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Learning loss due to university closures during the COVID-19 pandemic: Evidence from Thailand's largest public university

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Abstract

The COVID-19 pandemic has affected all segments of the population, including college students in higher education institutions. This paper examines the survey of 400 undergraduate students at the largest public university in Thailand between March and June 2021 to identify the causal impacts of the COVID-19 pandemic on college students' academic performance and expected labor market outcomes. The findings suggest a 0.27-point decline in semester-level GPA and a 2.5-hour decrease in weekly study hours. Additionally, students are found to delay graduation, withdraw from classes, and change their majors due to the COVID-19 pandemic. While the COVID-19 pandemic has lowered student's reservation wages after graduation, such an impact is not statistically significant. In addition, students expect a significant decrease in their future financial assets at age 35. These significant negative impacts on academic performance and expectations for future employment are more pronounced among students from lower-income families. This paper provides evidence that the pandemic seems to worsen inequality in higher education.

Keywords: online learning, COVID-19, higher education, academic performance, labor market
JEL Classifications: I14, I15, I21, I23, I24, I25

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1. Introduction

Over the past few decades, developing countries have made significant progress towards increasing access to education at all levels, including higher education. Higher education enrolment in low and middle-income countries increased from 6 percent to 35 percent between 1970 and 2020 (UNESCO, 2022). This figure is still low when compared to high-income countries, where 80 percent of their population obtain a tertiary education. Since economic returns for higher education are the highest in the entire educational system (Psacharopoulos & Patrinos, 2018; Montenegro & Patrinos, 2021), differences in access to higher education between regions and barriers to achieving universal access to higher education are central to the development policy debate (UNESCO, 2020).

Since 2010, higher education enrolment has grown at a much faster rate in low and middle-income countries (4.07 percent annually) than in high-income countries (0.99 percent annually). However, the COVID-19 pandemic, with its ensuring closure of educational institutions for significant periods, may undo years of progress made in higher education in developing countries. At the onset of the pandemic, almost all countries shut down schools and universities (Hale et al., 2021). From February 2020 to October 2021, educational institutions in developing Asia, on average, were closed for 272 instruction days (Molato-Gayares et al., 2022). The pandemic, therefore, has a disruptive impact on the education system worldwide. A recent paper by Patrinos et al. (2022) found that students lost about one-half year's worth of learning. In addition, learning losses during the pandemic are greater among students from low-income families (Moscoviz & Evans, 2022). Before the pandemic, there was a large learning gap between students from different family backgrounds. Therefore, the COVID-19 pandemic exacerbates existing inequality in education.

Despite growing evidence of the dramatic impacts of the pandemic on education, a question left unanswered is how the pandemic has affected higher education, especially in the context of developing countries. The present study focuses on a particular dimension of higher education in the time of COVID-19 and seeks to answer the following question: what is the causal impact of the COVID-19 outbreak on college students' academic performance and labor market expectations? This study also explores whether such impacts vary across demographic divisions. To answer these two questions, a survey with a sample size of 400 undergraduate students at Ramkhamhaeng University, one of the largest public universities in Thailand, was conducted between March and June 2021. During this period, all educational institutions in Thailand were closed and shifted to fully online instruction. The survey used in this study aims to recover counterfactual outcomes in the absence of COVID-19.[1] That is, students were asked about their current outcomes and what those outcomes would have been in the absence of COVID-19. This approach helps construct within-person differences in expectations across outcomes where each person is both treatment and control, thus addressing concern about the unobservability of counterfactuals and allowing for unrestricted heterogeneity across people (Giustinelli & Shapiro, 2019).

This study finds large negative impacts of the COVID-19 outbreak on college student's academic outcomes. The effect shows a 0.27-point decrease in semester-level GPA. About two-thirds of the students in the survey expect a decline in their semester-level GPA due to the pandemic. Also, students spend 2.55 fewer studying hours per week.

[1] See Arcidiacono et al. (2020), Aucejo et al., 2020), and Wiswall and Zafar (2021) for more detail.

In addition, 6 percent of the students in the survey delayed their graduation, 8 percent withdrew from classes, and 9 percent intended to change their majors.

Additionally, about 60 percent of students report that a family member was unemployed or experienced a reduction in income. However, college students' perceived probability of finding a job by graduation and their reservation wages have not changed significantly due to the COVID-19 pandemic. This indicates that college students do not think that the pandemic will affect the labor market, at least in the short run. Yet, it was found that college students expect to experience a decline in their earnings at age 35 due to the pandemic, suggesting that they believe that the pandemic could have a long-lasting effect on the labor market.

Moreover, there exists heterogeneity in the treatment effects. The negative effects are larger among males, students from lower-income families, and students in their fourth year of study. For instance, students from lower-income families expected a 0.22 lower semester-level GPA than their richer classmates. They are also 10 percentage points more likely to delay graduation and change majors.

This paper contributes to the literature on the COVID-19 pandemic that the pandemic and the ensuing sudden shift to online instruction have resulted in worse learning outcomes and the effects vary across student subgroups (Aucejo et al., 2020; Bird et al., 2022; Engzell et al., 2021; Hossain, 2021; Rodríguez-Planas, 2022). However, developing countries may have larger negative effects due to a lack of proper infrastructure and quality of online instruction.

The paper is structured as follows: Section 2 presents the literature on this subject. Section 3 describes the data and study setting. Section 4 shows the methodology. The empirical results are reported in Section 5. A final section concludes.

2. Literature review

While a large literature has investigated the impact of the COVID-19 outbreak on primary and secondary school students (Azevedo et al., 2021; Agostinelli et al., 2022; Engzell et al., 2021; Takaku & Yokoyama, 2021), evidence investigating such effects on higher education is limited. These studies largely focus on universities in high-income countries. For instance, Aucejo et al. (2020) surveyed students at Arizona State University and found that the average treatment effect of COVID-19 on semester-level GPA is a decrease of 0.17 points. A large number of students also delayed graduation, withdrew from classes, and intended to change majors. Using a randomized controlled trial in an economics course at the United States Military Academy at West Point, Kofoed et al. (2021) studied the impact of shifting from in-person to online instruction during the pandemic and found that the unexpected switch to online education has negative results for learning. Altindag et al. (2021) also find such negative learning outcomes. A recent study by Rodríguez-Planas (2022) deserves attention. Using higher-education administrative records and transcript data, it was found that low-performing, lower-income students outperformed their higher-income peers, due to the flexible grading policy. In contrast, there is no GPA advantage due to income among top-performing students. Overall, these studies suggested the negative impacts of the COVID-19 outbreak on college students' learning outcomes.

Despite this growing body of evidence on the impact of the COVID-19 pandemic on higher education, little is known about how the pandemic affects students in developing countries, and which socio-demographic groups of students have been more affected. There are various reasons why the COVID-19 crisis and the subsequent shift to

online instruction may have led to worse outcomes for college students in poorer countries. First, the budget in the education sector is lower in low-income countries than in high-income countries (Al-Samarrai et al., 2020). This suggests that developing countries may experience greater challenges in the transition to online learning due to a lack of mastery of technological resources and infrastructure (Dhawan, 2020; Oyedotun, 2020; Barrot et al., 2021;). These fiscally constrained countries may also have poorer prospects for recovery. Second, students in developing countries may face many obstacles in a home learning environment, for instance, poor internet service, high internet costs, and limited interaction among students (Kapasia et al., 2020; Suryaman et al., 2020). Additionally, students in countries severely affected by the pandemic may have been dealing with health challenges or have had a family member who became sick or unemployed. It is of particular concern for developing countries, given the sheer size of the informal workforce (Ohnsorge & Yu, 2021). Without proper social protection and a job contract, these workers are more prone to losing jobs and income during the COVID-19 crisis, which could, in turn, make it more difficult for them to afford online learning devices (Pokhrel & Chhetri, 2021; Hossain, 2022). Therefore, an unprecedented shift to online learning with limited resources may translate into poor learning outcomes for students.

3. Data

The effects of the COVID-19 outbreak on college students' academic outcomes and labor market expectations are examined using the students' responses to an online survey (see Appendix A). The sample for this research is undergraduate students at Ramkhamhaeng University, the largest public university in Thailand.

In Thailand, schools and universities across the country were fully closed from mid-March until August 2020 as a consequence of a nationwide lockdown. Like other universities in Thailand, Ramkhamhaeng University announced that instruction for the summer semester of 2019 would be transitioned online. Students were not allowed to come to the campus. Ramkhamhaeng University resumed full-time, in-person instruction for the first semester of 2020, starting from August to November 2020. The second semester of 2020 started in early December 2020. However, due to the new outbreak and increase in COVID-19 infection cases across the country in mid-December 2020, the government mandated the closure of educational institutions again. Ramkhamhaeng University closed again in January 2021, and the closure persisted throughout 2021. This means that the university continued with online learning during the second semester of 2020, the summer semester of 2020, the first semester of 2021, and the second semester of 2021.

Following Aucejo et al. (2020), this survey was designed to recover the causal impact of the COVID-19 outbreak on college student's academic performance and future labor market expectations. The survey was conducted between March and June 2021. During this period, Ramkhamhaeng University closed its campus and moved to online teaching. The sample size was limited by the research funds to 400 students. This group of students was selected from the 28,200 students at Ramkhamhaeng University using a stratified systematic sampling of the student database based on the students' majors provided by the admissions office. The sample size in each stratum is equal to the subgroup's proportion in the whole population. Of the 400 undergraduate students who completed the survey, 11 respondents were ineligible and dropped from the sample because they were first-year students who were taking the semester at the university and thus had no experience with in-person instruction. The survey collected information on

students' demographic characteristics, family background, current academic outcomes, and expectations towards the labor market.

The descriptive statistics of the sample respondents are reported in Tables 1 and 2. The average age of the respondents was 21 years old. The range of ages of respondents was wide because Ramkhamhaeng University offers education to all students regardless of age, nationality, or educational background. The average respondent's cumulative GPA was 3.01/4.00, or 75.25 percent of 100 percent. In addition, the average monthly expenditure of respondents was 10,739 Baht. Among respondents who reported that they own debt, the mean level was 23,887 Baht. The average savings among all respondents was 32,605 Baht.

Table 1: Descriptive Statistics of the Sample Respondents

Variable	Obs.	Average	Standard Deviation	Min.	Max.
Age	389	20.93	1.82	16.00	38.00
Cumulative GPA	388	3.01	0.40	1.96	4.00
Monthly Expenditure (Baht)	389	10,739.07	4,859.30	3,000.00	90,000.00
Total debt (Baht)	377	23,886.45	70,015.14	0	500,000.00
Total saving (Baht)	376	32,605.34	234,878.50	0	3,000,000.00

Source: Author's calculation

Table 2: Demographic Characteristics of the Respondents

		Frequency	Percentage	Cumulative Percentage
Gender	Male	174	44.73	44.73
	Female	215	55.27	100
Years in the university	1st	57	14.65	14.65
	2nd	82	21.08	35.73
	3rd	142	36.50	72.24
	4th and higher	108	27.76	100
Hometown	Bangkok	67	17.22	17.22
	Central (Excluding Bangkok)	66	16.97	34.19
	Northern	37	9.51	43.7
	North-eastern	74	19.02	62.72
	Southern	145	37.28	100
Family income per month (Baht)	< 10,000	3	0.77	0.77
	10,000 – 20,000	23	5.91	6.68
	20,000 – 30,000	93	23.91	30.59
	30,000 – 40,000	113	29.05	59.64
	> 40,000	157	40.36	100
Highest education level of father	Below bachelor's degree	207	53.21	53.21
	Bachelor's degree	158	40.62	93.83
	Master's degree	18	4.63	98.46
	Higher than Master's degree	6	1.54	100
Highest education level of mother	Below bachelor's degree	252	64.78	64.78
	Bachelor's degree	125	32.13	96.92
	Master's degree	12	3.08	100

Source: Author's calculation

As shown in Table 2, out of 389 respondents, there are 174 males (44.73 percent) and 215 females (55.27 percent). About one-third of the respondents were in their third year of university. More than one-third of the respondents (37.28 percent) were from the South of Thailand. Table 2 also indicates that the majority of the respondents reported that their monthly family income was greater than 40,000 Baht (40.36 percent), with less than one percent of students saying that their family income was less than 10,000 Baht per month. It is important to note that the highest level of education achieved by their parents among students from low-income families (having a family's income of less than 10,000 Baht per month) was below a bachelor's degree.

4. Methodology

The purpose of this paper is to investigate the causal impacts of the COVID-19 outbreak on college students' academic outcomes and labor market expectations in the context of developing countries. In this section, an analytic framework is outlined to examine causal effects and discuss key identification assumptions behind this approach.

Let $O_i(COVID19)$ be the potential outcome of undergraduate student i associated with COVID-19 treatment. The causal impact of the COVID-19 outbreak on college student's academic performance and labor market expecrations can be written as:

$$\Delta_i(O) = O_i(COVID19 = 1) - O_i(COVID - 19 = 0) \qquad (1)$$

where $O_i(COVID19 = 1)$ is undergraduate student i's outcomes when there is the COVID-19 outbreak and $O_i(COVID19 = 0)$ being undergraduate student i's outcomes when there is no outbreak.

In this context, we observe only the outcome conditional on the treatment, $O_i(COVID19 = 1)$, but not the counterfactual outcome absent the treatment, $O_i(COVID19 = 0)$. It is difficult to make inferences about causal effects when there is unobserved heterogeneity across students.

To address the unobservability of counterfactual outcomes and to make inferences about causal effects, a survey is designed to not only collect student outcomes and expectations after the pandemic but also to recover counterfactual outcomes in the absence of the outbreak (Aucejo et al., 2020). Individuals are asked to predict the outcome of interest under different scenarios that they might experience. To be specific, undergraduate students are asked about their expected outcomes in the state of the world without COVID-19. Therefore, this approach yields individual-level treatment effects (Giustinelli & Shapiro, 2019).

For example, the survey asks, "What is the number of hours you studied per week in the last two weeks?" This is the first term on the right-hand side of Equation (1). The second term (that is, the counterfactual outcome) is the answer to the question "Were it not for the COVID-19 pandemic, how many hours per week would you have studied per week in the last two weeks?" The difference between these two answers is the individual-level treatment effect of the COVID-19 pandemic. The survey also asks about outcomes that have been observed and those that will be observed in the future. Therefore, there are both ex-post and ex-ante treatment effects in this study.

This study examines the effects of the COVID-19 pandemic on academic performances and current and expected labor market outcomes. For academic performance, five outcomes are explored: semester-level GPA (out of 4.00), study hours

per week (number of hours), plan to graduate (a yes-no question), class withdrawal (a yes-no question), and intention to change major (a yes-no question). For current and expected labor market outcomes, seven outcomes are analyzed: working hours (number of hours), income from work in the past week (Baht), effects on family members being unemployed or seeing a reduction in income (a yes-no question), likelihood to get a job before graduation (a yes-no question), reservation wages (the lowest monthly wage the respondent can accept after graduation, Baht), a financial asset at age 35 (Baht), and a chance to take a career in the public sector (a yes-no question). Note that Ramkhamhaeng University is an open university, meaning that every person of all ages can attend the university. Therefore, it is common for some students to do a part-time or even a full-time job whilst taking courses at the university. During the pandemic, these students may have fewer hours worked, resulting in a lower income.

The key assumption of this identification strategy is that students can examine the outcome in the counterfactual scenario (without COVID-19). Therefore, students who complete the survey have to have experience with in-person instruction. In the case of Ramkhamhaeng University, this assumption is realistic because the counterfactual state (in-person instruction before university closure) was about two months before the survey. Students who have never come to the campus are dropped from the sample. Note also that Ramkhamhaeng University did not have a well-established online education program before the COVID-19 pandemic. Similar to Rodríguez-Planas (2022), the estimates, therefore, pick up both the switch to online learning and other disruptions caused by the pandemic.

5. Results

5.1 The average treatment effects

Results of the estimation of equation (1) are reported in Table 3. Panel A shows the effects of the COVID-19 outbreak on college student's academic performances, whereas Panel B presents the effects on labor market outcomes and expectations. The first two columns report the average outcomes in both states of the world (with COVID-19 and without COVID-19). Column 3 reports the average treatment effects. Column 4 reports the proportion of students for whom the individual-level treatment effect is negative, whereas Column 5 shows the proportion of students for whom the individual-level treatment effect is positive.

As shown in Panel A in Table 3, the average treatment effects of the COVID-19 outbreak are statistically significant for all outcomes. The average treatment effect of the outbreak on semester-level GPA is a decline of 0.27 points. The effects are statistically significant at the 1 percent level. This effect represents a 9 percent decrease in the first semester of 2020 cumulative GPA. The size of the effect is higher than that reported by Aucejo et al. (2020). About 67 percent of the respondents expect to see a decline in their semester-level GPA due to the COVID-19 outbreak. Note that only 5 percent of the students in the sample expect an increase in their semester-level GPA.

In addition, the average treatment effect of the COVID-19 outbreak on weekly study hours is a decrease of 2.6 hours. The size of the average treatment effect is twice as high in this study as it is in Aucejo et al. (2020). About 58 percent of the respondents expect a reduction in study hours per week. Moreover, 6 percent of the students in the sample delayed their graduation, 8 percent withdrew from a class in the previous semester, and 9 percent changed their major. All of the effects are statistically significant

at the 1 percent level. These findings suggest that the COVID-19 outbreak has significant negative impacts on college students in developing countries.

Table 3: The Average Treatment Effects

	With COVID-19 (1)	**Without COVID-19 (2)**	**Δ (2)-(1) (3)**	**Δ< 0 (4)**	**Δ= 0 (5)**
Panel A: Academic performances					
Semester GPA	3.04	3.32	-0.27***	0.67	0.28
	(0.65)	(0.56)	(0.45)		
Study hours per week	8.32	10.87	-2.55***	0.58	0.40
	(0.35)	(0.42)	(2.92)		
Delayed graduation (0/1)			0.06***		
			(0.24)		
Withdraw from a class (0/1)			0.08***		
			(0.27)		
Changed major (0/1)			0.09***		
			(0.28)		
Panel B: Labor market outcomes and expectations					
Working hours	35.57	36.68	-1.11	0.32	0.57
	(2.32)	(2.58)	(7.53)		
Income from work	14,884.62	14,746.15	138.46	0.04	0.88
	(1,588.74)	(1,607.24)	(1,013.14)		
Family member lost job or saw a decline in income (0/1)			0.62***		
			(0.49)		
Probability to get job offer by graduation	29.41	30.10	-0.69	0.22	0.61
	(30.94)	(31.69)	(15.67)		
Reservation wages	3,828.77	4,611.52	-782.75	0.17	0.05
	(6,948.38)	(10,697.32)	(6,936.37)		
Financial asset at 35	1,755,879	1,912,300	-156,421.20***	0.30	0.69
	(2,423,752)	(2,688,340)	(853,770)		
Choose to work in government sector (0/1)			0.01		
			(0.36)		

*Note: * p < 0.10, ** p < 0.05, *** p < 0.01, standard deviation in parenthesis.*
Source: Author's calculation

Panel B in Table 3 reports the impacts of the COVID-19 outbreak on college students' labor market outcomes and expectations. Only a few outcomes are statistically significant, however. The average treatment effect on working hours is negative, but the effect is trivial and not statistically significant. Similarly, the average treatment effect on income from work is positive but, again, not statistically significant. Perhaps surprisingly, about one-third of the students reported that a family member lost their job or saw a decrease in their income.

Concerning labor market expectations, the respondents expect a 63-percentage point decline in the probability of finding a job by graduation. Students may accept low-paying jobs due to poor market conditions driven by the COVID-19 pandemic. However, the average treatment effect of the COVID-19 outbreak on reservation wages is not statistically significant. Also, their expected financial assets at age 35 decreased by 156,214 Baht due to the COVID-19 outbreak. A significant decrease in expected financial assets at age 35 implies that students expect that the COVID-19 pandemic could have a long-lasting effect on their living standards.

5.2 Heterogeneous effects across student subgroups

This section examines whether the treatment effects on academic performances and labor market expectations are heterogeneous across demographic and economic characteristics, including gender, parental income, and student cohort. Students from lower-income families are defined as those whose parental income per month is less than

30,000 Baht. Students from higher-income families are those whose parental income per month is greater than 40,000 Baht. Regarding student cohorts, a junior is a student in their second year of study, whereas a student in their third year of study and beyond is defined as a senior.

Table 4 reports the heterogeneity of the effect across different demographic groups. Columns (2)-(5) provide the effects of the COVID-19 outbreak with respect to gender. Compared to their classmates, disruptive effects on academic performance were more pronounced among males. The decline in semester-level GPA among males was 0.36 points, 15 points larger than the decline among females. In addition, the negative impact of COVID-19 on weekly study hours is larger for males than that for females (a 2.92-hour reduction versus a 2.24-hour reduction in study time).

These findings suggest that the negative effects on academic performance are greater for male students than their peers. One possible reason is that female students have higher class engagement and stronger self-regulation skills than their peers during remote learning (Korlat et al., 2021; Chzhen et al., 2022; Oinas et al., 2022). Self-regulation skills are defined as a learning process in which a student manages their emotions, behaviors, and attitudes to reach a level where they can focus and learn (Schunk & Zimmerman, 2003; Etkin, 2018). These skills are viewed as important tools when learning takes place at home. In addition, female students may have better experiences in online learning during the COVID-19 pandemic than males (Aristovnik et al, 2020). In this study, the survey also asked Ramkhamhaeng University's students to rate their learning experiences in online classes relative to in-person classes. It is found that females were more likely than males to say that their learning experiences in online classes are better than in-person classes (20.29 percent versus 7.2 percent). Also, females are more likely to opt for the online option if given the choice to take a course online or in person (50.65 percent versus 43.60 percent). This explains why female students in this sample have better experiences moving from onsite to online learning.

However, there are several studies suggesting that the negative effects of the pandemic on female students are greater. This is because female students are less likely than their peers to access remote learning (UNICEF, 2021). According to Jones et al. (2020), there is evidence that the pandemic increases household chores for girls, making it difficult to focus on online classes. Therefore, more research is needed to better understand the impacts of the pandemic on learning outcomes between male and female students.

Table 4: Treatment Effects by Gender, Family Background, and Years in the University

		All (1)	Male (2)	Female (3)	P-value (2)-(3) (4)	Lower income (5)	Higher income (6)	P-value (5)-(6) (7)	Junior (8)	Senior (9)	P-value (8)-(9) (10)
Panel A: Academic Performance	Semester GPA	-0.27	-0.36	-0.21	0.03**	-0.44	-0.22	0.03**	-0.14	-0.31	0.05*
		(0.45)	(0.52)	(0.39)		(0.68)	(0.32)		(0.30)	(0.48)	
	Study hours per week	-2.54	-2.92	-2.24	0.03**	-2.69	-1.92	0.03**	-3.16	-2.20	0.00***
		(2.92)	(3.31)	(2.53)		(2.39)	(3.11)		(2.77)	(2.95)	
	Delayed graduation (0/1)	0.06	0.06	0.06	0.76	0.11	0.01	0.00***	0.05	0.06	0.59
		(0.24)	(0.24)	(0.23)		(0.31)	(0.08)		(0.22)	(0.25)	
	Withdraw from a class (0/1)	0.08	0.09	0.07	0.33	0.05	0.04	0.60	0.04	0.10	0.02**
		(0.27)	(0.29)	(0.25)		(0.22)	(0.19)		(0.19)	(0.30)	
	Changed major (0/1)	0.09	0.09	0.08	0.78	0.20	0.01	0.00***	0.16	0.05	0.00***
		(0.28)	(0.29)	(0.28)		(0.40)	(0.11)		(0.37)	(0.21)	
Panel B: Labor Market	Working hours	-1.11	-1.00	-1.19	0.95	0.29	0.00	0.95	-0.88	-1.2	0.92
		(7.53)	(11.16)	(3.27)		(8.79)	(0.00)		(2.47)	(8.85)	
	Income from work	138.46	0.00	257.14	0.53	173.33	0.00	0.8	-125.00	255.56	0.39
		(1,013.14)	(0.00)	(1,393.23)		(1,328.52)	(0.00)		(834.52)	(1,084.23)	
	Family member lost job or saw a decline in income (0/1)	0.62	0.61	0.64	0.57	0.94	0.43	0.00***	0.69	0.59	0.05*
		(0.48)	(0.49)	(0.48)		(0.24)	(0.50)		(0.46)	(0.49)	
	Probability to get job offer by graduation	-0.69	0.11	-1.35	0.36	3.28	-2.80	0.00***	2.37	-2.40	0.00***
		(15.67)	(17.27)	(14.26)		(18.04)	(15.97)		(11.07)	(17.51)	
	Reservation wages	-782.75	-293.05	-1,179.07	0.21	-193.28	-1,493.63	0.19	-1,161.87	-571.96	0.42
		(6,936.37)	(972.33)	(9,279.88)		(1,348.43)	(10,799.45)		(11,461.53)	(1,428.65)	
	Financial asset at 35	-156,421	-218,353	-106,355	0.2	-55,420	-345,256	0.01**	-157,086	-156,048	0.99
		(853,770)	(1,224,481)	(323,389.20)		(267,800.70)	(1,189,936)		(1,327,632)	(392,874.40)	
	Choose to work in government sector (0/1)	0.01	0.07	-0.03	0.01**	0.03	-0.03	0.26	-0.01	0.02	0.47
		(0.37)	(0.42)	(0.32)		(0.40)	(0.35)		(0.35)	(0.37)	

*Note: * p < 0.10, ** p < 0.05, *** p < 0.01, standard deviation in parenthesis, columns (4), (7), and (10) report the p-value of a difference in means test between the two preceding columns, lower-income students are defined as those whose parental income per month is less than 30,000 Baht, higher-income students are those whose parental income per month is greater than 40,000 Baht, a junior is a student in their second year of study while a senior is a student in the third year of study and beyond.*

Source: Author's calculation

The results shown in Columns (6)-(8) in Table 4 suggest that students from lower-income families were more severely affected by the COVID-19 outbreak in terms of academic performance. The decline in semester-level GPA among students from low-income families was 0.44 points, much larger than the decline among their richer classmates (0.22 points). This finding deserves attention because the cumulative GPA among students from lower-income families is, on average, lower than that of their richer classmates (2.9/4.00 versus 3.2/4.00). Thus, the COVID-19 outbreak could widen the existing gap in learning outcomes among college students.

The key reason for the larger negative impacts on poorer students is that they have limited access to technology and infrastructure at home (Armitage and Nellums, 2020; Thomas, 2000; Hossain, 2021; Unicef, 2000; Rodríguez-Planas, 2022). When instruction is online, students' lack of access to laptops, mobile phones, and high-speed internet is a significant obstacle to effective online learning. Therefore, education is out of reach for students from poor families. Like other educational institutions in developing countries, financial support for students who take online courses is limited. Reduction of tuition fees and academic charges may not be sufficient to help students cope with the difficult situation during the pandemic and the rising cost of online learning.

In addition, there exist the heterogenous effects of COVID-19 on study time with respect to economic background. The decline in weekly study hours is more pronounced among students from lower-income families compared to those from higher-income families (2.69 hours versus 1.92 hours). Moreover, students from lower-income families are about 10 percentage points more likely to delay their graduation and change majors due to the COVID-19 outbreak. The pandemic may force poor students to work to support their families. This could affect their time allocated to online learning at home. More research is needed, however, to confirm this possibility in the context of college students in Thailand.

In terms of the current labor market outcome, students from lower-income families were 51 percentage points more likely to report that their family members were unemployed or experienced a fall in income due to the COVID-19 outbreak. This indicates that students and their families are found to be disproportionally affected by the COVID-19 pandemic, and it could be associated with students' experiences and academic performances. For example, students from economically disadvantaged groups may be forced to leave university and work to support their families. The cost of education may become unaffordable for these families.

Moreover, there is a sharp difference among students with different economic backgrounds in the probability of finding a job before graduation. The findings show how students react to economic and health shocks brought on by the COVID-19 pandemic. Perhaps surprisingly, students from lower-income families expect a 3.28 percentage point increase in the probability of finding a job before graduation. Note, however, that the average perceived probability among poor students (defined as those whose family income per month is less than 20,000 Baht) fell by -3.46 percentage points due to the COVID-19 outbreak. This suggests that a positive attitude towards job opportunities may be held largely among middle-income students, and more research is needed to confirm this. The perceived probability of finding a job before graduation among higher-income students fell by 2.80 percentage points. This pessimistic view among students from higher-income families can also be seen in the larger negative impacts on their expected financial assets at 35.

Finally, this study examines whether the treatment effects vary among junior and senior students. Columns (8)-(10) in Table 4 present the results. It is found that the negative effect of the COVID-19 outbreak on semester-level GPA was larger among

students in their senior year of study than that of junior students. This is presumably due to the course available in the fourth year of a study is more specific and, therefore, more difficult to deliver online. Based on the survey, about 41 percent of students in their fourth year of the study reported that their learning experiences in online classes were worse than in-person classes, a much higher percentage than the students in their second (26 percent) and third (32 percent) year of the study.

Nevertheless, the negative impact on weekly study time is larger among junior students than that of senior students. One possible reason is that components of student grades (tests, papers, and assignments) are easier to change for courses in the later year of study. If this is the case, the required study hours may be reduced for senior students. They may focus more on self-study. However, more research is needed. Senior students are 6 percentage points more likely to withdraw from class compared to junior students. However, they are 9 percentage points less likely to change their major. Another worrying trend among senior students is that their perceived probability of finding a job before graduation decreased by 2.40 percentage points, approximately 3 times higher than the average treatment effect.

Table 5 reports differences in the average treatment effects by the education level of respondents. For the educational level, this report focuses on two groups of students: high-performing students (defined as those who have a cumulative GPA greater than or equal to 3.55, a 90th percentile of cumulative GPA) and low-performing students (defined as those who have a cumulative GPA less than or equal to 2.51, a 10th percentile of cumulative GPA).

Table 5: Treatment Effects by Gender, Family Background, and Years in the University

		High-performing (1)	Low-performing (2)	P-value (1)-(2) = (3)
Panel A: Academic Performance	Semester GPA	-0.19	-0.33	0.15
		(0.03)	(0.33)	(0.12)
	Study hours per week	-2.22	-1.91	-0.32
		(0.51)	(0.43)	(0.67)
	Delayed graduation (0/1)	0.00	0.13	-0.13**
		(0.00)	(0.05)	(0.05)
	Withdraw from a class (0/1)	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
	Changed major (0/1)	0.00	0.08	-0.08*
		(0.00)	(0.04)	(0.04)
Panel B: Labor Market	Working hours	0.00	5.40	-5.40
		(0.00)	(6.18)	(6.18)
	Income from work	200	1,150	-950
		(200)	(1,150)	(1,035.20)
	Family member lost job or saw a decline in income (0/1)	0.54	0.73	-0.19*
		(0.08)	(0.07)	(0.11)
	Probability to get job offer by graduation	-4.62	2.00	-6.62**
		(1.90)	(2.09)	(2.83)
	Reservation wages	-692.31	125.25	-817.56**
		(214.69)	(235.30)	(318.95)
	Financial asset at 35	-739,871.80	-73,974.36	-665,897.40*
		(358,503.30)	(55,532.38)	(362,778.80)
	Choose to work in government sector (0/1)	-0.05	0.06	-0.11
		(0.07)	(0.06)	(0.09)

*Notes: * p < 0.10, ** p < 0.05, *** p < 0.01, standard deviation in parenthesis, column (3) reports the p-value of a difference in means test between the two preceding columns, high-performing students are defined as those whose cumulative GPA is greater than or equal to 3.55, and low-performing students are defined as those whose cumulative GPA is less than or equal to 2.51*

Source: Author's calculation

It is found that the effects of the COVID-19 outbreak on semester-level GPA are greater in low-performing students than in high-performing students. However, such a difference is not statistically different from zero. In addition, the results suggest that about ten percent of low-performing students delayed their graduation plans and intended to change their majors. None of the high-performing students reports doing so. However, more research is needed to confirm the mechanism behind this finding, for instance, resources at home between these two groups of students and how they cope with online learning.

For future market expectations, about 73 percent of low-performing students report that a family member was unemployed or seeing a fall in their income. Such an impact is significantly different from the treatment effects experienced by high-performing students. Additionally, it is found that low-performing students are more optimistic about their future labor market since they think that the probability to get a job offer by graduation is higher and their reservation wage increases. However, high-performing students think that their financial assets at age 35 could shrink by about 0.7 million. This is presumably because high-performing students expect a good career path in high-paying sectors such as the financial sector and tourism (before the pandemic), and these sectors are hit hard by the pandemic.

Overall, the COVID-19 outbreak has disproportionate effects on students, especially those from lower-income families. Given poorer academic outcomes and lower economic status in the pre-COVID-19 period, the COVID-19 outbreak tends to exacerbate inequality in higher education.

6. Conclusion

This paper provides the first evidence of the COVID-19 pandemic's impact on college student's academic performance and labor market expectations and explores demographic heterogeneity in the treatment effects. Results from a survey of 400 undergraduate students at one of the largest public universities in Thailand suggest that the pandemic has large negative impacts on college student's semester GPA and weekly study hours. The pandemic also led students to delay graduation, withdraw from class, and intend to change their majors. A large number of students also reported that a family member had lost their job or had experienced a fall in income. Moreover, the pandemic, on average, seems not to affect college students' reservation wage, the perceived probability to get a job before graduation, and expected earnings at 35. However, the size of the effects is also heterogeneous across student subgroups. The negative effects on academic outcomes are more pronounced among males, students from lower-income families, and students in their fourth year of study.

For policy recommendations, as this study provides evidence of learning losses due to university closures during the COVID-19 pandemic, students should be tested to estimate the severity of the learning loss. As noted by Molato-Gayares et al. (2022), the results from this test are useful for lecturers on where to restart classes when the university reopens. In addition, teaching should be based on the current learning level among students. Together with revised curricula, instructors should adjust their teaching methods by placing an emphasis on foundational competencies such as literacy and mathematics (Azevedo et al., 2021).

As students from low-income families are hit the hardest in terms of academic performance, these students should be prioritized. Instructors should ensure that students are taught at their level. This could be done by dividing the classroom into groups and providing customized lessons based on their level of knowledge. Moreover, since

students from low-income families are negatively affected by the COVID-19 pandemic because of the negative effect on their parents, strong economic recovery is important for recovering learning losses from university closures. The government should ensure that the COVID-19 recovery is equitable, meaning that those who are hit hard by the pandemic (e.g., informal sector workers and workers in services) are supported through a wide range of coping strategies such as temporary cash handouts and short-term debt relief. Since the unemployment rate in Thailand has been increasing since the onset of the pandemic, economic growth is conducive to employment generation (i.e., labor-intensive export-oriented industrialization development strategy).

Future research can examine the mechanisms underlying the average treatment effects, such as home learning environment (lack of appropriate technology), several types of online learning (synchronous and asynchronous e-learning), teacher quality, academic dishonesty, pedagogy, availability and quality of e-learning materials, and socioeconomic factors (Donitsa-Schmidt & Ramot, 2020; Guangul et al., 2020; Khalil et al., 2020, Suryaman et al., 2020; Clark et al., 2021). As educational institutions remain closed throughout 2021 and fully reopened in mid-2022, the survey could be taken to explore whether the impact on college student's academic performance and expectations on the labor market change. The survey could be conducted at other universities, such as those in poorer regions. It is also important to explore the effects of online learning during the pandemic on college student's mental health (Copeland et al., 2021; Chen & Lucock, 2022). In addition, differences in the treatment effects by academic degree (e.g., political science, economics, and engineering) are worth exploring further. Unfortunately, the response from the survey conducted for this study does not allow me to delve into such a context.

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Appendix: Survey questions

Section 1: Characteristics

1. Gender
   □ 1. Male □ 2. Female

2. Age
   □ 1. Below 20 years old □ 2. 20 – 30 years old
   □ 3. 31 – 40 years old □ 4. Above 41 years old

3. Nationality
   □ 1. Thai □ 2. Others, please specify……

4. The highest level of education of your father
   □ 1. Below Bachelor's degree □ 2. Bachelor's degree
   □ 3. Master's degree □ 4. Above Master's degree

5. The highest level of education of your mother
   □ 1. Below Bachelor's degree □ 2. Bachelor's degree
   □ 3. Master's degree □ 4. Above Master's degree

6. Household's income
   □ 1. Less than10 , 000Baht □ 2. 10,000 – 20,000 Baht
   □ 3. 20,001 – 30,000 Baht □ 4. 30,001 – 40,000 Baht
   □ 5. More than 40,000 Baht

7. Hometown
   □ 1. Bangkok □ 2. Northern region
   □ 3. Central region except Bangkok □ 4. North-eastern region
   □ 5. Southern region

8. In the past months, has a family member become unemployed or experienced a reduction in income?
   □ 1. Yes □ 2. No

9. What is your major?

.....

11. What year are you at Ramkhamhaeng University?
   □ 1. 1st year □ 2. 2nd year
   □ 3. 3rd year □ 4. 4th year and beyond

12. What is your cumulative GPA?
.....

Second 2: The impact of the COVID-19 on academic performance and labor market expectations

13. When do you plan to graduate from Ramkhamhaeng University
- □ 1. Semester 2/2020
- □ 2. Summer semester/2020
- □ 3. 2021
- □ 4. 2022
- □ 5. 2023 or later

14. Does the COVID-19 pandemic affect your graduation plan?
- □ 1. I plan to graduate later
- □ 2. No impact
- □ 3. I plan to graduate earlier

15. How many hours did you work in the past two weeks?
……

16. If there were no COVID-19 pandemic, how many hours would you have worked in the past two weeks?
……

17. What is your income from work per week?
……

18. If there were no COVID-19 pandemic, how much you would have earned per week from work?
……

19. What is the lowest wage per month you can accept after graduating from Ramkhamhaeng University?
……

20. If there were no COVID-19 pandemic, what would have been your lowest wage per month you can accept after graduating from Ramkhamhaeng University?
……

21. At 35, how much do you expect to make from your full-time job?
……

22. If there were no COVID-19 pandemic, how much would you have expected to make from your full-time job at 35?
……

23. What percentage do you think you have of finding a job before graduating from Ramkhamhaeng University?
0 10 20 30 40 50 60 70 80 90 100

24. If there were no COVID-19 pandemic, what percentage do you think you have of finding a job before graduating from Ramkhamhaeng University?
0 10 20 30 40 50 60 70 80 90 100

25. What sector would you like to work in after graduating from Ramkhamhaeng University?
□ 1. Public sector (Government officials)
□ 2. Private sector

26. If there were no COVID-19 pandemic, what sector would you have expected to work in after graduating from Ramkhamhaeng University?
□ 1. Public sector (Government officials)
□ 2. Private sector

27.This semester, what GPA do you expect to get?
……

28. If there were no COVID-19 pandemic, what GPA would you have expected to get?
……

29. Did you withdraw from any courses due to the COVID-19 pandemic?
□ 1. Yes □ 2. No

30. Did you change your major due to the COVID-19 pandemic?
□ 1. Yes □ 2. No

31. In the past weeks, how many hours did you spend on studying?
……

32. If there were no COVID-19 pandemic, how many hours would you have spent on studying?
……