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Grade Disparities in Principles of Microeconomics Before and During COVID-19

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ABSTRACT: Student performance in economics has long suffered from racial, gender, and socioeconomic disparities at all levels, from introductory college courses to PhD graduate numbers. In March 2020, COVID-19 forced most universities to deliver all courses online. This shift online had the potential to increase grade disparities present along racial, gender, and socioeconomic lines in all college courses. Using data from Fall 2019 to Spring 2021 with 3,000 students enrolled in principles of microeconomics classes at a large non-flagship public university, we find evidence of grade disparities based on these key demographics. First, we show that disparities in microeconomics classes were similar to students' grades in all other classes, suggesting that what we see in economics is just a reflection of problems across many disciplines. Second, we demonstrate that the disparities remain relatively unchanged, even in the second year of the pandemic when classes continued online. These results suggest that policy and programmatic changes aimed at addressing disparities would be more effective if aimed at the university as a whole rather than just economics courses.

JEL: A22, I21, I24

Keywords: Educational Access, Inequality, Teaching Methods for Economic Principles

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Section 1: Introduction

In March 2020, over 1,000 college campuses across the United States hastily moved face-to-face courses online, changing the lives of over 14 million students (Hess 2020). One clear concern during the COVID-19 crisis was that the most vulnerable students would suffer the greatest negative educational consequences because of a lack of reliable internet access or quiet spaces to study or would face greater demands on their time because of the need to help with family. These factors could increase inequalities in classroom performance and, thus, access to higher education as well as future opportunities and success in the labor market.

Prior to the pandemic, the field of economics was already experiencing a crisis of underrepresentation of students and teachers along both racial and gender lines. A body of evidence examining gender and racial gaps shows that males and white students receive higher grades than females and non-whites in economics classes (Engelhardt et al. 2021; Johnson et al. 2014; Swope and Schmitt 2006; Elzinga and Melaugh 2009; Ballard and Johnson 2005). Lower performance in economics classes potentially discourages persistence in the major and may help explain why African American and Hispanic students represent just 5% and 12%, respectively, of economics bachelor's degrees awarded in the United States and women account for only 30% of economics majors (Hoover and Washington 2021; Avilova and Goldin, 2018). The pandemic, coupled with this performance gap among women and minorities, raises the question of whether existing disparities in economics classroom performance were widened by the move to online education during the pandemic.

Two studies suggest that socioeconomic, racial, and gender disparities did not increase and in fact shrank during the pandemic (Engelhardt et al. 2021; Kofoed et al. 2021). Using a sample of students at a public non-flagship university enrolled in principles of economics classes, Engelhardt et al. (2021) finds that low-income and minority students performed as well as in the Spring 2020 semester as they had in the previous semester. Additionally, they find that women in their study closed the performance gap with

male students during the Spring 2020 semester.[3] Similarly, Kofoed et al. (2021) found that the performance gap between male and female students at a military service academy decreased online; however, in their study, it was because the movement to online lowered grades, particularly for male students. They did, however, find that moving courses online widened the performance gap between students with lower versus higher college entrance exams scores. Two questions remain unanswered from these studies. The first is whether student performance in economics classes during the pandemic was unique or whether similar patterns exist in courses from other disciplines. And second, given that many campuses remained online for the entire 2020–2021 academic year, did we see longer-term changes in student populations or performance as the pandemic continued?

This paper's contribution is to show that disparities in principles of microeconomics courses are similar to those found in other disciplines at a diverse non-flagship public university. Students who are male, African American/Black, Hispanic, or from lower-income zip codes score significantly worse in an introduction to microeconomics course in a sample of over 3,000 students from 69 sections during the 2019–2020 and 2020–2021 academic years.[4] We also show that these differences are similar to those for students' grades in all courses, suggesting that the grade disparity problem is not unique to economics. As in Engelhardt et al. (2021) and Kofoed et al. (2021), this result is roughly consistent across groups pre-pandemic (Fall 2019) and during the first three semesters of the pandemic (Spring 2020, Fall 2020, and Spring 2021). That the disparities are analogous in other courses as well as during the pandemic suggests they are systemic; hence, we propose a promising intervention and discuss potential policies for addressing persistent grade disparities.

[3] This finding is not surprising considering the work of Patterson and Patterson (2017), who found that computer use in the classroom was more distracting to male students (and low-income students) and resulted in significantly worse classroom performance.

[4] Students self-report as African American or Black as a single category. More detailed discussion is provided in the data description section.

Section 2: Literature Review

Recent work on the impact of the pandemic on student outcomes in principles of economics courses is limited, but Engelhardt et al. (2021) find grade disparities both before and during the pandemic's first semester at a non-flagship public institution. Across three principles of introductory economics classes, their estimates—which control for performance in other classes—indicate that non-white students score 0.09 grade point average (GPA) points lower in their course than their white peers, and female students score roughly 0.10 GPA points lower than male peers. In their interactive model, they find evidence that the COVID-19 shutdown differentially impacted students. For example, the grade differential among women was eliminated entirely, and grades for transfer students were 0.26 GPA points higher than those of traditional students during the first pandemic-affected semester. The study also found no evidence of disproportionate grade changes in the principles courses for students with low income or low socioeconomic status.

One important empirical choice of the analysis in Engelhardt et al. (2021) is that they control for student's cumulative GPA in all courses. The estimated coefficient of between 0.79 and 0.86 for cumulative GPA on performance suggests that students' performance in economics principles classes is closely linked to their performance in other courses. However, the empirical choice of controlling for students' cumulative GPA in all courses, and not removing economics from the calculation, limits the capacity to compare how the disparities in economics classes compares with those in other classes.

Using West Point students, Kofoed et al. (2021) find that final grades for students taking an introductory economics course fully online were 0.215 standard deviations lower than their peers in a fully in-person section. Using a random allocation of students in the same semester and homogeneous content across sections to control for self-selection and instructor fixed effects, they find—similar to Engelhardt et al. (2021)—that males were more harmed by the move to online classes and that the negative impact was largest for students with below-median academic ability (as assessed by college

entrance exams).[5] Additionally, Kofoed et al. (2021) do not find any statistically significant difference for Black students relative to white students but suggests that statistical significance may be difficult to detect due to limited sample size.

Research in economics overwhelmingly suggests that men not only score higher in economics courses but also have higher expectations of their grades in introductory courses. For example, Ballard and Johnson (2005), using a small sample, find that women's low expectations about their ability to succeed in economics becomes self-fulfilling. While women have higher GPAs, men enter an economic course expecting to do better; this greater confidence outweighs academic preparation in determining success. Not surprisingly, these studies suggest that programs designed to motivate and encourage women might overcome the negative attitudes and bring women to—and keep women in—the study of economics (Ballard and Johnson 2005). This conclusion is also supported in a meta-analysis by Johnson et al. (2014) and findings by Hayley et al. (2007), who use a sample of undergraduate students enrolled in one of four sections of a business statistics course taught by economics faculty. Hayley et al. (2007) included two sections taught by a male faculty member and two by a female faculty member; after controlling for both mathematical and general academic background, they find that neither student nor faculty gender independently have any statistically significant impact on grade. However, students taught by a same-gender professor fare significantly better than those taught by an opposite-gender professor. The limited number of female faculty in economics coupled with this result would suggest negative effects on female students' grades in economics courses. The Johnson et al. (2014) meta-analysis is also important because—while they find that men score higher in economics courses,—the gap in performance declines almost 3% annually, which they suggest is largely due to increased interest and training in STEM.[6]

[5] More specifically, they use the college entrance examination rank score (CEER), which one could be argue is a broader measure of academic ability than that used by Engelhardt et al. (2021). They also find no statistically significant difference in grades between in-person and fully online sections among students with high CEER rankings (i.e., the top students at each school).

[6] Johnson et al. (2014) find that the narrowing of the gap in economics over time is considerably stickier than in other fields.

Similar challenges exist in understanding how race intersects with decisions regarding academic areas of study and performance. Comparing racial groups, the literature finds that students of color score lower in principles of economics courses than white students (Swope and Schmitt 2006; Elzinga and Melaugh 2009; Engelhardt et al. 2021). using data from the Naval Academy, Swope and Schmitt (2006) found that "male minority students continue to underperform relative to other students even when controlling for SAT scores" (p. 393).[7] The authors suggest that these group differences exist either because the peer group of minority students is limited or that they result from self-selected differences in extracurricular opportunities. Surprisingly, the paper makes no mention of the diversity of faculty, faculty attitudes toward minority students, or incoming differences in school quality among the groups.

Studies such as these expose the differential experiences across student groups in an economics classroom that perpetuate the homogeneity among faculty. These disparities create a "pipeline problem" in academia that undermines equal opportunities for student success (Bavishi et al. 2010). In the United States, only 30% of undergraduate economics majors are women, 5% are Black, and 9% Hispanic. These numbers fall far short of representation by these groups on college campuses, where 56% of students enrolled are women and Black and Hispanic students make up 14% and 18% of enrollment, respectively (McFarland et al. 2019). It has even been shown that the gender imbalance in economics has gotten worse from 2001 to 2015, are a time when the benefits of balance and diversity in the context of sex, race, and ethnicity are well accepted (Bayer and Wilcox 2019).

In the second year of the pandemic, many first-year college students in introductory economics classes had completed their senior year of high school online, so the early effects of COVID-19 on college performance may have been present. Early evidence regarding school closures supports a widening of the achievement gap at the K–12 level as a result of the pandemic: "It's the most vulnerable students who experienced the steepest setbacks" (Mervosh, July 28, 2021). Dorn et al. (2020) detail how

[7] The opposite is true for females; however, with only 80 women in the sample, the results are not statistically significant (Swope and Schmitt, 2006).

K–12 school shutdowns caused disproportionate learning losses and increased dropouts by removing the support structures that vulnerable children rely upon; they also estimate that losses for Black and Hispanic may be twice the size of those among whites.[8] Hanushek and Woessmann (2020) estimate that worldwide school closures could result in 3% decreases in lifetime earnings among K–12 students.[9]

The findings of Engelhardt et al. (2021), Kofoed et al. (2021), Dorn et al. (2020), and Hanushek and Woessmann (2020) demonstrate how the shift to online education potentially affected the achievement gaps based on race, income, and gender. One difference between the college studies and the K–12 studies is the portion of students of color in the populations. At the college level, the two institutions studied were roughly two-thirds and four-fifths white; nationally, only 55% of college students and 48% of K–12 students are white (Hanson 2021; Hussar et al. 2020). The setting used in this paper is advantageous to prior studies as it is an institution that more closely reflects the nation: 52% of students are white. A second gap in the literature exists on the second year of the pandemic's effects, though more studies are likely in the pipeline to help us better understand the effects. We hope that further studies will also look at how these effects may linger as K–12 students progress through college.

Section 3: Setting

Data used in the analysis comes from the 2019–2020 and 2020–2021 academic years at a large metropolitan public university in the mid-Atlantic region with around 20,000 undergraduate students. The economics department at this university offers both a microeconomic principles and macroeconomic principles course as separate, non-sequential, semester-long courses. Despite not being sequential, most students take the microeconomic principles course first, due to its lower number in the course catalog. Both semesters of these principles courses are required for the economics major and for other majors in the business school, which houses the economics department. In a typical fall semester, close to 1,000

[8] Their paper also discusses the disproportionately negative impact of these educational outcomes on health outcomes, incarceration, and political participation.
[9] Not all reports are this ominous. Comparing MAPS testing from students in thousands of schools, Kuhfeld et al. (2020) find no evidence of heterogeneity in learning gains or losses, suggesting that the results are consistent among groups in the population.

students enroll in the principles of microeconomics course at this university, with approximately 600 more enrolled in the spring. The course is taught by nine instructors: three tenured, one tenure-track, and five non-tenure-track. Of the nine professors, eight taught the class in all four semesters used in this analysis. Three of the nine professors were women. Each semester, students enroll in close to 20 unique sections, most of which have 35–40 students, though a handful of sections are closer to 90 students. None of the sections make use of teaching assistants.

Halfway through the Spring 2020 semester, students and faculty experienced a substantial shock in the form of the COVID-19 outbreak as social distancing measures at the university and across the world moved nearly all classes online. The university, like many other schools, made the decision on March 10 to move class online, just three days before a scheduled one-week spring break.[10] Faculty and students were informed that in-person classes would resume April 6, but the decision to move classes online for the rest of the semester was finalized March 19 and students never returned to in-person classes that spring or the following academic year.

Of particular interest is that the university also announced on March 27 that students had until the final day of class to opt into a pass/credit/fail grade that would be excluded from their total university GPA. Students who did not chose this option received a traditional letter grade under a typical 4.0 system that would be included in their total university GPA.[11] This decision would have to be made before the student took the final exam. Under this new option, students who received a C or above would earn a pass (PS), which would give them credit for the class both toward total graduation credits and toward requirements for their major.[12] Students who received a D or D+ would, consistent with previous semesters, receive credits toward graduation and for core requirements but not toward completion of their

[10] The final three days of pre-spring break classes were canceled to give faculty time to prepare for the transition.
[11] A pass-fail option existed before the Spring 2020 semester began, but it was only used 0.3% of the time in the Fall 2019 courses in the sample.
[12] One quirk of the 4.0 system is that the university eliminated C- and D- grades in 2006.

major. Finally, students failing would not receive credits, though the F would also not count against their GPA if they chose the pass/fail option.

In the second academic year of the pandemic (Fall 2020 and Spring 2021), all courses were online. Faculty were given the option before the start of the fall semester to hold classes in person or online; all faculty in the economics department chose to hold classes online.[13] This decision became moot when the university moved all classes online one week before the start of the fall semester. In Spring 2021, all economics courses were online. The university offered a limited number of courses outside of the economics department in person, such as laboratory sciences or dance classes.

Section 4: Descriptive Statistics

The data set comprises 3,114 students across all four semesters of the 2019–2020 and 2020–2021 academic years who were enrolled in any of the 69 sections of microeconomic principles.[14] The average grade in the course was a 2.47 on a 4-point scale, between a C+ (2.33) and a B- (2.67) (see Table 1). Students' grades in all other courses are substantially higher, averaging 2.81, which is over 0.3 points higher than principles of microeconomics. Over three-quarters of the students passed the class with at least a C, which is needed to count toward the economics or business majors. In the sample we also see that 5% of the students withdrew during the second half of the semester and therefore received a W (withdrawal), which does not count toward their GPA calculation. Students who withdrew earlier in the semester, within the first half, are unobservable and hence do not appear in our sample. An exception to this rule occurred in Spring 2020, when the withdrawal deadline was extended.

[13] The good news here is that since every section was held online, we avoid the self-selection problem discussed by Coates et al. (2004). However, there are students in our sample that we cannot identify who would have selected online if given a choice and are also better suited for that model of instruction; we are not able to identify those students.

[14] Comparing grades in one specific course reduces the likelihood of differences resulting from differential grading criteria across sections, as discussed by Walstad and Miller (2016). They also cite Sigfried and Walstad (2014), whose research suggests that principles courses are "fairly standard in their coverage because they focus on basic economics content" (p. 339).

Table 1: GPA, Pass Rate, Withdrawal Rate

	Grade MicroEcon	GPA Other Classes	Pass Rate	Withdrawal Rate	Observations
Total	2.479	2.813	77.8%	4.9%	3114
Fall 19	2.469	2.753	79.7%	3.9%	961
Fall 20	2.430	2.855	74.4%	7.4%	989
Spring 20	2.611	2.906	80.8%	1.8%	624
Spring 21	2.423	2.726	77.5%	5.7%	540

Microeconomic principles average course grades increased in the first semester of the pandemic (Spring 2020) by almost 0.2 GPA points but fell back to 2.4 for both Fall 2020 and Spring 2021 semesters. Students' overall GPA in other classes experienced a similar trend (Table 1): GPA for other classes increased from 2.75 in Fall 2019 to 2.90 for Spring 2020 but then fell again to 2.86 and 2.72 for the following two semesters.

Withdrawal rates followed the same pattern and increased from 3.9% in Spring 2020 to 7.4% in Fall 2020 and then fell to 5.7% in Spring 2021. The number of students who received a grade or withdrew was roughly equivalent in Fall 2019 and Fall 2020. Enrollment declined from Spring 2020 to Spring 2021, which raised concerns about a change in the makeup of the student body; however, the analysis presented in Appendix A indicates that students are not statistically different on observable characteristics between the Spring 2020 and Spring 2021 semesters or the Fall 2019 and Fall 2020 semesters.[15]

[15] Though enrollment at the university used in this analysis declined, we find no difference in decline by demographics. St. Armour (2020, 2021) first raised concerns about changing student demographics by noting that students from low-income high schools experienced a 30% drop in college enrollment as a result of the pandemic, compared with only a 17% drop for students from high-income schools; they also found that high schools with a larger minority population experienced a 26.4% drop in college enrollment compared to only an 18.1% drop for schools with a lower minority population.

We also use self-reported demographics from the university Office of Institutional Research—including race, ethnicity, gender, and student athlete status—to examine differences in grades. Students have eight categories to choose from when self-reporting their race/ethnicity: American Indian/Native Alaskan, Asian, African American/Black, Hispanic/Latino, foreign, Native Hawaiian/Pacific Islander, two or more races, and white. These categories are not precise, as students may bring their own definitions. Complexity is further increased by the potential overlap between categories (e.g., a Black, Hispanic foreign student from the Dominican Republic), though a student may choose the two more races category. Due to small numbers we combine Foreign, two or more races, American Indian/Native Alaskan, and Native Hawaiian/Pacific Islander into a single other category for the analysis.

Overall, we can see that demographic differences between microeconomic principles course grades and GPA in other courses are similar across racial, gender, and athletic status lines (Table 2). African American/Black and Hispanic/Latino students make up 29% and 9% of our sample, which roughly matches the university population as a whole.[16] We also find, consistent with Swope and Schmitt (2006), that African American/Black and Hispanic/Latino students perform slightly worse on average than their white peers, with a mean microeconomic principles course grade of 2.27 and 2.35, roughly a C+, for both African American/Black and Hispanic/Latino students, a mean grade of 2.61 for their white peers (this is statistically significant at the 1% level with a *t*-test).

Additionally, Table 2 reports that the grades for females and student athletes are higher in both microeconomic principles and in overall GPA than their male or non-athlete counterparts. The finding that females score higher contrasts with most of the literature. More specifically, we see that men scored 0.18 points lower in their microeconomic principles grade and 0.18 GPA points lower in other classes than women in our sample. This is important to note as over 56% of our sample is male, for a campus

[16] At the university, the student population was 23% African American/Black and 8.3% Hispanic/Latino in 2019, increasing to 26% and 8.8% in 2020, respectively.

where approximately 59% of the student body reports as female.[17] This is particularly interesting given the findings in the literature that even when women outperform men in introductory economics, they are less likely to persist in the major.[18] Additionally, athletes, who make up roughly 5% of our sample, have a have a mean in microeconomic principles that is 0.14 higher than that of non-athletes; their mean GPA for other classes is 0.19 points higher than that of non-athletes.

[17] Our sample is more heavily male than the university population as a whole because the business major—for which the microeconomic principles course is a prerequisite—is 62% male; these students make up the majority of those enrolled in the course.

[18] The work of Rask and Tiefenthaler (2008) suggests that this outcome is because men are less responsive to the relative grade signal than women so that the higher overall GPA of female students, even with identical grades in microeconomic principles, results in a greater gap between performance in economics and overall academic performance and discourages persistence for female students.

Table 2: Race, Gender, Athletic Status on Grades

	Grade MicroEcon	GPA Other Classes	%Sample
Race			
Asian	2.523	2.857	6.5%
African American/Black	2.265	2.657	29.2%
Hispanic/Latino	2.346	2.633	8.5%
Other	2.550	2.845	8.0%
White	2.609	2.923	46.9%
Gender			
Male	2.403	2.733	56.2%
Female	2.578	2.915	42.9%
Athlete			
Non-Athlete	2.473	2.804	95.6%
Athlete	2.608	2.998	4.4%

Prior to performing any statistical analysis, we must also evaluate the possible correlation between ethnic groups and socioeconomic status variables commonly found in social and behavioral science research; if uncontrolled, these would create omitted variable bias. From the university Office of Institutional Research at the metropolitan university from which the data was made available, we were able to obtain home zip code for each student, which were matched with median income data by zip code.[19] The average zip code in the sample is relatively wealthy, with a median household income of over $118,000, compared to the median of $64,000 for the whole United States in 2018. Zip code income is then separated into three terciles (lowest-, middle- and highest-income zips). Table 3 reports that students in the lowest income bin scored on average 0.13 and 0.19 points lower on their microeconomic principles course grade and 0.11 points lower on their GPA in other classes than students in the middle- and highest-income bins; both differences are statistically significant with a simple *t*-test. Differences within the lowest bin (e.g., between bottom and third decile) were tested; no statistically significant differences are found, so we did not generate additional bins for zip code income analysis (see Appendix B).

[19] Fewer than 1% of the students lacked a US zip code, so these students are omitted from the sample. Ideally, we would have been able to obtain an individual or household measure of socioeconomic status, but privacy regulations precluded access to this individually matched data. Instead, we used data on income by zip code found at https://mcdc.missouri.edu/geography/ZIP-resources.html data.

Table 3: Grades by Income Tercile

	Grade MicroEcon	GPA Other Classes	Average Zip Median Income
Richest	2.561	2.85	$153,022
Middle	2.504	2.849	$116,369
Poorest	2.365	2.735	$83,825

Section 5: Econometric Approach

We estimate a student's grade using equation (1), which includes subscripts for the individual student (*i*), semester (*t*), and instructor (*j*). The three main outcomes of interest (*Y*) are the student's grade on a 4.0 scale, the probability of passing the class with a C or higher, and the probability of withdrawing from the class.[20] To compare pandemic semesters to the pre-pandemic Fall 2019 semester, we introduce the variables *Spring20*, *Fall20*, and *Spring21*, which are binary indicators equal to 1 if the course was during the relevant semester (time *t*), and 0 otherwise.

We test for grade disparities along demographic characteristics using binary measures of self-reported race (*African American/Black, White, Other, Hispanic/Latino*, with *Asian* the omitted comparison group), gender (*Female*), and athletic status (*Athlete*).[21] Socioeconomic status is proxied by the median household income in the student's home zip code. As discussed above, the relationship between grades and home zip code income was non-linear, so we divide the sample into three equal bins, with lowest, middle, and highest third of income. Binary indicators are used for the lowest two bins (*LowIncZip, MedIncZip*) compared to the highest bin (the omitted category).

$$(1)\ Y_{ist} = \beta_0 + \alpha_1 Spring20_t + \alpha_2 Fall20_t + \alpha_3 Fall21 + \beta_1 AfricanAmerican/Black_i + \beta_2 White_i + \beta_3 Other_i + \beta_4 Hispanic/Latino_i + \beta_5 Female_i + \beta_7 Athlete_i + \beta_8 LowIncZip_i + \beta_9 MedIncZip_i + \sum_{j=1}^{8} Professor_j + \varepsilon_i.$$

[20] In Spring 2020, students could take the course pass-fail up until the final exam. The 4.0 grade is the grade they received or would have received if they had not taken course pass-fail.

[21] Race groups are self-reported, categories are mutually exclusive, and the "other" category contains those reporting themselves to be multiracial or biracial.

However, the move to online classes during the pandemic may have widened disparities based on ethnic group, gender, or socioeconomic status. We incorporate this possibility into our model by including an interaction term to evaluate whether and how disparities changed. Equation (2) shows an example for Black students, where the indicator for Black students is interacted with each of the three semester variables (*Spring20*African American/Black, Fall20* African American/Black, Spring21* African American/Black*). In this model, the term *Spring20* African American/Black* measures the difference in the gap between African American/Black and Asian students between the Spring 2020 semester and the omitted Fall 2019 pre-pandemic semester. Equation (2) is then re-estimated for Hispanic/Latinos, females, and the lowest income bin, where the interaction terms for African American/Black students are replaced with one of these other demographic characteristics.

All models are estimated using professor (*Instructor*) fixed effects for eight instructors compared to the ninth omitted instructor. We run a standard ordinary least squares regression because the interpretation of interaction terms is difficult using probits or logits. We cluster the standard errors at the professor level. Finally, ε represents the individual error term.

$$(2)\quad Y_{ijt} = \beta_0 + \alpha_1 Spring20_t + \alpha_2 Fall20_t + \alpha_3 Fall21 + \beta_1 Black_i + \beta_2 White_i + \beta_3 Other_i + \beta_4 Hispanic_i + \beta_5 Female_i + \beta_7 Athlete_i + \beta_8 LowIncZip_i + \beta_9 MedIncZip_i + \gamma_1 Spring20_t * Black_i + \gamma_2 Fall20_t * Black_i + \gamma_3 Fall21 * Black_i + \sum_{j=1}^{7} Professor_j + \varepsilon_i.$$

To compare grade disparities between economics classes and all other courses, we revised equation 1 for three different estimations. In the first, we add in a control variable for average GPA in all other courses (*OtherCourseGPA)*. With this addition, the demographic variables become estimations for differences in microeconomic principles courses controlling for differences in other courses, thereby giving estimates of how student performance in the microeconomic principles course compares to their

other courses.[22] In the second estimation, we replace the grade in microeconomic principles with the difference between the student's grade in microeconomic principles from their total GPA in other courses. The third estimation uses total GPA, exclusive of the microeconomic principles grade, as the dependent variable.

Section 6: Results

Table 4 reports the grade estimations using a 4.0 scale; these are consistent with the disparities discussed previously with regard to Table 2. The results also indicate limited change in average grade for all students, with an exception in Spring 2020. Overall, African American/Black and Hispanic/Latino students scored roughly 0.25 and 0.17 GPA points, respectively, below Asian students (the omitted category); these results are statistically significant across models and consistent with Swope and Schmitt's (2006) findings. Consistent across models, female students score about 0.19 GPA points higher than males, and those in the lowest income tercile score an average of 0.12 GPA points lower than those in the highest tercile.[23]

The interaction terms do not consistently indicate that changes in terms of disparities occurred during the pandemic. We do find that Hispanic/Latino students performed slightly worse during the Spring 2020 semester and female students performed better in the Fall 2020 semester but worse in the Spring 2021 semester. This latter finding on female performance is consistent with Brown and

[22] This is distinct from what was done by Engelhardt et al. (2021), who incorporated the economics grade in the calculation of GPA; this strategy did not allow for a comparison between performance in other classes unique from performance in the economics class.

[23] Our findings for women are different from what has historically been found and cited (Johnson et al. 2014); however, there is some precedent for this finding in Rask and Tiefenthaler (2008) and particularly Hayley et al. (2007), as the economics department at this university falls within their business school.

Leidholm's (2002) finding that women's grades were 6% lower than males' grades for in-person classroom settings, a gap that decreased by 2% in online settings.[24]

[24] This may be attributed to differences in self-direction and internal motivation that differ among students, or perhaps the online setting removes some faculty bias that can disproportionately and negatively impact female students, but we cannot do more than speculate in this case.

Table 4: Semester and Demographic Relationship with Grade on 4.0 Scale

	(1)	(2)	(3)	(4)	(5)
Interactions	None	Black	Hispanic	Female	LowIncZip
Fall20	-.036	-.009	-.043	-.145	.034
	(.105)	(.08)	(.112)	(.117)	(.091)
Spring20	.15*	.134	.175**	.108	.137
	(.09)	(.107)	(.084)	(.103)	(.101)
Spring21	-.029	-.034	-.016	.176	.003
	(.149)	(.151)	(.155)	(.147)	(.141)
African American/ Black	-.248***	-.232	-.247***	-.258***	-.242***
	(.063)	(.152)	(.062)	(.065)	(.063)
Hispanic/Latino	-.169**	-.168**	-.103	-.152*	-.166**
	(.081)	(.081)	(.144)	(.087)	(.081)
White	.081	.08	.082	.09	.084
	(.09)	(.09)	(.089)	(.094)	(.089)
Other	.012	.01	.014	.016	.019
	(.093)	(.093)	(.093)	(.101)	(.092)
Female	.194***	.196***	.195***	.166**	.192***
	(.049)	(.048)	(.048)	(.069)	(.048)
Athlete	.124	.127	.121	.129	.129
	(.105)	(.103)	(.102)	(.104)	(.098)
Middle Income Zip	-.02	-.02	-.02	-.031	-.022
	(.061)	(.06)	(.06)	(.063)	(.061)
Low Income Zip	-.123***	-.121***	-.123***	-.136***	-.046
	(.041)	(.042)	(.04)	(.043)	(.093)
AA/ Black*Fall20		-.098			
		(.243)			
AA/ Black*Spring20		.056			
		(.124)			
AA/ Black*Spring21		.008			
		(.092)			
Hispanic/Latino*Fall20			.099		
			(.247)		
Hispanic/Latino *Spring20			-.262**		
			(.116)		
Hispanic/Latino *Spring21			-.157		
			(.224)		
Female*Fall20				.258***	
				(.065)	
Female*Spring20				.098	
				(.108)	
Female*Spring21				-.407***	
				(.084)	
LowIncZip*Fall20					-.22
					(.146)
LowIncZip *Spring20					.034
					(.151)
LowIncZip *Spring21					-.097
					(.092)
Constant	2.464***	2.459***	2.457***	2.479***	2.436***
	(.17)	(.165)	(.166)	(.189)	(.154)
Observations	2832	2832	2832	2832	2832

*Standard errors clustered at the professor level are in parentheses. Dependent variable is grade in microeconomic principles course, on a 4.0 scale. *** p<.01, ** p<.05, * p<.1, professor fixed effects included in estimations*

The relationship between a student's grade in microeconomic principles and their grades in other courses is also quite strong. Table 5 shows that GPA in other classes (excluding microeconomics principles) has a coefficient of 0.86 when predicting a student's grade in microeconomic principles, similar to the 0.80 estimate from Engelhardt et al. (2021). The results also suggest that disparities in microeconomic principles are similar to the average for all courses at the university: When we control for GPA in other courses, the only statistically significant variable is the lowest income tercile, and only at the 10% level. To confirm, we first re-ran the model using the difference between the microeconomic principles course grade and the average in all other courses, finding again that none of the variables are statistically significant. Finally, in regression three of Table 5, we present estimates of the relationship between demographics and the student's grade in all other courses. The results are extremely similar to those found in Table 4, where grades increased in the Spring 2020 semester and then dropped a bit by Fall 2020, females fared better than male students, athletes fared better than non-athletes, and both Black and Hispanic students suffered significant ($p < 0.01$) and meaningful differences of over 0.2 points in their overall GPA. In sum, microeconomics grade disparities appear similar to those found in other courses in all three empirical approaches (controlling for other grades, difference in microeconomics and other grades, and coefficient comparisons between grades in microeconomics and other classes).

Table 5: Controlling for Other Courses and Disparities in Other Courses

	(1) MicroGrade	(2) Difference Micro And Other Courses	(3) Other Courses
GPA Other Course	.864***		
	(.031)		
Fall20	-.126	-.141	.107***
	(.118)	(.119)	(.037)
Spring20	.017	-.006	.166***
	(.091)	(.089)	(.016)
Spring21	-.01	-.008	-.018
	(.124)	(.124)	(.085)
Low Income Zip	-.084*	-.076	-.057
	(.045)	(.05)	(.054)
Middle Income Zip	-.041	-.044	.025
	(.048)	(.048)	(.026)
African American/Black	-.068	-.041	-.200***
	(.075)	(.081)	(.052)
Hispanic/Latino	.02	.049	-.214**
	(.081)	(.088)	(.086)
White	.025	.017	.062
	(.083)	(.084)	(.052)
Other	.025	.029	-.03
	(.101)	(.103)	(.046)
Female	.017	-.009	.196***
	(.035)	(.037)	(.029)
Athlete	-.041	-.066	.178**
	(.067)	(.065)	(.079)
Constant	.136	-.234	2.711***
	(.2)	(.182)	(.043)
Observations	2803	2803	2803

Standard errors are in parentheses. Dependent variable is GPA on a 4.0 scale.
**** p<.01, ** p<.05, * p<.1*
Professor fixed effects included in the estimation but omitted for readability. Errors clustered at the professor level

We also estimate a linear probability of passing the class with a grade of C or higher (Table 6). Our model indicates that pass rates were 6–7 percentage points lower in Fall 2020, but this decrease does not appear to persist into Spring 2021, suggesting a one-semester adjustment period to changes in course delivery.[25] These results also support our findings that students in the lowest income groups suffered

[25] We can only speculate, but unscientific measures (i.e., conversations around the water cooler) suggest that faculty were more generous in student accommodations in Spring 2020, when the pandemic first hit and struggled with success in Fall 2020 using new delivery methods and with both students and faculty still under significant stress. By Spring 2021, both students and faculty felt increasingly confident in online delivery methods and in holding one another more accountable for their work.

larger academic losses during the pandemic and corresponding academic delivery shift. More specifically, our findings are that students in the lowest zip code income tercile were 3 percentage points less likely to pass than those in the highest; the interaction of pass rate suggests that the lowest income tercile was driving the entirety of the reduction in pass rates in Fall 2020. Additionally, we find that female students were 5 percentage points more likely to pass than their male counterparts, consistent with results in Table 4, where we found that female students scored about 0.19 GPA points higher than males. What is different in this model is that we do not observe a difference in pass rates for African American/Black or Hispanic/Latino students, suggesting that the differences of roughly 0.20 GPA points found in Table 4 do not translate to increased rates of course failure.

Table 6: Semester and Demographic Relationship with Probability of Passing

Interactions	(1) None	(2) Black	(3) Hispanic	(4) Female	(5) LowIncZip
Fall2020	-.067**	-.05***	-.07**	-.103**	-.041*
	(.031)	(.019)	(.032)	(.04)	(.023)
Spring20	-.001	-.014	.004	-.02	-.004
	(.025)	(.019)	(.025)	(.04)	(.024)
Spring21	-.032	-.037	-.03	.019	-.029
	(.037)	(.035)	(.041)	(.041)	(.038)
Low Income Zip	-.031***	-.03***	-.031***	-.034***	-.006
	(.011)	(.011)	(.01)	(.01)	(.027)
Middle Income Zip	-.004	-.005	-.005	-.007	-.005
	(.021)	(.021)	(.021)	(.021)	(.021)
African American/Black	-.081	-.074	-.081	-.084*	-.079
	(.05)	(.065)	(.05)	(.05)	(.051)
Hispanic/Latino	-.053	-.052	-.049	-.049	-.052
	(.061)	(.061)	(.082)	(.063)	(.061)
White	.024	.024	.025	.027	.025
	(.051)	(.051)	(.051)	(.051)	(.051)
Other	0	-.001	.001	.002	.002
	(.039)	(.039)	(.04)	(.039)	(.04)
Female	.051***	.052***	.051***	.031	.051***
	(.013)	(.014)	(.013)	(.024)	(.013)
ATH	.058	.06	.057	.06	.06
	(.062)	(.062)	(.062)	(.061)	(.06)
AA/Black*Spring20		.045			
		(.048)			
AA/Black*Spring21		.012			
		(.051)			
AA/ Black*Fall20		-.059			
		(.081)			
Hispanic/Latino*Spring20			-.046		
			(.049)		
Hispanic/Latino *Spring21			-.023		
			(.088)		
Hispanic/Latino *Fall20			.037		
			(.064)		
Female*Spring20				.046	
				(.039)	
Female*Spring21				-.096***	
				(.035)	
Female*Fall20				.085**	
				(.033)	
LowInceZip*Spring20					.008
					(.068)
LowInceZip*Spring21					-.01
					(.038)
LowInceZip*Fall20					-.079*
					(.042)
Constant	.813***	.811***	.813***	.822***	.804***
	(.076)	(.071)	(.077)	(.083)	(.068)
Observations	2993	2993	2993	2993	2993

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*
Professor fixed effects included in the estimation but omitted for readability. Errors clustered at the professor level

Table 7 shows the ways in which semester and demographic variables impact the student's decision to withdraw from the class after the halfway point. We find that, on average, withdrawal rates increased by 5 and 3 percentage points in the Fall 2020 and Spring 2021 semesters, respectively. These findings are closely related to those in Table 6, as pass rate calculations equate a withdrawal with not passing, suggesting that some of the reduction in pass rates in the fall was due to higher withdrawal rates. Athletes were less likely to withdraw by about 2.5 percentage points,[26] and African American/Black students were 5.4% more likely to withdraw during the second academic year of the COVID-19 pandemic.

[26] The low withdrawal rate among athletes may be tied to many factors, including the NCAA Progress Towards Degree Regulations. These regulations, which were adopted in 2003, require athletes to enroll in a minimum of 12 credits each semester and to pass a minimum of 24 credits by the beginning of their second year.

Table 7: Semester and Demographic Relationship with Probability of Withdrawing

Interactions	(1) None	(2) Black	(3) Hispanic	(4) Female	(5) LowIncZip
Fall20	.053***	.038***	.052***	.055***	.055***
	(.011)	(.013)	(.012)	(.015)	(.013)
Spring20	-.004	-.004	-.003	.003	-.004
	(.008)	(.009)	(.01)	(.007)	(.005)
Spring21	.035**	.021	.034**	.032**	.029
	(.016)	(.018)	(.017)	(.014)	(.022)
Low Income Zip	.007	.007	.007	.007	.006
	(.01)	(.009)	(.009)	(.009)	(.011)
Middle Income Zip	.003	.004	.003	.004	.003
	(.01)	(.01)	(.01)	(.01)	(.01)
African American/Black	.036*	.009	.036*	.036*	.036*
	(.021)	(.019)	(.021)	(.021)	(.021)
Hispanic/Latino	.026	.025	.022	.025	.026
	(.03)	(.03)	(.02)	(.03)	(.03)
White	.01	.01	.01	.01	.011
	(.016)	(.016)	(.016)	(.016)	(.016)
Other	.015	.016	.015	.015	.016
	(.022)	(.022)	(.022)	(.022)	(.022)
Female	-.003	-.003	-.003	.001	-.002
	(.006)	(.006)	(.006)	(.006)	(.006)
Athlete	-.026***	-.027***	-.026***	-.027***	-.025***
	(.009)	(.008)	(.009)	(.008)	(.009)
AA/ Black*Spring20		.001			
		(.005)			
AA/ Black*Spring21		.046*			
		(.027)			
AA/ Black*Fall20		.054***			
		(.016)			
Hispanic/Latino*Spring20			-.007		
			(.021)		
Hispanic/Latino *Spring21			.008		
			(.034)		
Hispanic/Latino *Fall20			.014		
			(.043)		
Female*Spring20				-.015*	
				(.009)	
Female*Spring21				.006	
				(.027)	
Female*Fall20				-.006	
				(.012)	
LowIncZip*Spring20					.001
					(.015)
LowIncZip*Spring21					.017
					(.02)
LowIncZip*Fall20					-.009
					(.02)
Constant	.001	.009	.002	0	.001
	(.012)	(.012)	(.012)	(.012)	(.015)
Observations	3077	3077	3077	3077	3077

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Section 7: Conclusions and Policy

Our works shows that grade disparities exist between microeconomic principles and all other courses by various demographic characteristics, including African American/Black students, Hispanic/Latino students, men, and students from lower-income zip codes scoring between 0.15 and 0.25 GPA points lower than white, female, or higher income zip code comparison groups. The analysis also adds to evidence from previous work on the impact of the pandemic on grades in introductory economics classes and provides two new contributions. Similar to previous work (Engelhardt et al. 2021; Kofoed et al. 2021), grades dropped in the first semester of the pandemic but returned to pre-pandemic levels in the second and third pandemic semesters.[27] Our first contribution is new evidence on the second year of the pandemic that shows the race, gender, and home zip code income disparities were relatively consistent across two academic years, spanning the first three semesters of the COVID-19 pandemic.

A second important contribution is that these findings within economics courses are not unique to the economics department; grade differentials in a microeconomic principles class are consistent with a student's overall academic performance (as measured by overall GPA in other courses). Therefore, the one-eighth- to one-quarter-point decrease in course GPA that we find, when magnified across all courses, generates a meaningful impact on a student's overall GPA; this impact disproportionately hurts students of color and students from low-income communities beyond the college.

This analysis does, however, have two potential limitations. First, we only observe students' zip code median income and not their household median income. Ideally, we would have an individual measure such as estimated family income or whether the student was eligible for a Pell Grant because individual information on need-based financial aid would give a clearer picture of where disparities exist. Second, external validity may be a potential limitation for an analysis of performance at a single non-flagship public university. Our response to this is that our data is from a university relatively similar to that studied by Engelhardt et al. (2021) and more widely applicable because more students attend non-

[27] This disparity is not new and is discussed in the work of Xu and Jaggars (2013), who find that (controlling for course fixed effects and selection bias) online learning negatively impacts course persistence and course grade in a community college setting; these negative effects are larger for non-white students.

flagship state universities than flagship state universities, private selective colleges, and non-profit college combined (Jaquette 2017).[28]

The findings from this research underscore the need for policies and programmatic changes to address and remediate a) the disproportionate effects and b) the growing disparities caused by educational disruptions. With limited research in economics that has attempted to resolve recruitment and retention challenges on any scale within the discipline and address performance differences between groups, there is none that we could find focusing on how these challenges are impacted by large-scale social and economic disruptions such as the COVID-19 pandemic. However, our findings—along with existing literature in economic education—indicate that resources could potentially best be aimed at programmatic changes that focus on students of color and those from low-income households. These could include resources to close the "digital divide" that widened during the pandemic (St. Amour 2020, 2021), hiring or facilitating more tutors and educational specialists, providing access to technology and training for both students and educators, and utilizing strategies from the encouragement studies found in economic education (Li 2018; Carrell and Kurlaender 2020; Porter and Serra 2020).

[28] It should be noted, however, that the impact of COVID-19 on Fall 2020 enrollment was considerably more difficult for public four-year institutions as their enrollment was down -1.6%, while enrollment at private four-year institutions was up +3.2%.

Appendix A:

We find that the demographic observables are similar between the Fall 2019 and Fall 2020 semester and between the Spring 2020 and Spring 2021 semesters, with a few minor exceptions (noted below). This result diminishes the likelihood of sample selection affecting changes in grades between the semesters. It also suggests that the population of a demographic category by race or gender is largely the same. That is, an influx or reduction of population of a group may change the composition of that group, but since we do not see changes in the groups' proportions, this suggests that female, African American/Black, or Hispanic/Latino students are from a similar population in each semester. As the *t*-test shows below, we only see an increase in African American/Black students from 27% of the population in Spring 2020 to 35% in Spring 2021. The only other statistically significant (at the 5% level) change we observe is an increase in the population of athletes, from 2.7% of the sample in Spring 2020 to 5% in Spring 2021.

Comparison of Fall 2019 and 2020 Demographics

	Fall 19 Obs	Fall 20 Obs	Mean Fall 19	Mean Fall 20	Difference	St Err	t value	p value
Grade	839	900	2.47	2.43	.039	.052	.75	.457
Female	838	900	.401	.43	-.029	.024	-1.25	.22
African American/Black	838	900	.254	.278	-.024	.021	-1.1	.267
Hispanic/Latino	838	900	.081	.075	.005	.013	.45	.665
Other Race	838	900	.079	.096	-.017	.014	-1.25	.216
White	838	900	.52	.486	.034	.024	1.4	.162
Athlete	839	900	.06	.042	.018	.011	1.65	.099
Zip Code Median Income	834	897	119256	118733	523	1596	.35	.743

	Spring 20 Obs	Spring 21 Obs	Mean Spring 20	Mean Spring 21	Difference	St Err	t value	p value
Grade	603	501	2.611	2.423	.189	.066	2.9	.004
Female	603	501	.448	.495	-.047	.03	-1.55	.118
African American/Black	603	501	.274	.35	-.075	.028	-2.7	.007
Hispanic/Latino	603	501	.103	.082	.021	.018	1.2	.233
Other Race	603	501	.083	.062	.021	.016	1.35	.182
White	603	501	.468	.435	.033	.03	1.1	.28
Athlete	603	501	.026	.05	-.024	.012	-2.05	.041
Zip Code Median Income	602	499	117897.	116443.	1454.	2068	.7	.482

Appendix B: Income Bins

In the analysis, we elect to divide the sample into three zip code median income bins based on our finding that students in the bottom three deciles perform similarly. Table B shows average grades, pass rates, and withdrawal rates by income bin deciles. To further look at the poorest students, we divide the bottom decile into a <5th percentile and a 5th–10th percentile. Average grades and pass rates are roughly similar for the 5th–10th, 10th–20th, and 20th–30th percentile. There is a slight reduction for those in the bottom 5th percentile of grades in the class and pass rates, however a *t*-test comparing students in the bottom 5th percentile to those in the 5th–10th percentile is not statistically significant in terms of GPA or pass rates.

Grades by Zip Code Median Income

Zip Income Percentile	Micro Grade 4 scale	% Pass	% Withdraw	Median ZipCode Income
5 <	2.270	68.9%	6.5%	59834.42
5-10	2.352	74.3%	3.9%	75384.74
10-20	2.382	75.5%	6.7%	83521.81
20-30	2.362	76.6%	3.2%	95534.22
30-40	2.527	78.4%	5.5%	103835.4
40-50	2.572	82.5%	3.2%	111673.5
50-60	2.465	77.8%	4.2%	122775
60-70	2.456	75.9%	4.9%	129235.3
70-80	2.520	79.2%	3.1%	135988.5
80-90	2.621	82.0%	4.1%	148986.9
90-100	2.577	78.6%	8.4%	184925.9

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