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ABSTRACT

COVID-19 and College Academic Performance: A Longitudinal Analysis*

Using an unbalanced panel of close to 12,000 academic records, and difference-in-differences models and event study analyses with individual fixed effects, we evaluate the impact of the COVID-19 pandemic on lower-income students' academic performance during the spring 2020 semester relative to their higher-income peers. We find a differential effect by students' pre-COVID-19 academic performance. Top-performing lower-income students experienced a decrease in both grades (5% lower) and earned credits (11% fewer) during the spring 2020 semester relative to their higher-income peers. In contrast, lower-income students in the bottom quartile of the fall 2019 cumulative GPA distribution outperformed their higher-income peers with a 9% higher spring 2020 GPA. After ruling out alternative mechanisms, we find suggestive evidence from survey data that top-performing lower-income students' lower relative performance may be driven by greater challenges with online learning and a disproportionate intake of incomplete courses relative to their higher-income peers. Among bottom-performing lower-income students, greater concerns with maintaining financial aid than their higher income peers may have led them to a higher use of the credit/no credit grade option instead of a letter grade.

JEL Classification: I24, I23, I22

Keywords: COVID-19, income and performance inequality, unbalanced panel of academic records, difference-in-difference models and event analysis

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1. Introduction

With the COVID-19 pandemic, most higher education institutions closed campuses, cancelled all physical class meetings, and moved to online teaching. The already existing higher-education inequalities between the lower- and higher-income students may well have widened because of the digital divide in education and the uneven access to e-learning resources[1], lower-income students' scarcer access to physical learning space and conducive learning environment, and their higher stress and anxiety caused by the greater uncertainty about the future as the hardships of the shutdown were disproportionately felt on the poorer households.[2] Indeed, several recent studies (Aucejo et al. 2020; Rodríguez-Planas 2020) have found that the COVID-19 pandemic has adversely affected academic *expectations* of college students in the US with lower-income students more likely to experience online-learning challenges, consider dropping classes, and delaying graduation than their higher-income peers.[3]

At the same time, another dimension of inequality that may be particularly relevant with college closings and online learning is the one between lower- and higher-performing students as online learning requires more discipline and self-regulated learning than traditional in-person learning. To the extent that human capital accumulation is a process of dynamic complementarities (e.g., Cunha et al., 2006; Cunha and Heckman, 2007), it ought to be easier for higher-performing students to accumulate additional skills than lower-performing ones. Indeed, Grenewig et al. (2020) find that, after COVID-19 school closures in Germany, higher-performing students spent more time on school-related activities daily than their lower-performing peers. The authors did not find any differential learning time between lower- and higher-performing students prior to the school closures.

[1] For instance, Rodríguez-Planas (2020) finds that lower-income students were more likely to report experiencing online-learning challenges because of lack of internet connection (54% higher) and software difficulties (23% higher) than their higher-income peers.

[2] Rodríguez-Planas (2020) finds that lower-income students were 21% more likely to report experiencing online-learning challenges because of being stressed or overwhelmed than their higher-income peers.

[3] Aucejo et al. (2020) finds that lower-income students were 55% more likely than their higher-income peers to consider delaying graduation due to COVID-19. Rodríguez-Planas (2020) finds that lower-income students were 8% more likely to have online-learning challenges and 11% more likely to consider dropping a course than their higher-income peers.

Despite recent work on the impact of COVID-19 on college students' academic expectations, little is known on how the pandemic affected college students' academic performance during the spring 2020 semester and whether it had any differential impact on lower-income students relative to their higher-income peers. This is the main objective of this paper. Using an unbalanced panel of close to 12,000 academic records from Queens College (QC), an urban college with a socially vulnerable and ethnically diverse student population[4] located in the borough of Queens in New York city, and difference-in-differences models and event study analyses with individual fixed effects, we estimate the impact of the COVID-19 pandemic on the academic performance during the spring 2020 semester of students who ever received the federal Pell grant (hereafter lower-income students) relative those who never received the Pell grant (hereafter higher-income peers).[5] The analysis is done both for the average student, as well as for lower- versus higher-performing students (where students are classified into four quartiles based on their fall 2019 cumulative GPA distribution). We also explore the mechanisms behind our findings by using the students' responses to a rich survey collected between July 24th and September 18th 2020 at QC.

While most students experienced major challenges with the pandemic and online learning during the spring 2020 semester, it is unclear whether their *actual* academic performance (including GPA, and credits earned and dropped) would necessarily be adversely affected because: (1) a different assessment process with easier exams and/or more lenient grading; (2) a more difficult supervising process as exams were online, leading to potentially greater cheating; (3) an improvement in students' learning strategies with online learning; (4) lower opportunity costs of studying due to less employment available; (5) lower financial stress due to greater availability of emergency relief funds from the college or the government; and/or (6) greater flexibility in students' grading choices with the credit/no credit grade option may have well increased students' GPA in the middle of the pandemic.

[4] QC is one of the most affordable colleges in the country with a median undergraduate tuition of $6,530, which is $14,203 less than the national average for Master Colleges and University ($20,733). In 2017, the undergraduate acceptance rate was 42.7%. In comparison, the undergraduate tuition at ASU is $11,338 and the acceptance rate is 85%. https://datausa.io/profile/university/MAS

[5] We use information on ever Pell grant receipt to define low-income students because to be eligible for this grant students' expected family contribution towards their education expenses has to be lower than $5,273.

Figure 1 plots the coefficients on the semester dummies and the 95% confidence intervals from an individual fixed-effects model using the whole sample (Panel A) and students in each of the four quartiles of the fall 2019 cumulative GPA distribution (Panels B to E).[6] Standard errors are clustered at the individual level. Figure 1 shows a sharp increase in the spring 2020 semester GPA relative to earlier semesters for the whole sample and for students at each of the different quartiles of the fall 2019 GPA distribution. Not surprisingly, such increase is inversely related to the pre-COVID-19 performance because there is more room for grade improvements at lower than higher GPA levels. Figure 1 also shows that students in the bottom quartile dropped fewer credits and earned greater credits during the spring 2020 semester than in previous semesters. While students in the top half of the distribution also earned relatively more credits during the spring 2020 semester than before the pandemic, they dropped more credits than earlier semesters.

In contrast with students' academic expectations for spring 2020 semester (Aucejo et al. 2020; Rodríguez-Planas 2020), the difference-in-differences with individual fixed effects analysis reveals that lower-income students had 3.4% higher GPA and dropped 31% fewer credits during the spring 2020 semester than their higher-income peers. Both effects are statistically significant at the 1% level. However, average effects hide important differences by pre-COVID-19 academic performance.

The COVID-19 pandemic negatively impacted lower-income top-performing students by reducing their GPA by 5% and credits earned by 11% relative to their higher-income peers (and relative to their pre-COVID-19 academic performance). The GPA result is statistically significant at the 1% level, and the credits result is marginally significant at the 10% level. In contrast, the COVID-19 pandemic improved the academic performance of the lowest performing lower-income students by marginally raising their spring 2020 GPA by 9% relative to their higher-income peers (significant at the 10% level). The event analysis shows no differential GPA or credits earned between top- (or bottom-) performing lower- and higher-income students prior to the pandemic.

We find suggestive survey evidence that students' grading choices may be driving the aforementioned differential impact of COVID-19 on academic performance. More specifically, we find

[6] We have normalized the coefficients to 0 in fall semester 2019.

suggestive evidence that greater concerns with maintaining financial aid and higher relative use of the credit/no credit option among the bottom-performing lower-income students (relative to their higher-income peers) may have driven their improved academic performance. In contrast, the higher relative use of incompletes among the top-performing lower-income students would explain their lower credits earned relative to their higher-income peers. Top-performing lower-income students were also disproportionally disrupted by moving to online teaching, supporting the lower performance relative to their higher-income peers.

Our work relates to at least the following two strands of literature. First, we are close to studies analyzing the effect of crises on students' academic performance (Brück et al. 2019; Sacerdote 2012) or students' earnings after graduation (Oreopoulos et al. 2012; Fernández-Kranz & Rodríguez-Planas 2018).[7] While these earlier studies focus on the effects of events long after they occurred, we study the immediate effects of the event. Consistent with our findings, both Brück et al. (2019) and Sacerdote (2012) find heterogeneous effects along students' academic-performance distribution.[8]

Second, we contribute to a recent but growing literature analyzing the consequences of the COVID-19 pandemic on college education (Aucejo et al. 2020; Rodríguez-Planas 2020). In contrast with these studies that focus on students' self-perceived challenges, we find that the immediate impacts of the COVID-19 pandemic on academic performance are not only positive, but seemed to benefit most lower-performing lower-income students. While it is unclear whether these beneficial effects represent real human-capital gains, or whether they will persist over time, these findings suggest that college policies may be able to counteract negative shocks as in Han et al. (2020).

The rest of the paper is structured as follows. Sections 2 and 3 describe the data and the statistical methods. Sections 4 and 5 present the results and discuss potential mechanisms, before concluding in Section 6.

[7] Brück et al. (2019) analyze the impacts of violent conflicts, Sacerdote (2012) those of natural disasters, and Oreopoulos et al. (2012) and Fernández-Kranz & Rodríguez-Planas (2018) those of economic recessions.
[8] Brück et al. (2019) find that students in the upper tail of the distribution are not negatively affected by violent conflicts, whereas Sacerdote (2012) finds academic gains among high-school age Katrina evacuees students in the lowest quintile of the test score distribution.

2. Data

We merged individual administrative academic records with survey data on students' challenges during the early months of the pandemic. Most of our analysis focuses on an unbalanced panel of 11,888 academic records from 3,147 QC students spanning from the spring semester 2017 or later (if the student enrolled in QC at a later date) to spring semester 2020.[9] For each semester, we observe students' semester GPA, and credits earned and dropped. Other information available in QC administrative records include students' sex, age, race, and ethnicity. In addition, we also observe the following information collected at the beginning of spring 2020 semester: students' major, class level[10], fall 2020 cumulative GPA, part-time student status, and whether the student had ever receipt the federal Pell grant. We use information on ever Pell grant receipt to define lower-income students because to be eligible for this grant students' expected family contribution towards their education expenses has to be lower than $5,273.[11]

To identify potential mechanisms behind our findings, we use the students' responses to an online survey on their experiences during the spring 2020 semester that was fielded between Friday, July 24th and Friday, September 18th 2020. As QC had 15,982 graduate and undergraduate students enrolled during spring 2020 semester, our sample of analysis represents 20% of the QC student population at that point in time, which is higher than what is considered as target for such type of surveys—10% to 15% based on https://www.appjetty.com/blog/acceptable-response-rate-for-online-surveys/—, and higher than the usual response rate on CUNY online surveys of 13%.[12] Below, we discuss the external validity of this sample. Nonetheless, it is important to underscore that our estimates have internal validity as our models use difference-in-differences models and also control for students' time-invariant unobserved heterogeneity using individual fixed effects as explained in the next section.

[9] Students gave us consent to access their academic records prior to responding to an online survey on their experiences during the spring 2020 semester. We received IRB approval (IRB file #2020-0475) on July 21st 2020 to conduct the survey, collect, and de-identify administrative records, and merge both data sources. IRB approval is available from the author upon request.

[10] Class-level indicate whether the student is a freshman, sophomore, junior, senior, or graduate student.

[11] The minimum Pell Grant award for 2020-21 is $639 and the maximum is $6,345. http://pell-grants.org/how-is-the-pell-grant-affected-by-academic-performance/

[12] Our sample of students is also twice as large as that of other studies analyzing the impact of COVID-19 on students' survey responses (Aucejo et al. 2020).

External Validity

Columns 1 and 2 in Table 1 display baseline characteristics for our student sample by income status. To explore the external validity of our sample, we compare these means to averages for all QC students registered in the fall 2019 semester (shown in column 4).[13] We observe small differences between students in our sample and the overall QC student population in the racial/ethnic distribution, the share of students who ever received the Pell grant[14], the share of part-time students, and the distribution of majors[15]. In contrast, we observe that our sample has a higher share of females (67% versus 57%) and older-than-25-years-old students (35% versus 29%) than the overall QC population, and a lower share of US born (44% versus 68%), ESL learners (23% versus 36%), and transfer students (23% versus 55%).

Columns 5 and 6 display averages for students from Arizona State University (ASU) and students from the largest public university in each state, and allow us to compare QC students to those of other public state universities. CUNY is known to be an institution that educates some of the poorest students in the country. It is also known to have a very diverse student population. Hence, it is not surprising that QC students are more racially diverse and more likely to be first-generation college students than students from Arizona State University or students from the largest public university in each state.

Lower-Income Students versus Higher-Income Students

Lower-income students represent 46% of our sample. They are more likely to be Asians or Hispanics than higher-income students. Lower-income students are also more likely to be first-generation college students, transfer students, English second-language learners (ESL) students, less likely to be US born than general population students, and have a lower fall 2019 cumulative GPA. Given the Pell-grant requirements, lower-income students are younger, and less likely to be graduate students or study part-time than higher-income students. To the extent that our models control for individual fixed effects, we will control for time-invariant observable and unobservable student characteristics.

[13] Data for the spring 2020 semester at the college level will not be available until spring semester 2021.
[14] While the share of students who ever received the Pell grant in our sample is 46%, it jumps to 52% if we restrict the sample to undergraduate students, which is not far from the 55% observed at the college level.
[15] Descriptive statistics on students' major is shown in Appendix Table A.1.

3. Statistical Methods

To estimate the differential impact of the COVID-19 pandemic on lower-income students' academic performance, we estimate the following difference-in-differences model with individual fixed effects:

$$Y_{ist}=\beta_0 + \beta_1\, Spring_{ist} + \beta_2\, (Spring_{ist} * Low\text{-}Income_{ist}) + \varphi_i + \phi_s + \delta_t + \varepsilon_{ist} \qquad (1)$$

where Y_{its} is the outcome of interest (for example, semester GPA) for student *i* in semester *s and* year t. $Spring_{ist}$ is a dummy equal 1 if the academic record is for the spring 2020 semester and 0 prior to that. $Low\text{-}Income_{ist}$ is equal to 1 if student *i* ever received the Pell grant and 0 if the student never received the Pell grant. φ_i represents the individual fixed effects, ϕ_s is the semester dummy indicating whether the academic record is for the spring or fall semesters, and δ_t represents the year fixed effects. Standard errors are clustered at the student level.

Our coefficient of interest, β_2, captures the differential post-pandemic effect on the outcome, Y_{ist}, for lower-income students relative to their higher-income peers. Note that the individual fixed effects, φ_i, absorb the lower-income indicator (as well as all the other time-invariant observable characteristics). β_1 captures how the academic performance of higher-income students changed in spring 2020 semester when the COVID-19 pandemic hit. As identification comes from comparing outcomes from the same student before and after the pandemic, there is no need to control for time-invariant observable characteristics. The semester dummy controls for semester-specific characteristics, and the year fixed effects control for cohort differences over time.

The critical identifying assumption is that there are parallel trends in the outcome variable across both groups (lower- versus higher-income students). To assess the validity of this assumption, we check for pre-existing diverging trends using an event-study framework. To test the parallel-trends assumption, we estimate the following regression:

$$Y_{ist}=\gamma_0 + \sum_{s=-6}^{1} \gamma_s(S_{is}) + \sum_{s=-6}^{1} \xi_s(S_{is} * Low\ Income_i) + \varphi_i + \varepsilon_{ist} \qquad (2)$$

where S_{is} is a dummy for the s^{th} semester before (-s) or after (+s) January 27 2020, which is when spring 2020 semester began. The fall 2020 semester dummy is the omitted semester. In the absence of any pre-existing differential pre-trends between lower- and higher-income students, the estimated coefficients ξ_s corresponding to the semesters prior to the spring 2020 semester should be non-statistically different from zero.

4. Findings

Average Effects. We begin our analysis by presenting results for the difference-in-differences model using the whole sample, shown in Panel A, Table 2. Focusing on the coefficient, β_2, which captures the differential impact of COVID-19 on lower-income students relative to their higher-income peers, we observe that lower-income students had 11 percentage points higher GPA in the spring 2020 semester, a 3.4% increase relative to the pre-COVID-19 average GPA for the comparison group. At the same time, lower-income students dropped 31% (or 20.3 percentage points) fewer credits during the spring 2020 semester relative to their counterparts. Both effects are statistically significant at the 1% level.

Moving to the effect of COVID-19 on higher-income students' academic performance (captured by β_1), we observe a statistically significant 19% increase in semester GPA, but no effect on credits dropped or earned during the spring 2020 semester.

By Quartiles. To explore whether these average effects hide differences by students' pre-COVID-19 academic performance, Panels B to E in Table 2 present difference-in-differences estimates using four separate samples defined by in which quartile the student was in based on his or her fall 2019 cumulative GPA. Focusing on the effects of COVID-19 on the spring semester GPA, we observe an average 8.8% increase for lower-income students in the bottom quartile relative to their wealthier counterparts. This effect is only marginally statistically significant with a 10% significance level. In contrast, lower-income students in the top quartile experienced an average 5.1% decrease in the spring 2020 GPA relative to their wealthier counterparts. This effect is statistically significant at the 1% level. Interestingly, there is no differential effect for students in the middle quartiles as β_2 is close to 0 and lacks statistical significance.

Moving to the effect of COVID-19 on higher-income students by pre-COVID-academic performance (captured by β_1), there is an inverse relationship between the percent increase in spring 2020 GPA (relative to earlier semesters) and the average GPA in each quartile, with students in the top quartile experiencing an 11% increase in spring 2020 GPA relative to their GPA in earlier semesters, those in the third quartile a 15% increase, those in the second quartile a 22% increase, and those in the bottom quartile a 52% increase. This reflects that there is more room for grade improvements at lower than higher GPA levels.

In terms of credits, the only differential impact between lower- and higher-income students that is statistically significantly different from zero takes place among top-quartile students. Top performing low-income students earned 10% lower credits than their counterparts. This effect is statistically significant at the 10% level.

Event Study. A possible concern is that the regression results from Table 2 are driven by pre-existing differential trends by income level. To test the parallel pre-trends assumption, we show results from an event study by estimating model (2) and plotting in Figure 2 the coefficients on the interactions between semester dummies and the lower-income indicator, that is, the coefficients ξ_s, where we normalize the coefficients to 0 in fall semester 2019. Figure 2 shows the analysis for the whole sample (Panel A) and for each of the quartiles in the fall 2019 cumulative GPA distribution (Panels B to E).

Focusing on the figures representing the event study for the semester GPA, they suggest there was no pre-trend before the spring 2020 semester. Panel A shows no pre-trends with a sharp increase in GPA in the spring 2020 semester for the whole sample. Panels B to E show that this increase is driven by students in the bottom quartile. Consistent with estimates in Table 2, the picture is quite different for students in the top quartile. Panel E shows that the lack of pre-trends is followed by a sharp drop in the spring 2020 GPA. A similar pattern emerges for credits earned among students in the top quartile with no pre-trends followed by a sharp drop in the spring 2020 semester. In the next section, we explore the potential mechanisms behind the aforementioned differential impact of COVID-19 on students' academic performance by pre-COVID-19 income and performance inequalities.

5. Mechanisms

Because of the disruptions that COVID-19 represented to higher secondary education and the abrupt move to online learning, we would have expected academic performance of college students to drop. In contrast, Figure 1 documents a sharp increase in the average spring 2020 semester GPA relative to earlier academic performance after holding for individual fixed effects. Several reasons could explain this improvement: (1) a different assessment process with easier exams and/or more lenient grading; (2) more difficult supervising process as exams were online, leading to potentially greater cheating; (3) an improvement in students' learning strategies with online learning; (4) lower opportunity costs of studying due to less employment available; (5) lower financial stress due to greater availability of emergency relief funds from the college or the government; and (6) greater flexibility in students' grading choices due to the flexible grading policy.

In response to the change to online teaching when colleges closed, many colleges exceptionally implemented flexible grading policies to prevent adverse impact of the COVID-19 pandemic on students' GPA. Following regulations from the City University of New York, QC implemented such policy at the end of March 2020, giving students a window of 20 days after the instructor submitted the final grade to decide whether they wanted to not factor in their GPA lower than expected grades (B+ to D for undergraduate students, B+ to C- for graduate students) while earning credit for those courses, or to convert a grade of F into a grade of no credit.[16] In addition, the flexible grading policy also gave students a 20-day window after final-grade submission to decide whether to leave a course incomplete giving students more time to work on their course's assignments and aim for a better grade.[17]

While we are unable to derive strict tests for the relative importance of these mechanisms, systematic heterogeneity of the effects of COVID-19 between the different groups of students based on pre-COVID-19 income and performance inequalities ought to provide suggestive evidence consistent with one mechanism but not with another.

[16] If the student elected a No Credit grade in place of an F then the grade was not factored into the GPA, but the student did not earn the credit.
[17] Final grades were due May 28 2020.

To the extent that the assessment and supervising processes were the professors' discretion, and differential treatment by students' income status is highly unlikely (as faculty do not observe whether the students receive the Pell grant), any differential effect of COVID-19 on academic performance by income status would be washed out by the difference-in-differences approach. To put it differently, while changes in both assessment and supervising may be behind the higher post-COVID-19 GPA observed in the whole sample, they are unlikely the mechanisms driving the observed academic-performance differences between lower- and higher-income students.

Based on the dynamic complementarities of human capital accumulation (e.g., Cunha et al., 2006; Cunha and Heckman, 2007), we would expect smaller learning costs and greater improvements in students' online-learning strategies for higher- than lower-performing students as the former ought to outperform the latter in skill accumulation, consistent with results from Grenewig et al. (2020) for school students in Germany. Yet, panels B to E in Figure 1 indicate that the spring 2020 GPA increase was inversely related to pre-COVID-19 performance suggesting that it is unlikely that dynamic complementarities are behind our findings.

To explore the other possibilities, we estimate the model below using as outcomes students' survey responses regarding: (1) their perception of having challenges with online learning; (2) their opportunity costs of studying, measured by whether they worked during the spring 2020 semester and whether they worked less due to COVID-19; (3) their receipt of emergency relief funds; and (4) their grading choices as a consequence of the flexible grading policy. The model below is estimated using a linear regression model:

$$Y_{iSpring20} = \alpha_0 + \sum_{q=2}^{4} \gamma_q\left(Q_{iqFall19}\right) + \alpha_1 \, Low\ Income_i + \sum_{q=2}^{4} \rho_q\left(Q_{iqFall19} * Low\ Income_i\right) + X'_{i0}\,\alpha_2 + \varepsilon_i \quad (3)$$

where $Y_{iSpring20}$ is the students' i outcome during spring 2020 semester (for example, a dummy indicating whether the student marked a particular answer in the flexible grading question[18]); $Q_{iFall20}$ are dummies

[18] In the survey, we asked students whether the flexible grading policy implemented as a consequence of COVID-19 influenced them in: not dropping a course; choosing a CR/NC class; or asking for an incomplete for the spring 2020 semester. Students could also mark that they were not aware of the flexible grading policy. Students were instructed to mark all responses that applied to them.

indicating in which quartile of the fall 2019 cumulative GPA distribution student i falls in. X_{i0} is a vector of the following baseline controls: a female, race and ethnicity indicators, a USA-born indicator, a first-generation student indicator, a transfer-student indicator, a ESL-learner indicator, class-level indicators, and major dummies. The coefficient α_1 captures the association between being a lower-income student in the bottom quartile and the students' outcome relative to their higher-income low-performing peers. Similarly, $(\alpha_1 + \rho_q)$ captures the association between being a lower-income student in the q^{th} quartile and the students' outcome relative to their higher-income peers. While these estimates are not capturing a causal relationship, they may present suggestive evidence of which mechanisms may be associated with the differential outcomes observed in the results' section above.

Table 3 shows estimates from regressing model (3) for each of the different outcomes. Column 1 reveals that top-performing lower-income students were 7.7 percentage points more likely to experience challenges with online learning than their higher-income counterparts. No such income differential effect is observed at other quartiles. While column 2 reveals that students in the top half of the fall 2019 cumulative GPA distribution are less likely to be employed during the spring 2020 semester than those in the bottom half, there is no differential impact by income. Column 3 and 4 show that lower-income students worked 6.1 percentage points less due to the COVID-19 pandemic (albeit only marginally significant) but received 14.8 percentage points more emergency relief funds than their higher-income peers (this last effect is statistically significant at the 1% level). While there is no differential effect by pre-COVID-19 performance for receipt of emergency relief funds among lower-income students, ρ_4 is of larger in size and opposite sign (albeit lacking precision) than ρ_1 suggesting that a plausible driver of the differential spring 2020 GPA results could be the post-COVID-19 lower opportunity cost of studying among lower-income bottom performers because they are less likely to be employed after the pandemic hit relative to their higher-income peers.

Columns 5 to 8 present estimates from estimating model (3) using as outcomes each of the four possible answers to the survey question on the influence of flexible grading policy on students' spring

2020 credits and grades.[19] It is noteworthy that top-performing lower-income students were 6.9 percentage points more likely to ask for an incomplete than their bottom-performing lower-income peers (significant at the 5% level) and 3.2 percentage points (3.2 = 6.9 - 3.7) more likely to ask for an incomplete than their higher-income peers (significant at the 10% level), consistent with their relative fewer credits earned. In contrast, bottom-performing lower-income students were 6.1 percentage points more likely to choose a credit/no credit for a class than their higher-income peers. Even thought, this estimate is only marginally significant (at the 10% level), it suggests that the bottom-performing lower-income students improved their spring 2020 academic performance by converting poor grades in pass or fail, preventing them from lowering the semester GPA and dropping courses. It is interesting to underscore that the bottom-performing lower-income students are 13.9 percentage points more likely than their higher-income peers to report facing challenges to maintain financial aid, which would explain their higher intake of pass/fail instead of a letter grade. In contrast, no such income differential is observed among students in the other quartiles.[20] While the Pell Grant is not awarded based on academic performance, students are expected to maintain a GPA at or above 2.0 and have a good class attendance record that does not lead to an automatic withdrawal from a college course. Hence, it is not surprising that lower-income bottom-performing students weary of losing their Pell Grant, or of having to return a portion of the funding already received may be willing to use the credit/no credit option to avoid getting a grade that would hurt their GPA.

6. Conclusion

Using individual students' administrative academic records from spring 2017 to spring 2020 and controlling for individual fixed effects, this papers first document an increase of the spring 2020 GPA relative to prior academic performance among college students and regardless of pre-pandemic academic performance. Difference-in-differences models and event-study analysys with individual fixed effects reveal heterogeneity by pre-COVID-19 income and performance inequality. We find that

[19] See footnote 18 for a thorough explanation of the possible answers to this question.
[20] For students in the top quartile, the differential between lower- and higher-income students is 0.05 (standard error = 0.034).

top-performing lower-income students underperformed both in terms of GPA and credits earned relative to their higher-income counterparts. We find suggestive evidence that this lower performance may be driven by lower-income top-performing students experiencing greater challenges with online learning and asking for more incompletes than their higher-income peers.

In contrast, we find that the bottom-performing lower-income students outperform their higher-income peers. Their greater concerns with maintaining financial aid and their greater use of credit/no credit grading option, offered exceptionally during spring 2020 semester, appear to be plausible explanations for this finding. A marginal lower probability of employment among this group relative to their higher-income peers may also be consistent with this result.

Overall, our research reveals that there is no one solution that fits all and that students may need different type of services and assistance to cope with the disruptions the COVID-19 caused to their academic and personal lives. With the data at hand, it is too early to tell whether the widening inequality among top-performers will persist. Similarly, it is unclear whether the convergence among the bottom-performers is the result of gains in human capital accumulation and/or whether it will persist over time. Future research ought to investigate such issues.

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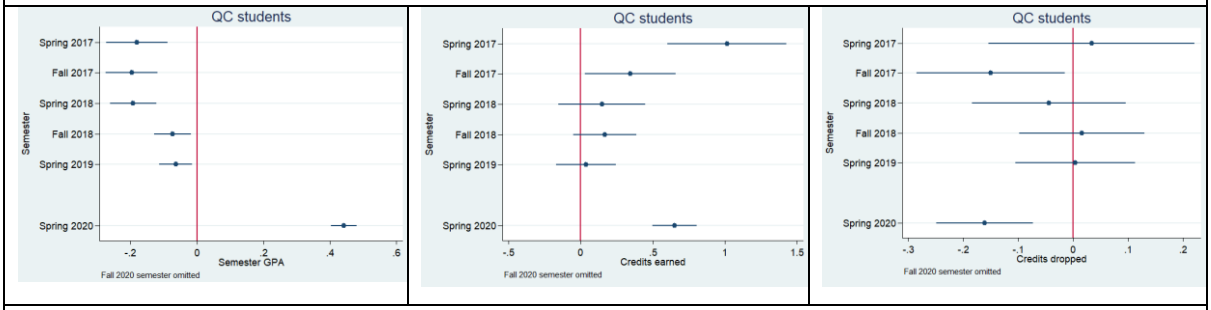
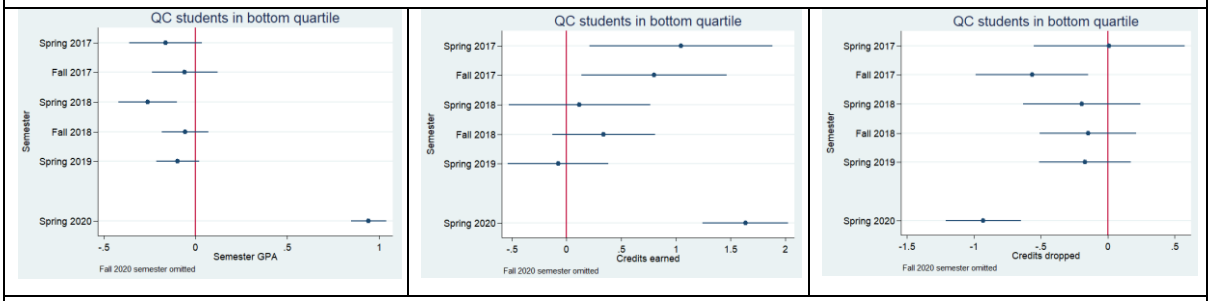
Figure 1. Event Analysis, Queens College Students

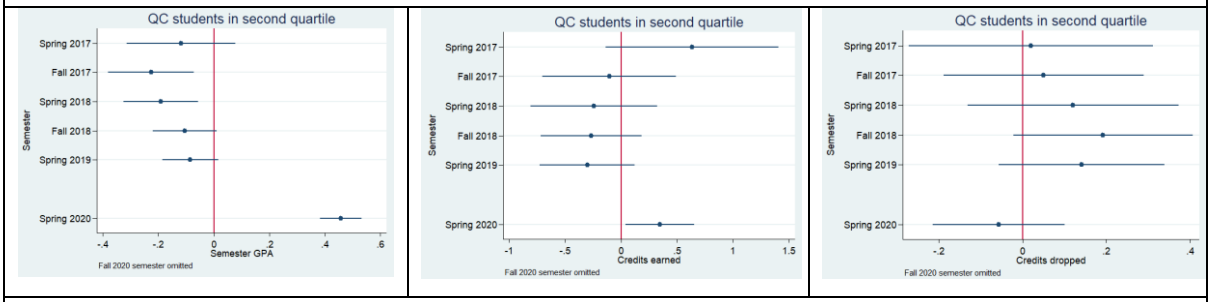
Panel A: ***Whole sample***



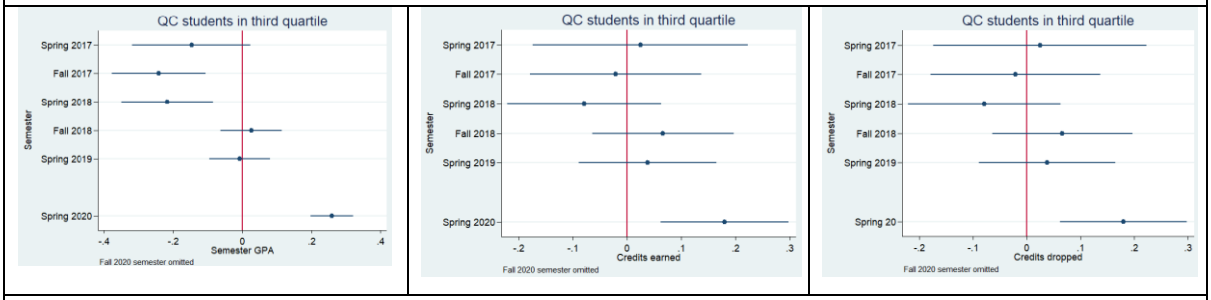
Panel B: ***Bottom quartile***



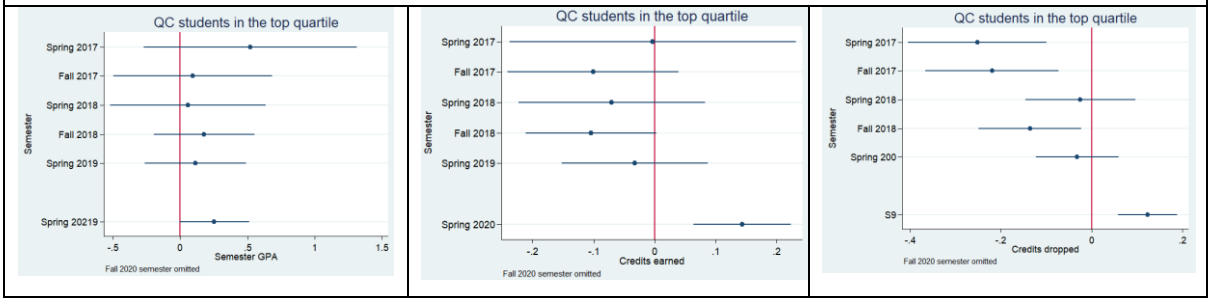
Panel C: ***Second quartile***



Panel D: ***Third quartile***



Panel E: ***Top quartile***



Notes: Figure 1 plots the coefficients on the semester dummies (and the 95% confidence intervals) from an individual fixed-effects model for each subgroup of students. Standard errors are clustered at the individual level.

TABLE 1. Descriptive Statistics

	Queens College					*Arizona State University* [b]	*Flagship university* [c]
	General students	*Low-income students*	*Difference (2) minus (1)*		*Registered in fall 2019* [a]		
	(1)	*(2)*	*(3)*		*(4)*	*(5)*	*(6)*
Baseline Characteristics							
Female	0.6769	0.6674	-0.009	(0.017)	0.568	0.48	0.50
Black	0.1175	0.1170	-0.000	(0.011)	0.086	0.04	0.07
Asian	0.2567	0.4066	0.150***	(0.017)	0.285	--	--
Hispanic	0.2650	0.3450	0.080***	(0.016)	0.284	0.24	0.12
White	0.3561	0.1444	-0.212***	(0.015)	0.269	0.49	0.61
18 years old	0.1351	0.1143	-0.021	(0.012)	0.163	--	--
19 years old	0.0875	0.1348	0.047***	(0.011)	0.098	--	--
20 to 22 years old	0.2609	0.3087	0.019	(0.012)	0.312	--	--
23 to 24 years old	0.1240	0.1239	-0.000	(0.012)	0.136	--	--
25 to 29 years old	0.1580	0.1677	0.010	(0.013)	0.158	--	--
30 to 44 years old	0.1604	0.1259	-0.034**	(0.013)	0.105	--	--
Over 45 years old	0.0617	0.0233	-0.038***	(0.007)	0.028	--	--
US born	0.4700	0.3990	-0.071***	(0.018)	0.677	--	--
Pell grant receipt	--	--	--	--	0.469[d]	--	--
Ever Pell receipt	0	1			0.547[d]		
ESL	0.1904	0.2608	0.070***	(0.015)	0.357[d]	--	--
First-generation	0.2967	0.4305	0.134***	(0.017)	--	0.28	--
Transfer student	0.1957	0.2683	0.073***	(0.015)	0.555	--	--
Employed	0.7209	0.6845	-0.036***	(0.016)	--	0.67 [e]	--
Part-time student	0.4530	0.2444	-0.209***	(0.016)	0.351	--	--
Freshman	0.0646	0.0054	-0.059***	(0.007)	--	0.27	--
Sophomore	0.2397	0.4155	0.176***	(0.016)	--	0.24	--
Junior	0.1627	0.1396	-0.023	(0.013)	--	0.22	--
Senior	0.2086	0.2793	0.071***	(0.015)	--	0.28	--
Graduate	0.2609	0.0835	-0.177***	(0.013)	--	--	--
Online enrollment	--	--	--	--	0.023	--	--
Fall 2019 GPA	3.215	2.973	-0.242***	(0.028)	--	--	--
Sample size	1,693	1,454	3,147		19,923	60,108	1,339,304

Note: Standard errors are reported in parentheses in column 3. Column 3 presents the coefficient on the low-income dummy from a regression model with no other controls.
Significant at the: ***1 percent level, ** 5 percent level, *10 percent level.
[a] Source: https://www.qc.cuny.edu/about/research/Pages/CP-Enrolled%20Student%20Profile.aspx. College-level data for spring 2020 semester will not be available until late January 2021.
[b] From column 2 in Table 1 of Aucejo et al. (2020).
[c] Includes the largest public university in each state. From column 4 in Table 1 of Aucejo et al. (2020).
[d] Excludes graduate students.
[e] Refers to working in the ASU campus.

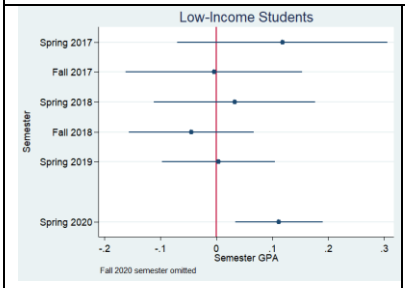
TABLE 2. Academic Performance Post-COVID-19 and Low-Income Status

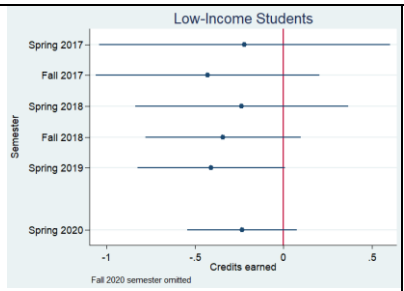
OUTCOMES	Semester GPA	Credits earned	Credits dropped
	(1)	(2)	(3)
Panel A: ***Whole sample***			
Post-COVID-19	0.613***	-0.016	0.017
	(0.045)	(0.202)	(0.082)
Low Income x Post-COVID19	0.110***	-0.040	-0.203***
	(0.037)	(0.159)	(0.076)
Pre-mean comparison group	3.220	9.533	0.648
Number of observations	11,888	11,888	11,888
Number of students	3,147	3,147	3,147
R^2	0.081	0..009	0.003
Panel B***: Quartile 1: fall 2019 GPA=<2.65***			
Post-COVID19	1.012***	0.977**	-0.456*
	(0.104)	(0.415)	(0.263)
Low Income x Post-COVID19	0.171*	-0.108	-0.239
	(0.087)	(0.345)	(0.228)
Pre-mean comparison group	1.952	7.326	2.311
Number of observations	2,927	2,927	2,927
Number of students	717	717	717
R^2	0.201	0.035	0.021
Panel C***: Quartile 2: 2.65<fall 2019 GPA=<3.24***			
Post-COVID19	0.665***	0.306	-0.088
	(0.092)	(0.358)	(0.140)
Low Income x Post-COVID19	0.014	-0.422	-0.055
	(0.071)	(0.293)	(0.136)
Pre-mean comparison group	2.958	10.494	0.655
Number of observations	3,028	3,028	3,028
Number of students	705	705	705
R^2	0.079	0.004	0.002
Panel D***: Quartile 3: 3.24<fall 2019 GPA=<3.71***			
Post-COVID19	0.511***	-0.637*	0.182*
	(0.074)	(0.364)	(0.102)
Low Income x Post-COVID19	0.004	0.202	-0.012
	(0.058)	(0.272)	(0.118)
Pre-mean comparison group	3.511	10.406	0.148
Number of observations	2,881	2,881	2,881
Number of students	698	698	698
R^2	0.044	0.005	0.005
Panel E***: Quartile 4: 3.71<fall 2019 GPA***			
Post-COVID19	0.433***	-0.839	0.223**
	(0.080)	(0.537)	(0.107)
Low Income x Post-COVID19	-0.201***	-0.907*	-0.001
	(0.061)	(0.308)	(0.097)
Pre-mean comparison group	3.911	9.476	0.108
Number of observations	3,052	3,052	3,052
Number of students	1,027	1,027	1,027
R^2	0.029	0.071	0.012

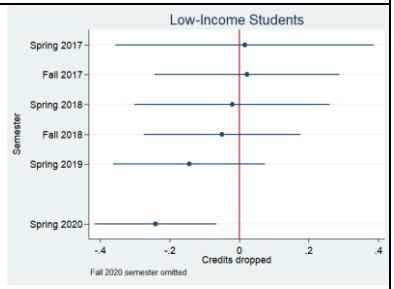
Notes: The table reports individual fixed-effects estimates associated with post-pandemic and low-income students on the dependent variables indicated in column headings. Robust standard errors clustered at the individual level are reported in parentheses. All regressions include a spring-semester indicator and year 2018 and year 2019 dummies. *, **,*** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

Figure 2. Event Analysis, Lower- versus Higher-Income Students

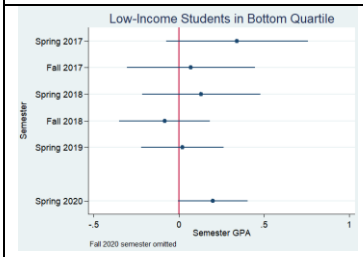
Panel A: ***Whole sample***

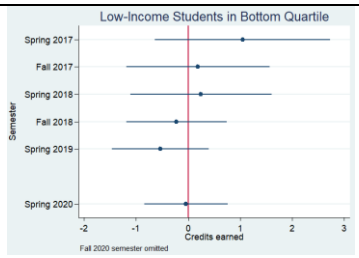


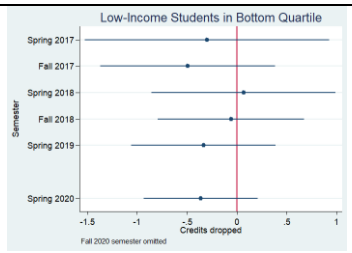




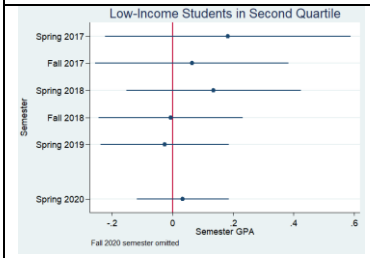
Panel B: ***Bottom quartile***

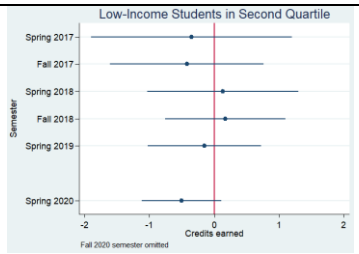


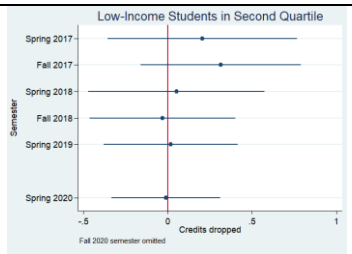




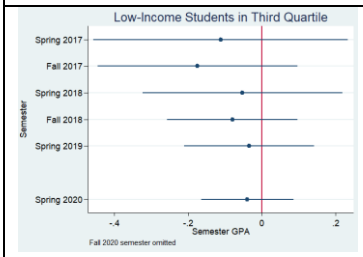
Panel C: ***Second quartile***

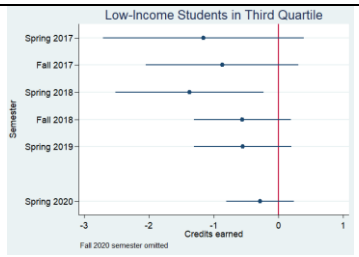


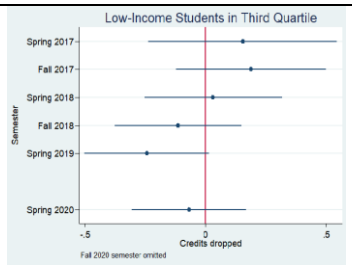




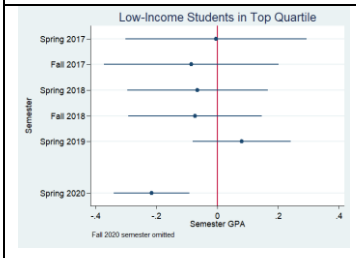
Panel D: ***Third quartile***

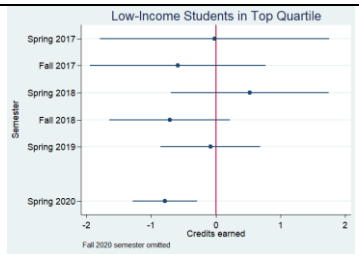


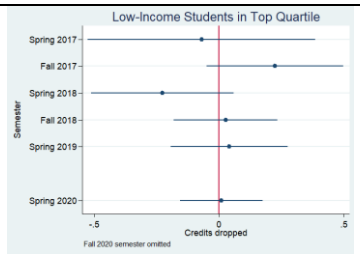




Panel E: ***Top quartile***







Notes: Figure 2 plots the coefficients on the interaction between the semester dummies and the lower-income dummy (and the 95% confidence intervals) from an individual fixed-effects model for each subgroup of students. The model also has semester dummies and individual fixed effects as shown in model (2) in the main paper. Standard errors are clustered at the individual level.

TABLE 3. Flexible Grading Post-COVID-19 by Ever Pell Receipt Status and Fall 2019 Cumulative GPA Quartiles

OUTCOMES	Online challenges during spring 2020	Employed during spring 2020	Worked less during spring 2020	Received emergency relief assistance	Prevented from dropping a class	Chose credit/no credit for a class	Asked for an incomplete	Not aware of flexible grading policy	Challenge in maintaining financial assistance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	0.405***	0.356***	0.252***	0.491***	0.411***	0.446***	0.156***	0.169**	0.134**
	(0.053)	(0.055)	(0.054)	(0.055)	(0.058)	(0.060)	(0.034)	(0.040)	(0.060)
Quartile 2:	-0.003	-0.009	-0.038	0.008	0.008	0.057	-0.041*	-0.027	-0.005
2.65<GPA=<3.24	(0.034)	(0.036)	(0.033)	(0.038)	(0.037)	(0.038)	(0.024)	(0.028)	(0.042)
Quartile 3:	-0.045	-0.072**	-0.003	0.038	0.026	0.020	-0.074***	-0.020	-0.065*
3.24<GPA=<3.71	(0.036)	(0.035)	(0.034)	(0.038)	(0.037)	(0.038)	(0.022)	(0.029)	(0.039)
Quartile 4:	-0.044	-0.059*	-0.012	0.067*	-0.063*	0.015	-0.079***	-0.024	-0.051
3.71<GPA	(0.031)	(0.032)	(0.031)	(0.035)	(0.033)	(0.034)	(0.022)	(0.026)	(0.036)
Ever Pell receipt	-0.004	-0.030	0.061*	0.148***	-0.007	0.061*	-0.037	-0.009	0.139***
	(0.031)	(0.033)	(0.032)	(0.035)	(0.035)	(0.036)	(0.023)	(0.026)	(0.041)
Pell x Quartile 2	-0.008	-0.019	-0.004	0.029	-0.004	-0.106**	0.032	0.005	-0.104*
	(0.043)	(0.046)	(0.044)	(0.047)	(0.048)	(0.049)	(0.030)	(0.035)	(0.056)
Pell x Quartile 3	0.055	0.022	-0.034	-0.001	-0.009	-0.038	0.042	-0.024	-0.081
	(0.045)	(0.046)	(0.045)	(0.047)	(0.049)	(0.050)	(0.027)	(0.035)	(0.053)
Pell x Quartile 4	0.077*	-0.013	-0.072	-0.030	0.062	-0.025	0.069**	-0.018	-0.089*
	(0.044)	(0.046)	(0.044)	(0.046)	(0.048)	(0.049)	(0.029)	(0.035)	(0.053)
Number of students	2,831	2,831	2,831	2,831	2,831	2,831	2,831	2,831	2,112
R^2	0.070	0.181	0.118	0.108	0.106	0.119	0.027	0.046	0.063

Notes: The table reports individual OLS post-pandemic estimates associated with post-pandemic and low-income students on the dependent variables indicated in column headings. Robust standard errors are reported in parentheses. All regressions include a female, race and ethnicity indicators, a USA born indicator, a first-generation student indicator, a transfer-student indicator, a ESL-learner indicator, class-level indicators, and major dummies.

*, **, *** Estimate significantly different from zero at the 0.1 or 0.05 level or 0.01 level.

ONLINE APPENDIX

Appendix Table A.1. Descriptive Statistics

	Queens College			
	General students	*Low-income students*	*Difference (2) minus (1)*	*Registered in fall 2019* [a]
	(1)	*(2)*	*(3)*	*(4)*
Majors				
Accounting major	0.0617	0.0841	0.022* (0.009)	0.084
Education major	0.0799	0.0589	-0.021* (0.009)	0.051
Psychology major	0.0811	0.1109	0.030** (0.010)	0.122
Biology major	0.0288	0.0541	0.025*** (0.007)	0.050
Computer science	0.0741	0.1136	0.040*** (0.010)	0.109
Economics	0.0306	0.0404	0.010 (0.007)	0.050
Library science	0.0470	0.0034	-0.044*** (0.006)	0.019
Mathematics	0.0270	0.0335	0.006 (0.006)	0.021
Media	0.0135	0.0075	-0.006 (0.004)	0.019
Music	0.0370	0.0110	-0.026*** (0.006)	
Sociology	0.0194	0.0287	0.009 (0.005)	0.029
No degree	0.0529	0.0020	-0.051*** (0.006)	
Undeclared	0.1199	0.1307	0.011 (0.012)	
Sample size	1,693	1,454	3,147	19,923

Note: Standard errors are reported in parentheses in column 3. Column 3 presents the coefficient on the low-income dummy from a regression model with no other controls.
Significant at the: ***1 percent level, ** 5 percent level, *10 percent level.
[a] Source: https://www.qc.cuny.edu/about/research/Pages/CP-Enrolled%20Student%20Profile.aspx. College-level data for spring 2020 semester will not be available until late January 2021.
[b] From column 2 in Table 1 of Aucejo et al. (2020).
[c] Includes the largest public university in each state. From column 4 in Table 1 of Aucejo et al. (2020).
[d] Excludes graduate students.