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Digitally Divided: The Varying Impacts of Online Enrollment on Degree Completion

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This study examines the influence of varying levels of online enrollment on community college students' likelihood of degree completion, with a particular focus on completion outcomes among traditionally underserved subgroups of students. Using institutional transcript data from a high-enrollment community college and a propensity score weighting approach, I find that lower levels of online enrollment have a positive relationship with the likelihood of degree completion for Black, Hispanic, and low-income community college students, but enrolling in *all* online courses has a negative influence on the likelihood of degree completion across subgroups of community college students.

Introduction

Community colleges provide access to higher education for many historically underrepresented and academically underprepared students who may not have attended college otherwise. Although community colleges can open doors to new opportunities, the majority of students who begin at a community college do not earn an associate or bachelor's degree. Completion rates among community college students are stratified by race/ethnicity and socioeconomic status, with Black, Hispanic, and low-income students completing college at significantly lower rates than their white and higher-income peers (Bailey et al., 2015; Causey et al., 2022).

In response to lagging completion rates, a growing share of community colleges have increased their commitment to online education to accommodate time- or location-constrained students and offer additional pathways to degree completion. Specifically, the proportion of community college students who enrolled in at least one online course has increased from 5.9% in 2000 (Ortagus, 2017) to 42.6% in 2016 (author's calculations using National Postsecondary Student Aid Study data). Online education has the potential to remove barriers and increase access to higher education, but previous studies typically report negative or mixed effects of online enrollment on community college students' academic outcomes. Prior work on online education often confounds the student taking an online course or two with the exclusively online student, revealing the need to consider the proportion or "dosage" of online courses when seeking to examine the implications of online education on degree completion. Community college students who enroll exclusively in online courses may have to rely more on self-directed learning than their peers who take a mixture of face-to-face and online courses. These

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differences in coursetaking patterns can affect specific subgroups of students in different ways, as white students and students with higher levels of educational attainment have greater success with self-directed learning than Black students and students with lower levels of educational attainment (Xu & Xu, 2020).

Black, Hispanic, and low-income community college students, in particular, have been found to perform worse in online courses (e.g., exam scores and course grades) when compared to face-to-face courses (Xu & Jaggars, 2014; Xu & Xu, 2020). However, those same students may face significant time or location constraints and be able to benefit in the long term by taking online courses as a way to continue to make progress toward graduation in lieu of halting their academic momentum (Ortagus, 2018). Despite a growing body of literature focused on online education in higher education, researchers, practitioners, and policymakers lack nuanced evidence related to whether online enrollment helps or hinders the likelihood of degree completion for the students who are the most likely to drop out of college: racially minoritized or low-income students who begin at community colleges.

To examine the varying impacts of online enrollment on degree completion, I address the following research questions:

Research Question 1: To what extent does the proportion of online courses influence community college students' likelihood of degree completion?

Research Question 2: Do results vary among Black, Hispanic, or low-income community college students?

Data

This study draws detailed administrative data from a high-enrollment community college,

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Sunshine Community College (pseudonym hereby referred to as SCC). Due to national data limitations, the only way to consider the influence of the proportion of online courses on students' likelihood to graduate is to use institutional transcript data. By gaining access to ten years (2009-2019) of institutional transcript data from SCC, I am able to offer a nuanced analysis of the heterogeneous treatment effects of online enrollment behaviors and the extent to which the proportion of online courses influences various subgroups of community college students' likelihood to complete an associate or bachelor's degree.

The treatment variables of this study capture varying levels of online enrollment among SCC students. To operationalize levels of online enrollment, I consider the impact of enrolling in 1-24%, 25-49%, 50-74%, and 75-99% of online courses in addition to all (100%) online courses. Among the 41,302 SCC students in the sample, 60.6% enrolled in at least one online course during the period of the study (2009-2019). More specifically, 16,293 students in the sample did not take online courses (reference group), 11,964 enrolled in 1-24% of online courses, 6,614 enrolled in 25-49% of online courses, 3,675 enrolled in 50-74% of online courses, 1,664 enrolled in 75-99% of online courses, and 1,092 enrolled in all (100%) online courses. Although 55.7% of SCC students in the sample were classified as Black, Hispanic, or low-income students, only 2.8% of SCC students were classified as any of the other race/ethnicity categories. As a result, I was not able include subgroup analyses for Asian students, Native American students, and other race/ethnicity groups.

To account for SCC students who may have transferred and completed their degree elsewhere, I also use National Student Clearinghouse data to identify students who transferred vertically and completed their bachelor's degree at another college or university. I account for

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systematic differences in pre-college student characteristics and individuals' conditional

probability of receiving the treatments (levels of online enrollment) by employing a propensity

score weighting (PSW) approach for each treatment variable. The pre-treatment variables

included in the PSW models include gender, age, race/ethnicity, socioeconomic status, academic

degree program, first-generation status, degree goal (associate or bachelor's degree), veteran

status, marital status, U.S. citizenship, and county of residence. The use of PSW should reduce

selection bias and improve the balance between non-equivalent groups of data (see Figure 1). A

full description of the methods used in this study can be found in the Methodological Appendix.

[INSERT FIGURE 1 HERE]

Results

Table 1 shows the influence of the proportion of online courses on degree completion.

The aggregated results show that community college students who enrolled in *some*, but not all,

online courses were more likely to earn their associate degree and bachelor's degree, but students

who enrolled in *all* online courses were less likely to earn their associate degree and bachelor's

degree. Specifically, students who enrolled exclusively in online courses were 15.8 percentage

points less likely to obtain their associate degree and 8.6 percentage points less likely to

complete their bachelor's degree.

Table 1 also provides the heterogenous effects of the proportion of online courses on

degree completion, focusing specifically on Black, Hispanic, and low-income students. For

Black community college students, enrolling in *some* online courses (fewer than 50% of total

courses) was related to a greater likelihood of completing their associate and bachelor's degree,

but enrolling in *all* online courses had a negative influence on their likelihood of attaining an

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associate degree (18.1 percentage points) and bachelor's degree (8.0 percentage points). Hispanic community college students who enrolled in lower proportions of online courses had higher likelihoods of earning an associate degree (between 7.8 and 22.4 percentage points). Hispanic students who enrolled in some online courses (1-99%), but not all online courses, had a greater likelihood of transferring to a four-year university and earning their bachelor's degree (between 6.0 and 10.8 percentage points). Similar to the pooled sample and subgroup of Black students, Hispanic students who enrolled in all online courses were less likely to obtain their associate degree (17.8 percentage points) or bachelor's degree (5.3 percentage points).

For low-income community college students, lower levels of online enrollment (fewer than 75% of total courses) had a positive influence on the probability of associate degree completion (between 5.4 and 18.5 percentage points). Similar to Hispanic students, enrolling in some online courses (1-99%) had a positive influence on students' likelihood of transferring to a four-year university and earning their bachelor's degree (between 5.1 and 9.9 percentage points). Low-income community college students who enrolled in *all* online courses had a lower likelihood of obtaining their associate degree (16.8 percentage points) or bachelor's degree (10.5 percentage points) at any point during the time period of this study.

[INSERT TABLE 1 HERE]

Discussion

Online education at community colleges can either open doors to new opportunities by improving educational access or constrain opportunities by hindering students from achieving their educational aspiration of completing their degree. Prior work related to the effectiveness of online education typically focuses extensively on short-term academic outcomes and confounds

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the online learner taking an online course or two with the exclusively online student. This study represents the first empirical examination of the extent to which the proportion of online courses affects the probability of degree completion across different student subgroups.

For any practitioner or policymaker seeking to better understand the extent to which community colleges should engage online education as a medium of instruction, I show that enrolling in some online courses, particularly lower levels of online enrollment, has a positive relationship with the likelihood of degree completion for Black, Hispanic, and low-income students, but enrolling in *all* online courses has a negative influence on the likelihood of degree completion for those same students. This study advances our understanding of the implications of varying levels of online enrollment and shows the value of online education as a supplement to face-to-face education for community colleges seeking to identify ways to improve students' likelihood of degree completion. For policymakers, these findings highlight the harmful impact of enrolling in all online courses on degree attainment among community college students. Policymakers can respond to these findings by requiring transparent reporting of completion rates by medium of instruction and enhancing accountability efforts for exclusively online degree programs.

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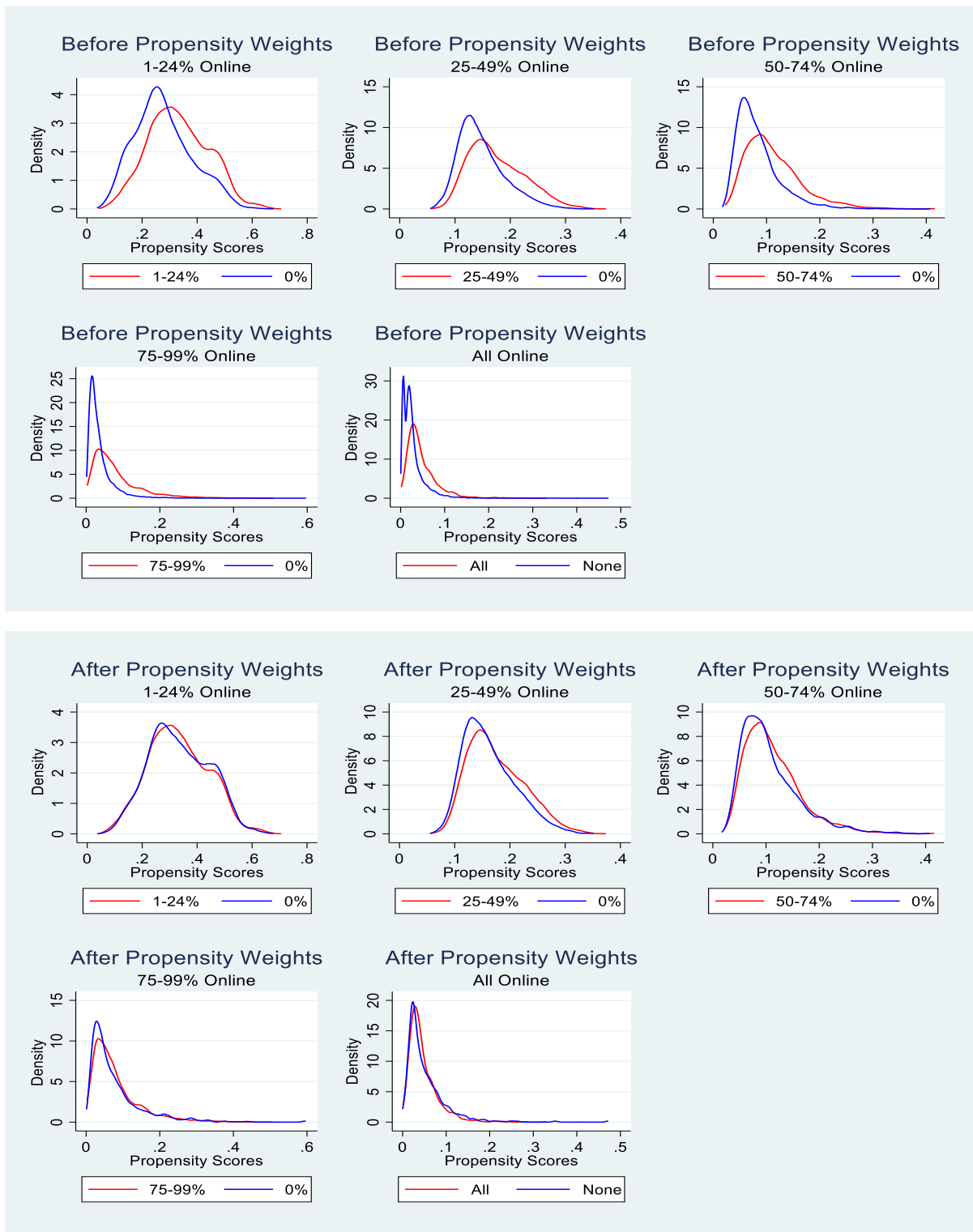
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Figure 1. Probability densities for students' varying levels of online enrollment

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Table 1. The influence of the proportion of online courses on degree completion

Variables	All Online	Online: 1-24%	Online: 25-49%	Online: 50-74%	Online: 75-99%
Panel A: Pooled Sample (N = 41.302)					
Associate Degree	-.158***	.207***	.151***	.063***	.067***
	(.011)	(.005)	(.006)	(.008)	(.013)
Bachelor's Degree	-.086***	.112***	.098***	.061***	.091***
	(.009)	(.005)	(.006)	(.008)	(.012)
Panel B: Black Students Only (N = 8,691)					
Associate Degree	-.181***	.230***	.166***	.032	.041
	(.014)	(.011)	(.014)	(.018)	(.028)
Bachelor's Degree	-.080***	.124***	.116***	.039	.043
	(.019)	(.011)	(.013)	(.022)	(.024)
Panel C: Hispanic Students Only (N = 6,824)					
Associate Degree	-.178***	.224***	.127***	.078**	.047
	(.023)	(.013)	(.016)	(.023)	(.039)
Bachelor's Degree	-.053*	.108***	.062***	.060**	.102**
	(.023)	(.013)	(.015)	(.020)	(.033)
Panel D: Low-Income Students Only (N = 13,919)					
Associate Degree	-.168***	.185***	.135***	.054***	.013
	(.022)	(.009)	(.011)	(.014)	(.021)
Bachelor's Degree	-.105***	.099***	.094***	.059***	.051**
	(.017)	(.009)	(.010)	(.013)	(.019)

Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$

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Methodological Appendix

In this study, I examine the influence of varying levels of online enrollment on degree completion. To ensure that regression models did not confound non-completers with students who earned a different degree at another institution, I removed 1,658 students who earned a bachelor's degree but not an associate degree for models focused on associate degree completion and removed 8,017 students who earned an associate degree but not a bachelor's degree for models focused on bachelor's degree completion. In addition, as I noted in the brief, I also controlled for every student's degree attainment goal (whether they sought to obtain an associate degree or bachelor's degree) in each regression model. The analytic sample includes ten years of transcript data (2009-2019) but only includes entering cohorts of students at SCC between 2009 and 2015 to allow for the time needed for community college students to make progress toward degree completion.

A primary concern for this study is selection bias. If the SCC students who enroll in online courses differ from those who do not enroll in online courses in ways that influence their likelihood of degree completion, I would face challenges determining whether differences in outcomes across groups are due to their level of online enrollment rather than the pre-treatment differences across student subgroups. In quasi-experimental studies, such as propensity score weighting (PSW), the counterfactual model can be used to allow treatment and control groups to be equivalent based on a host of pre-treatment characteristics. By using a PSW approach to account for individuals' conditional probability of receiving the treatments, I am able to reduce selection bias and improve the balance between non-equivalent groups of data.

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After calculating the propensity score weights, I use a weighted scheme to calculate the average treatment effect on the treated (Guo & Fraser, 2015). Figures 1 demonstrates the overlap between treated and untreated units within the overall sample by including multiple graphs showing the probability densities for varying levels of online enrollment before and after propensity score weighting. I provide doubly robust estimates by including all of the pre-treatment covariates from the PSW approach as controls in the regression equation along with additional post-treatment controls that may confound a given student's likelihood of degree completion, such as grade-point average, enrollment intensity (part-time or full-time), and whether the student enrolled in developmental coursework. To estimate the impact of the proportion of online enrollment on the likelihood of degree completion, I use various linear probability models (additional analyses used logit models and found consistent results in statistical significance, direction, and magnitude of coefficients). The linear probability models for this study can be represented by the following equation:

$$y_{ic} = \beta_0 + \beta_1 I_{ic} + \beta_2 X_{ic} + \eta_c + \varepsilon_{ic},$$

where y_{ic} is an indicator equaling one or zero for whether individual i in cohort c completes an associate or bachelor's degree. The variable I_{ic} is a treatment indicator that equals one if an individual in a given cohort enrolled in the identified level of online courses. X_i represents a vector of demographic variables and information on the academic performance and circumstances of individual i in cohort c. η_c represents the cohort fixed effects. The error term is represented by ε_{ic}.

In the PSW and regression models, I include the following pre-treatment covariates: gender, age, race/ethnicity, socioeconomic status, academic degree program, first-generation status, degree goal (associate or bachelor's degree), veteran status, marital status, U.S. citizenship, and county of residence. To ensure that covariates included in the models are

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balanced, I followed the recommendations of Shadish et al. (2008) and Rubin (2001) and employed a covariate balancing approach using standardized mean differences and variance ratios. Specifically, I calculated the standardized mean differences (Cohen's *d*) before and after using propensity score weights, as indicated by the following equation:

$d = (\bar{x}_t - \bar{x}_c) / \sqrt{(s_t^2 + s_c^2)/2}$. In short, this balancing approach should result in *d* being close to zero ($|d| < 0.1$) after applying the propensity score weights. I also tested the variance ratio before and after using propensity score weights by calculating the variance ratio as $v = s_t^2 / s_c^2$ and specifying an acceptable range around one ($4/5 < v < 5/4$).

The identifying assumption of the balancing tests suggests that conditioning on the previously identified covariates can reduce bias. Such an assumption requires the distributions of covariates to be the same between different samples after reweighting the data. In unreported results, the balance checks for this study indicate that covariates are reasonably well-balanced given that both the standardized mean differences and variance ratios typically fall within their recommended ranges after applying the propensity score weights. The standardized differences show the differences in the means of each variable, and the variance ratios check for similarity in the dispersion of the data (results from all balance checks are available upon request).

Although this study provides several contributions, the findings outlined in the brief are subject to numerous limitations. First, I focus on a single high-enrollment community college to be able to leverage transcript data capturing nuanced online enrollment information, but such a decision limits the external validity of the findings and prevents researchers from making generalizable claims across institution types. Second, I control for the degree attainment goal of

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each SCC student (whether they sought to earn an associate or bachelor's degree), but this information was collected prior to registering for courses and could have changed over time. Future researchers can explore the varying impacts of online enrollment for an entire state system, as an example, if they gain access to statewide transcript data, and such analyses can expand upon the present study by considering four-year institutions.

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