pronounced for Black, Hispanic, and Native Hawaiian/Pacific Islander students and students of two or more races. These students may be more likely to attend institutions (e.g., private for-profits) that provide fewer resources for their affected students and are thus less able to access the support needed to successfully reenroll and persist. Students enrolled in associate, bachelor's, and graduate degree programs fare better than those in certificate programs, perhaps because they also tend to reenroll in public and private nonprofit institutions that can provide the additional student support services necessary for persistence. It is also possible that, compared to students in certificate programs, those in associate and bachelor's degree programs have more sunk costs associated with their education (e.g., longer time enrolled, more money invested in education, fewer opportunities for employment if they do not complete). Students in certificate programs may have similar career prospects without completing a short-term credential and may therefore opt to forego the burden of reenrolling. The greater reenrollment rates in some sectors (namely private nonprofit and public institutions) are likely attributed to the existence of closure contingency plans, including assisting students with reenrollment or providing teach-out opportunities at other institutions.

When comparing students who experienced closure with control students who chose to transfer for reasons unrelated to closure, treatment students are significantly more likely to enroll in an institution of the same sector. Many of these students may be automatically reenrolled by the closing institutions into a branch campus or an online campus within the same institutional system. While this process may appear seamless and therefore beneficial to the students experiencing a closure, previous research has revealed that closures are rarely limited to a single branch campus,

35. Colston, J., Fowler, G., Laitinen, A., McCann, C., Studely, J., Tandberg, D., & Weeden, D., (2020). *Anticipating and managing precipitous college closures.* New America. www.newamerica.org/education-policy/reports/anticipating-and-managing-precipitous-college-closures

and that one campus closure may precipitate future campus closures. Therefore, students who are automatically reenrolled in another branch campus are at risk of experiencing a second or third closure, which has increasingly negative impacts on student outcomes.[36] For students who are automatically reenrolled in an online campus, the change in modality may create barriers to completing a credential. Moving from in-person to online courses may conflict with preferred student learning styles or incur unanticipated costs for technology and broadband access. Other students who are not automatically reenrolled may also seek to replicate their academic experience at a similar institution, in a similar program, with a similar major field of study and are thus more likely to remain in the same sector. Treatment students who transfer for a reason unrelated to closure, on the other hand, may be seeking a different educational experience and therefore choose to enroll in an institution in a different sector that can offer alternative programs and majors.

Students who were enrolled in institutions in the private nonprofit and for-profit two-year sector are the most likely to choose to reenroll in an institution of a different sector. For students who experienced a closure, this choice may be due to the lack of similar educational programs in the vicinity. Many of these students reenroll in a public two-year institution in their local community, as these institutions are often open access and may enable students to transfer their credits. Moreover, these students may have attempted to reenroll in a branch campus of the same institutional system only to experience a second or third closure, ultimately leading them to transfer outside of the sector. Control students, alternatively, may choose to transfer out of the private two-year sector due to tuition costs, wariness of sanctions and closures occurring at other institutions, or more educational opportunities.

Interestingly, students who experienced a closure are equally as likely as control students to ever earn a postsecondary credential. This finding may be due in part to the higher likelihood of treatment students to enroll in non-credit or certificate programs during their educational trajectory, allowing them to earn credentials early in their postsecondary enrollment. Treatment students may also be incentivized to complete a credential quickly when their institution announces closure to avoid the complications associated with transferring. When credentials earned prior to closure (or the matched artificial closure date) are excluded, closure has a significant negative impact on credential completion. Excluding students who dropped out and did not ever reenroll after closure, completion rates are much lower for treatment students than control students. **This suggests that simply reenrolling after closure is not sufficient to ensure student success in the long-term. Students who experienced a closure have confronted a profound disruption to their postsecondary education and, despite reenrolling, may not be able to overcome the challenges associated with closure to complete a credential.**

Consistent with the patterns in enrollment after closure, students of color, male students, and students in certificate programs have worse post-closure completion outcomes than white students, female students, and students in associate or bachelor's programs. Older students also fare worse than traditionally college-aged (18-21 years) students, which may stem from additional financial burdens accrued from more time enrolled, family and work responsibilities outside of school, or greater opportunities for entering the workforce based on prior experience. Alternatively, when analyzing any postsecondary completion, older students are more likely than traditionally college-aged students to have earned a credential, perhaps for the same reasons

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36. Burns, R., Brown, L., Heckert, K., & Weeden, D., Kim, H., Randolph, B., Pevitz, A., Karamarkovich, S., & Causey, J., (2022). *A dream derailed? Investigating the impact of college closures on student outcomes.* State Higher Education Executive Officers Association and National Student Clearinghouse Research Center. www.sheeo.org/wp-content/uploads/2022/11/SHEEO_NSCRC_CollegeClosures_Report1.pdf

that they do worse post-closure (e.g., more financial investment in postsecondary education and more incentive to complete, greater financial resources from employment, and greater social support from family). Students in certificate programs are more likely than students in associate degree programs to complete, which may be attributed to the shorter program lengths of certificate programs and the lower financial and time investments needed for a short-term credential.

While some students are able to successfully reenroll and complete a credential post-closure, many are forced to readjust their educational aspirations and change their educational pathways, often reenrolling in a degree program that is different from the one they were pursuing at the time of closure. The transfer into a shorter-term (i.e., fewer credits) credential program may be due to the inability to transfer all credits to the new institution, the accumulation of student loan debt that precludes additional time spent in postsecondary education, the inability to find a program that suits their interests, or the decision to leave without further education beyond the credentials already earned from prior experience. The movement to shorter credential programs indicates that closure not only reduces reenrollment and completion rates, but also acts as a barrier to students from attaining the level of credential they were seeking. The impacts of this change stem from the differential earnings potentials of different credentials, with proportionally higher salaries for each successively advanced level of credential a student completes. The change in educational aspirations has implications not just for short-term completion, but also for long-term employment opportunities and earning potential.

Unsurprisingly, college closure extends a student's time to completion. While time to completion variables do not account for whether a student was enrolled part time or had multiple stopouts, these findings suggest that students who experience a closure spend more time in postsecondary education. This translates to more time out of the workforce, without full-time employment, accruing student loans, navigating a disrupted educational landscape, and managing reenrollment and transfer. **The effect size of this difference is reassuringly small, with treatment students taking just several additional months to complete than control students.** The largest differences in time to completion from closure exist across degree program, age at time of closure, and institution sector. Differences by degree program are unsurprising, given that different programs inherently take longer or shorter times to complete based on the number of credit hours required for fulfillment. Variation by institutional sector, while likely driven largely by the types of programs offered, may also stem from the varying levels of academic and social support provided to students. In addition, results from *Impacts* found that private nonprofit and for-profit institutions accepted students affected by closure much more quickly (within one month) than public institutions, meaning students were disenrolled for a shorter time. The shorter post-closure time to completion for older students is also unsurprising, as older students have likely been enrolled for longer times and accrued more credits prior to experiencing closure, and thus have fewer credits to complete post-closure.

POLICY IMPLICATIONS

The findings in this report confirm what prior research suggested and provide estimates of the significant negative associations between college closure and students' educational pathways. **While institution closures are not always predictable or preventable, it is essential for the regulatory triad to protect students enrolled in institutions that ultimately close.** In recent years, the federal government has targeted for-profit institutions through such mechanisms as the 90/10 Revenue Test, the Two-Year Rule for awarding FSA funds at proprietary or vocational schools, annual cohort default rate rules for awarding FSA funds, and the currently defunct

Gainful Employment regulations. Institutions with financial or compliance issues can be placed on Heightened Cash Monitoring (HCM), which offers institutions additional oversight of the management of federal student aid funds. Although these regulations have identified some of the institutions most at risk of closing abruptly and prevented some institutions from continuing to operate and engage in predatory practices, federal actions alone are not sufficient to protect students once closures occur.

State agencies of higher education are an essential component of the triad and can ensure institutions take actions to prevent closures or provide accommodations for students in the event of closure. State authorization, in which institutions apply for and receive approval to operate within a state, is a critical process during which states can regulate the extent to which institutions develop and implement plans for responding to institutional closure. The findings in this report underscore the recommendations put forth in *Impacts* (sheeo.org/wp-content/uploads/2022/11/SHEEO_NSCRC_CollegeClosures_Report1.pdf) and further reinforce calls for improving consumer protection policies with regard to institutional closure. Additional suggestions for policy improvements are outlined below.

State agencies and institutions can simplify the transfer process for students affected by closure, allowing them to quickly reenroll and continue their postsecondary education with minimal interruptions. The findings of this study confirm the descriptive results of *Impacts* and provide causal evidence of the negative effects of institutional closure on reenrollment post-closure. While the barriers to reenrollment cannot be ascertained from this study, challenges related to transfer of credits, reapplying for programs and financial aid, and finding suitable alternatives for the closed program are all likely causes of student disengagement. State agencies can require institutions to maintain transfer articulation agreements with local institutions, which enable students to transfer seamlessly. States and institutions can also collaborate on the development of course equivalencies to identify the programs and credit hours that are equivalent across institutions in the state and sector. These guidelines can eliminate students' uncertainty around the transferability of credits and can guide students toward the appropriate coursework. Collectively, these efforts can simplify the transfer process in the event of institutional closure.

State agencies and institutions should provide additional student support (e.g., transfer counseling and orientation, academic advising, tutoring services) for students who reenroll after experiencing a closure. The results of this study found that reenrollment alone is not enough to guarantee long-term student success: Many students reenroll within one year of closure but do not persist beyond one year and do not earn a credential. Thus, reenrollment cannot be considered a positive outcome of institutional closure and does not predict future postsecondary success. State agencies and institutions can collaborate to provide support for not only rapid reenrollment, but also long-term persistence and eventual completion. These supports may include additional counseling and orientation services in the immediate aftermath of transfer, academic advising to place students on the correct academic track, financial counseling to ensure students have received the maximum financial aid available that is suitable for their needs, and tutoring services to ease the transition into new programs and coursework. Although these investments will require additional funding or the reallocation of current resources, the benefits to students, institutions, and states through increased enrollment and completion rates may outweigh the costs associated with providing these services. States should reexamine current student protection fund contributions and surety bond amounts and consider raising amounts to help ensure these funds are adequately funded to serve students and potentially provide additional services. Additionally, states that do not operate student protection funds or require surety bonds may want to consider establishing these consumer protection policies to provide additional student supports after a closure.

States and institutions should consider the effects of closure from an equity perspective that accounts for the persistently worse outcomes for students of color, older students, and students in subbaccalaureate degree programs. The students who are most likely to attend institutions at risk of closing are also the students with the worst post-closure reenrollment and completion outcomes. The lower rates of reenrollment, persistence, and completion among students of color, non-traditional college-aged students, and students in subbaccalaureate degree programs are likely to exacerbate the existing educational disparities that exist by student demographics and programs. Institutions and state agencies can develop programs to assist these students, including specialized scholarship/grant programs, student resource groups, targeted orientation and mentorship programs, and persistent counseling and advisement.

State authorization policies should require institutions to submit and implement contingency plans to which they are held accountable in the event of college closure. The results of *Impacts* indicated that students experiencing abrupt closures have worse educational outcomes than students attending institutions that closed in an orderly process.[37] The findings in this report confirm that outcomes also vary by institution sector, with students in the for-profit sector less likely to reenroll, persist, and complete a credential after closure. These institutions are also the least likely to maintain and implement teach-out plans, transfer policies, record retention agreements, and tuition refunds for students affected by closure. States can mandate through state statute or administrative rules that institutions submit proactive plans for managing closure during the authorization or reauthorization process. It is then incumbent on state agencies to audit institutional plans and ensure that institutions follow through in the event of closure. Institutions that do not develop, maintain, and implement contingency plans can face sanctions from state agencies.

States should ensure authorization offices have the capacity, resources, and authority needed to serve students in the event of a closure. A recent SHEEO survey demonstrated that most authorization offices face significant capacity constraints in terms of budget and staffing. Many authorization offices need greater capacity to complete the initial authorization process. When a closure occurs, these state officials need even greater budgetary support as well as authority. For instance, state authorization offices may need to seize student records or initiate legal proceedings for violations of state law. State policymakers also need to ensure authorization offices have the necessary authority and capacity to monitor institutional quality and financial risk. Assessing student-level outcomes during the renewal process can help states take preventative action against bad actors. Additionally, regular assessments of institutional financial health with standardized data elements and measures could help prevent precipitous closures and help states work with distressed institutions to develop orderly closure plans.

States and institutions should scrutinize branch-to-branch transfer after closure and should provide pathways for students to reenroll at financially stable, accredited institutions. Students who remain within the same institutional system by switching to another branch campus are more likely to experience multiple closures and less likely to persist and complete than students who transfer to another system or sector. Many students are automatically reenrolled in the new branch as a part of an institution's closure policy. State agencies should require institutions to develop teach-out agreements with a variety of institutions, providing students with as many viable options as possible in the wake of closure. Institutions should strive to develop not just

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37. Abrupt closures are those that were described as abrupt in news reports, did not include a teach-out plan, or did not give students at least three months' notice prior to closure. Orderly closures were those that gave students at least three months' notice before the closure, included a teach-out plan at the institution or a partner institution, and retained student records and transcripts.

teach-out plans (i.e., general guidelines for assisting students with persistence and completion), but also teach-out agreements with partner institutions that agree to automatically reenroll students in their institution after closure. Teach-out agreements, particularly those with more than one institution, provide a more robust and definitive pathway for students seeking to reenroll.

State agencies should ensure that institutions receiving transfer students after closure meet certain quality criteria, including financial stability and a robust history of accreditation. The finding that many students do not persist after reenrolling following a closure suggests that teach-out institutions and agreements need greater scrutiny. Closing an institution can be a hectic process, and some institutions may pursue teach-out plans with the most convenient partner rather than the best institution for students. State agencies should conduct thorough financial stability analysis of teach-out partners, ensure that all students are covered by transfer agreements into comparable programs, and make certain that these programs have a history of providing quality educational opportunities. These safeguards may prevent students from experiencing a second or third institutional closure and may increase the likelihood of student success after transfer.

The findings in this report build on the descriptive findings from *Impacts* and provide causal evidence of the impact of institutional closures at the student level. The worse enrollment and completion outcomes for students who experienced a closure calls for attention from the regulatory triad to support students long-term through reenrollment, persistence, and completion. SHEEO will publish a third follow-up report in a series analyzing the impacts of college closure on student outcomes. Report three will incorporate the state authorization policy context to ascertain if policy interventions can ameliorate the negative effects of closures on students. The findings of this forthcoming report will supply additional evidence-based support for and refinement of these policy implications.

APPENDIX A. DEFINITIONS

AGE CATEGORY: Student age is measured during the last term enrolled at the first institution where a student experienced a closure (for treatment students) or the matched closure institution (for control students). Age categories include under 18 years old (primarily omitted from most results), 18 to 20 years old, 21 to 24 years old, 25 to 29 years old, and 30 years and older.

CONTROL AND LEVEL: Because some institutions can change their educational offerings over time, institutional level for closed campuses was measured at the time of the closure. Institutional control is also subject to change, most often when for-profit institutions switch to nonprofit status or when institutions from different sectors merge. Given that the majority of institutions making this change continue to function as for-profit entities, any closed institution that was ever designated as for-profit is considered for-profit in the sample.

CREDENTIAL COMPLETION: Students who completed a credential after reenrolling post-closure (for treatment students) or after the matched artificial closure date (for control students); includes any students who earned a certificate, associate, bachelor's, graduate, or unknown credential type as of February 2022.

CREDENTIAL LEVEL: Credential level indicates what credential type a student was pursuing at closure or on the matched artificial closure date. Beginning in the 2014-15 academic year, it became mandatory for participating institutions to report program-level data to the Clearinghouse. Prior to 2014, data coverage ranges from 11.6% to 80.7%. Credential level is measured during the last term enrolled at the first closure institution. Students in non-credential programs are classified separately from credit-bearing credential programs. Students in post-baccalaureate certificate programs are classified as students in certificate programs. Students in graduate certificate programs are classified as graduate students.

ENROLLMENT STATUS: Enrollment status is defined by whether the student was enrolled entirely full time, entirely part time, or a mix of full time and part time across all terms enrolled at the closure institution. A student's enrollment is reported by each institution based on its own credit thresholds for what is considered full-time or part-time enrollment. Students defined as part time include those enrolled 3/4 time, half time, or less than half time.

FIRST-TIME CREDENTIAL EARNER: First-time credential earners are students who had not earned any credential prior to closure or the matched artificial closure date. Students who earned credentials at the closure institution or the matched control institution or another postsecondary institution while dually enrolled are not considered first-time credential earners.

GEOGRAPHIC REGION: Geographic region is determined by the state of operation of the first institution where a student experienced a closure or the matched control institution. Branch campuses of institutional systems that operate in more than one state are categorized by the physical location of the campus that closed. The New England region includes CT, ME, MA, NH, RI, and VT. The Mid-Atlantic region includes DE, DC, MD, NJ, NY, and PA. The Great Lakes region includes IL, IN, MI, OH, and WI. The Plains region includes IA, KS, MN, MO, NE, ND, and SD. The Southeast region includes AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV. The Southwest region includes AZ, NM, OK, and TX. The Rocky Mountains region includes CO, ID, MT, UT, and WY. The Far West region includes AK, CA, HI, NV, OR, and WA.

LENGTH OF STOPOUT: The length of stopout measures the number of days between a student's last enrollment at the closed institution (last term end date) and their enrollment at a subsequent institution (first term begin date). Students who were concurrently enrolled in another postsecondary institution at the time of a closure are considered to have a reenrollment time frame of 0 days. Length of stopout categories were chosen based on the overall distribution of days between a closure and reenrollment. Notably, many of the closed institutions in this sample have continuous enrollment or non-standard enrollment terms. Students whose institution closed at the end of the spring semester and who reenrolled at the beginning of the fall semester may be categorized into reenrollment within one month or reenrollment within one and four months.

PRIOR ENROLLMENT EXPERIENCE: Students who had enrolled at any postsecondary institution prior to their first enrollment at the closure institution or matched control institution are considered to have prior enrollment experience. Students who were concurrently enrolled in another postsecondary institution during their first enrollment at the closure institution are also considered to have prior enrollment experience, as long as the overlapping enrollment term began before the term begin date of the first enrollment term at the closure institution.

RACE/ETHNICITY: In recent years, data coverage for race/ethnicity has improved to 83% of the undergraduate population with a valid report of race/ethnicity. This coverage was previously much lower, with less than 15% of institutions reporting race/ethnicity to the Clearinghouse in 2009 (see Additional Data Elements for historical coverage rates). The share of students with missing race/ethnicity information was 37% (31.5% missing and 5.5% unknown). Due to this higher level of missing data, findings by race/ethnicity should be interpreted with caution. Student race/ethnicity was determined by any enrollment term. Race/ethnicity data for an individual student did not vary across enrollment terms or institutions. Students who did not reenroll may be more likely to have missing race/ethnicity data as they had fewer enrollment terms and fewer opportunities for race/ethnicity data to be reported by the institution.

REENROLLMENT STATUS: Students are defined as reenrolled if they subsequently enrolled in another postsecondary institution that reports data to the Clearinghouse. Students moving from a main campus to a branch campus or from a branch campus to another branch campus with the same 6-digit OPEID were coded as having changed institutions. Students who were concurrently enrolled in another postsecondary institution at the time of the closure are considered reenrollees, as long as the overlapping reenrollment term extends beyond the term end date of the closure term.

TIME TO COMPLETION: Time to completion is measured only for students who earned their first-ever credential after reenrolling after closure or the matched artificial closure date. Time to completion is measured from the first postsecondary enrollment to the completion of the first credential in total time elapsed. Time to completion from closure is measured from closure or the matched artificial closure date to the completion of the first credential in total time elapsed. Time to completion is reported in calendar years and does not account for part-time enrollment or stopouts. Students who were not first-time credential earners are excluded from these calculations.

APPENDIX B. SUPPLEMENTAL METHODOLOGY

Matching institutions and students is a necessary step to control for non-observable confounding characteristics that may differ between the treatment and control groups, with the aim of reducing the preexisting imbalance between the two groups on key variables of interest. After matching procedures, analyses performed using the two groups can estimate the causal effects of a particular condition or treatment.

INSTITUTION MATCHING PROCEDURE

The purpose of selecting a control group of institutions was to minimize the number of student-level cases that were identified as potential matches for the 143,215 students who experienced a closure. Selecting a sample of non-closed institutions eliminated the need to sample the entire Clearinghouse database in order to perform a student-level match. Several options for conducting the institution-level match were considered, including propensity score weighting and kernel propensity score matching. Both of these techniques (described in more detail below) require the identification of an outcome variable (i.e., completion rate), which was not available for the institution sample. Matching for the institution sample thus necessitated an approach that did not incorporate modeling of the dependent variable. Coarsened exact matching (CEM) offers an alternative solution to a model-based matching approach.[38]

CEM coarsens the values of the matching variables to generate "bins" of values into which each treatment and control case is categorized. The user can identify the bounds of these coarsened cut-points or can allow the program to generate cut-points automatically. Treatment and control cases are then matched if they fall into the same bins across all matching variables. The primary advantages of CEM over other matching techniques include speed, fewer assumptions, automation, and ease of understanding. Moreover, CEM is a monotonic imbalance bounding (MIB) technique, meaning changes to the balance of one covariate do not affect the balance of other covariates. Importantly, CEM works on the multiply-imputed data used for the institution sample (for more details on imputation, see *Impacts*).

Given the nature of the institution sample (i.e., multiple observations per institution across all years of the panel), several approaches to CEM were explored: one-to-one match by collapsing all years into an average for each observation; weighted matching for all rounds of imputation with multiple control observations per treatment observation; and weighted matching using only the final round of imputation. Given the large size of the sample and the wide variability in the values of the continuous variables used for matching, CEM was run in 12 steps, with successively smaller numbers of variables included in each step. This allowed for the best and highest quality match for as many observations as possible. Institutions that did not report data to the Clearinghouse were excluded from the matching procedure to ensure that only eligible institutions and students were identified as a suitable match for treatment students. This reduced the pool of eligible institutions from 3,299 in IPEDS to 816 in the Clearinghouse database. The variables used for each step of the matching process and the number of institutions matched in

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38. Blackwell, M., Iacus, S., King, G., & Porro, G., (2010). *cem: Coarsened exact matching in Stata.* gking.harvard.edu/files/cem-stata.pdf

each step are presented in *Table 1*. Comparisons across the four matching approaches clearly identified one-to-one across a single (collapsed) year as the best option for reducing imbalance and restricting the number of matched control institutions. The pre- and post-matching summary statistics for the one-to-one single-year match are reported in *Table B1*.

TABLE B1
INSTITUTION-LEVEL COVARIATE BALANCE TABLE

MATCHING VARIABLE	UNMATCHED (N=1,283)			MATCHED (N=934)		
	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE
UNDERGRAD FTE	587.43	2,418.29	10.37	587.43	2,032.85	10.29
PERCENTAGE AGE 24+	15.90%	14.44%	-1.65	15.90%	16.13%	0.23
PERCENTAGE FEMALE	69.52%	58.78%	-10.92	69.52%	60.68%	-7.97
PERCENTAGE STUDENTS OF COLOR	54.47%	42.87%	-7.76	54.47%	44.46%	-5.92
PERCENTAGE PART TIME	22.26%	24.37%	1.62	22.26%	28.09%	3.83
PERCENTAGE WITH PELL	55.09%	35.68%	-16.55	55.09%	39.14%	-11.95
AVERAGE LOANS	$7,398	$5,794	-16.79	$7,398	$5,636	-16.13
TUITION REVENUE	$7,610,530	$24,700,000	8.03	$7,610,530	$15,800,000	7.03
PERCENTAGE DIST ED	11.17%	9.57%	-1.30	11.17%	10.36%	-0.56
GRADUATION RATE	49.76%	50.94%	1.02	49.76%	48.60%	-0.89
RETENTION RATE	63.77%	71.21%	10.39	63.77%	69.45%	6.99
SECTOR						
PUBLIC 4-YR	0.86%	15.81%	8.69	0.86%	6.85%	4.81
PRIVATE NP 4-YR	20.13%	54.17%	12.60	20.13%	46.47%	8.88
PRIVATE FP 4-YR	25.70%	4.66%	-11.59	25.70%	6.00%	-8.55
PUBLIC 2-YR	0.00%	16.54%	9.61	0.00%	27.41%	13.26
PRIVATE NP 2-YR	6.42%	2.08%	-4.00	6.42%	3.21%	-2.30
PRIVATE FP 2-YR	34.48%	3.68%	-16.39	34.48%	5.57%	-11.83
PUBLIC <2-YR	0.00%	1.47%	2.64	0.00%	2.36%	3.35
PRIVATE NP <2-YR	3.64%	0.37%	-4.59	3.64%	0.43%	-3.50
PRIVATE FP <2-YR	8.78%	1.23%	-6.78	8.78%	1.71%	-4.90
CONTROL						
PUBLIC	0.86%	33.82%	14.89	0.86%	36.62%	15.74
PRIVATE NP	30.19%	56.62%	9.43	30.19%	50.11%	6.33
PRIVATE FP	68.95%	9.56%	-28.05	68.95%	13.28%	-20.95
HIGHEST LEVEL						
<1 ACAD YR	1.93%	0.00%	-4.00	1.93%	0.00%	-3.03
1-2 ACAD YRS	10.49%	3.06%	-5.55	10.49%	4.50%	-3.50
ASSOCIATE	34.48%	17.28%	-7.12	34.48%	28.27%	-2.05
2-4 ACAD YRS	6.42%	5.02%	-1.05	6.42%	7.92%	0.89
BACHELOR'S	21.20%	23.04%	0.76	21.20%	24.41%	1.17
POSTBAC CERT	0.21%	0.49%	0.76	0.21%	0.64%	1.00

MATCHING VARIABLE	UNMATCHED (N=1,283)			MATCHED (N=934)		
	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE
MASTER'S	13.28%	20.83%	3.40	13.28%	18.20%	2.07
POSTMAST CERT	3.00%	4.17%	1.06	3.00%	3.85%	0.72
DOCTORAL	8.99%	26.10%	7.55	8.99%	12.21%	1.59

SOURCE: Integrated Postsecondary Education Data System (IPEDS), 2004-2020

STUDENT MATCHING PROCEDURE

The aims of the matching procedure were (1) to achieve better balance across the treatment and control groups, (2) keep as many treatment observations as possible, and (3) to slightly reduce the number of control observations to aid in analysis while still maintaining a healthy pool to use as a weighted control group. Several matching procedures at the student level were explored, including kernel propensity score matching, propensity score weighting, coarsened exact matching, one-to-one caliper matching, and Mahalanobis distance matching with variable ratios with and without a caliper. The variables used for matching are presented in *Table B2*. These approaches are discussed in further detail below.

KERNEL PROPENSITY SCORE MATCHING

This approach involves a logistic regression of treatment on student-level covariates (see *Table B2*) to generate a probability of treatment for each observation given all covariates. Then, using the *psmatch2* package in Stata 17, matching occurs within each of four exact-match strata. These strata were created by creating unique groups of exact matches on successively fewer covariates. For example, the first stratum includes treatment and control observations that match on all covariates. The second and third strata include subsets of observations that match exactly on subsets of the covariates. Finally, the fourth stratum includes a subset of observations that match exactly on race, gender, and age group. The kernel match matches every treated subject within each stratum with the weighted average of the control subjects in that stratum. This achieves lower variance by using more information from the control pool. The match also imposes common support which drops treatment observations whose propensity score is outside the range of propensity scores among the control observations. The resulting treatment and control samples appear to be balanced on all key covariates except for prior credential, but this method was not selected because it removes treatment cases.

PROPENSITY SCORE WEIGHTING

Also known as inverse probability of treatment weighting (IPTW), this approach involves a logistic regression of treatment on student-level covariates (see *Table B2*) to generate a probability of treatment for each observation, given all covariates. This approach involves retention of all control observations and assigns weights created from these probabilities of being treated. Treated observations are weighted with the inverse probability of treatment (1/P) and control observations are weighted with the inverse of 1 minus the probability of treatment (1/(1-P)). In our sample, this did not result in increased balance on key covariates.

COARSENED EXACT MATCHING (CEM)

This method is implemented using the *cem* package in Stata. As discussed in the main report for the institution-level match, CEM coarsens the values of specified variables using automatic binning and then generates strata for each unique observation which are then used to identify matches between the treatment and control groups. To generate the most precise matches, CEM was run in four steps, with progressively smaller numbers of matching variables in each step. Observations matched in one step were dropped from the next step, and then merged at the conclusion of the matching process. This matching was set up to produce a matching result with the same number of treatment and control observations in each matched strata by randomly dropping observations. This resulted in a sample that retained all treatment observations, but balanced only on three covariates that were included in each stage of matching: race, gender, and age category.

ONE-TO-ONE CALIPER MATCHING

Using the *calipmatch* package, a one-to-one match is specified with an exact match on binary variables and caliper width of two units for categorical variables. These matches are made without replacement or "greedily." The resulting samples were well-balanced on the exact match binary covariates, but not well-balanced on the other covariates. Further, this approach has the drawback of not being able to use the variation in the large pool of potential control cases.

MAHALANOBIS DISTANCE MATCHING (MDM)

Ultimately, MDM without a caliper was selected for the student-level match, but MDM with a caliper was also tested. MDM was implemented using the *ultimatch* package in Stata 17.[39] MDM assigns a distance measure to each observation based on covariates and creates weights for the selected control observations to balance the treatment and control samples. For two units to have a Mahalanobis distance of 0, they have to have identical covariate values. The matching process specified exact matches on race, gender, and age group, requiring that control cases be in the same stratum as their corresponding treated observations in these respects. Distance was minimized between counterfactual cases and treated cases based on the other key covariates in *Table B2*. If the Mahalanobis distance between a treated case and control case is minimized, this pair is expected to have similar covariate values. By extension, the distribution of the covariates in the treatment sample and matched sample should be similar.[40] This differs from propensity score matching (PSM), which works by reducing the distributions of multiple covariates into a single dimension: probability of treatment assignment. Thus, in PSM, covariates with similar propensity scores may not have similar covariate values. PSM is capable of yielding balanced samples but has also been criticized[41] for yielding samples comprised of matches that may not be proximate to one another on actual covariate values. MDM with a caliper of 0.04 was also explored. This specifies the maximum absolute distance between a treated and control observation. The addition of the caliper resulted in a well-balanced sample but dropped observations from the treatment group. MDM without a caliper was chosen for its balance and ability to retain all treated cases.

39. Doherr, T. (2019). *ULTIMATCH: Stata module to implement nearest neighbor, radius, coarsened exact, percentile rank and Mahalanobis distance matching.* Boston College Department of Economics. ideas.repec.org/c/boc/bocode/s458632.html

40. Griefer, N. (2022). *What are the pros and cons of using Mahalanobis distance instead of propensity scores in matching?* StackExchange. stats.stackexchange.com/questions/511294/what-are-the-pros-and-cons-of-using-mahalanobis-distance-instead-of-propensity-s

41. King, G., & Nielsen, R. (2019). Why propensity scores should not be used for matching. *Political Analysis, 27*(4), 435–454. doi.org/10.1017/pan.2019.11

TABLE B2
STUDENT-LEVEL COVARIATE BALANCE TABLE

MATCHING VARIABLE	UNMATCHED (N=1,283)			MATCHED (N=934)		
	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE
PRIOR ENROLLMENT	39.50%	60.83%	157.82	60.84%	60.83%	-0.07
PRIOR CREDENTIAL	14.05%	11.17%	-30.25	10.84%	11.17%	2.82
GENDER						
FEMALE	53.69%	54.59%	6.51	54.59%	54.59%	0.00
MALE	41.65%	44.28%	19.28	44.28%	44.28%	0.00
MISSING	4.66%	1.13%	62.61	1.13%	1.13%	0.00
RACE/ETHNICITY						
AMER. IND.	0.62%	0.65%	1.74	0.65%	0.65%	0.00
ASIAN	6.54%	2.49%	60.81	2.49%	2.49%	0.00
BLACK	11.95%	17.29%	58.59	17.29%	17.29%	0.00
HISPANIC	20.21%	12.23%	-72.91	12.23%	12.23%	0.00
MISSING	20.27%	36.91%	146.90	36.91%	36.91%	0.00
PACIFIC ISLANDER	0.34%	0.60%	15.22	0.60%	0.60%	0.00
NON-RESIDENT	1.59%	0.25%	-40.06	0.25%	0.25%	0.00
TWO OR MORE	3.50%	4.57%	20.62	4.57%	4.57%	0.00
WHITE	34.98%	25.01%	76.18	25.01%	25.01%	0.00
AGE CATEGORY						
MISSING	0.29%	0.03%	172.93	0.02%	0.03%	1.23
UNDER 18	6.45%	0.79%	-86.16	0.80%	0.79%	-0.23
AGE 18-20	32.30%	17.60%	-115.37	17.60%	17.60%	0.00
AGE 21-24	23.49%	22.29%	-10.24	22.29%	22.29%	0.00
AGE 25-29	13.00%	20.31%	77.20	20.31%	20.31%	0.00
AGE 30+	24.76%	38.98%	117.73	38.98%	38.98%	0.00
PROGRAM LEVEL						
MISSING	33.24%	12.17%	-165.53	12.17%	12.17%	0.00
NON-CREDIT	0.99%	1.48%	17.28	1.43%	1.48%	1.00
CERTIFICATE	7.52%	21.25%	177.92	21.08%	21.25%	1.07
ASSOCIATE	33.52%	41.97%	64.52	42.18%	41.97%	-1.11
BACHELOR'S	18.81%	17.98%	7.75	17.96%	17.98%	0.10
GRADUATE	5.92%	5.16%	11.75	5.18%	5.16%	-0.22
ENROLLMENT INT.						
MISSING	1.84%	11.97%	229.16	11.81%	11.97%	1.36
FULL TIME	19.29%	51.48%	287.74	51.49%	51.48%	-0.01
PART TIME	30.93%	7.48%	-189.19	7.64%	7.48%	-1.63
MIX FULL & PART TIME	47.93%	29.06%	-137.67	29.07%	29.06%	-0.01

MATCHING VARIABLE	UNMATCHED (N=1,283)			MATCHED (N=934)		
	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE	TREATMENT MEAN/FREQ	CONTROL MEAN/FREQ	T-VALUE
MAJOR						
MISSING	33.23%	12.59%	162.04	12.19%	12.59%	3.29
COMP. SCI.	2.41%	15.47%	261.03	3.85%	15.47%	107.41
ENGINEERING	2.23%	11.54%	198.75	3.32%	11.54%	84.88
PHYS. SCI. & MATH	4.62%	0.47%	74.56	4.04%	0.47%	-64.91
GENERAL STUDIES	16.17%	1.65%	148.42	15.87%	1.65%	-139.05
SOC. SCIENCES	4.75%	0.82%	69.38	4.02%	0.82%	-56.03
HUMANITIES	1.84%	0.18%	46.60	1.83%	0.18%	-44.65
HEALTH CARE	9.59%	28.51%	220.03	19.85%	28.51%	54.45
BUSINESS	9.51%	13.59%	-49.43	14.64%	13.59%	-8.10
EDUCATION	2.11%	1.36%	19.12	1.81%	1.36%	-9.66
OTHER	13.53%	13.82%	-3.02	18.58%	13.82%	-34.67
SECTOR						
PUBLIC 2-YR	55.35%	0.00%	-421.33	43.39%	0.00%	-331.35
PRIVATE NP 2-YR	0.41%	0.88%	25.01	1.18%	0.88%	-8.02
PRIVATE FP 2-YR	1.00%	36.46%	750.00	9.21%	36.46%	183.67
PUBLIC 4-YR	12.81%	0.53%	-138.70	12.12%	0.53%	-131.12
PRIVATE NP 4-YR	18.63%	15.69%	-27.50	14.13%	15.69%	11.70
PRIVATE FP 4-YR	11.80%	46.44%	370.00	19.96%	46.44%	156.75

SOURCE: Integrated Postsecondary Education Data System (IPEDS), 2004-2020

APPENDIX C. SUPPLEMENTAL TABLES

Supplemental tables are available on the project website at sheeo.org/project/college-closures. These tables contain full regression analyses for the summary tables presented herein.