Impacts of In-Person School Days on Student Outcomes During the COVID-19 Pandemic: Evidence from Korean High Schools

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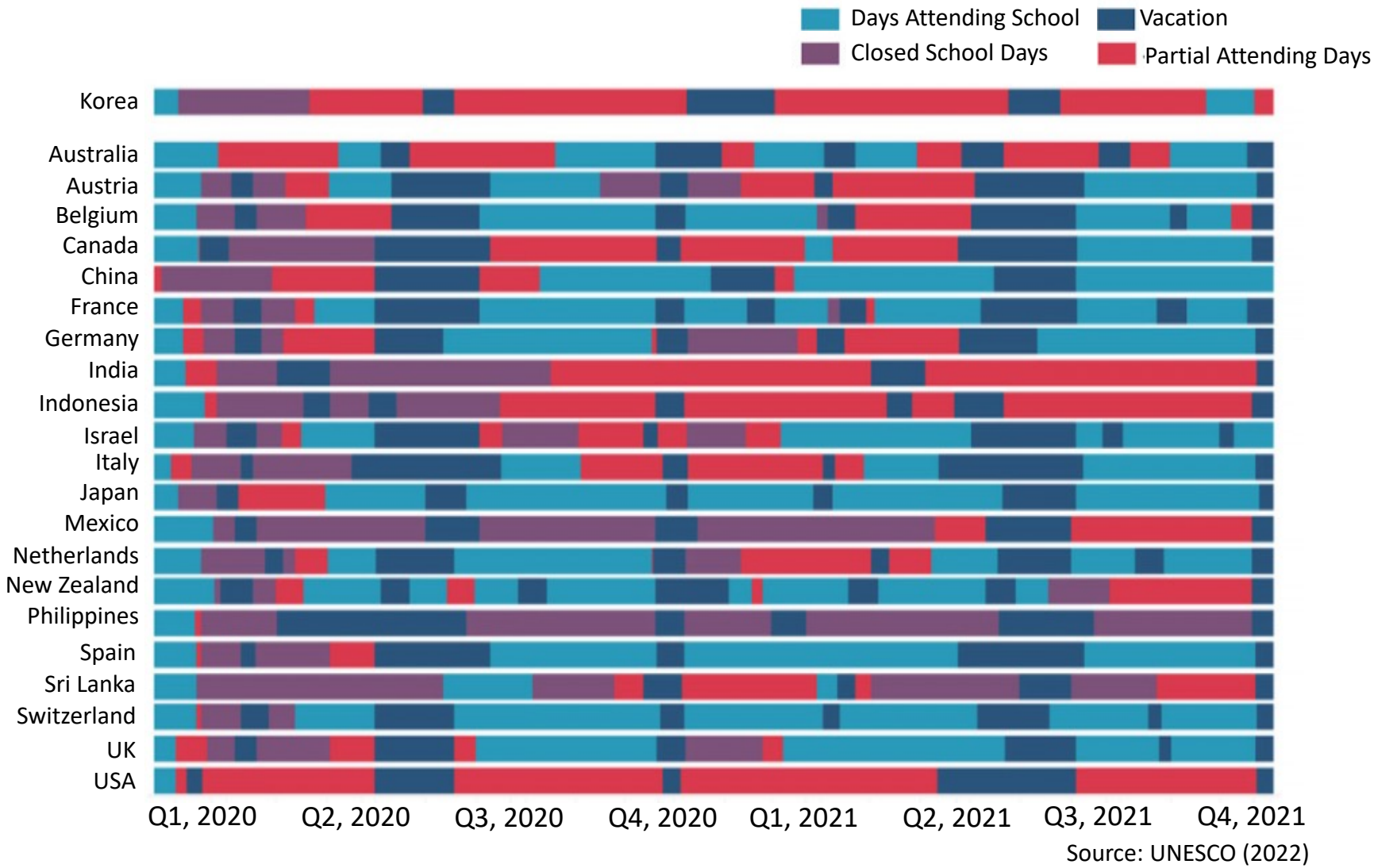
Introduction

- The outbreak of COVID-19 impacted a wide number of children and adolescents in their school-age

- If school closure leads to loss of education, it affects one's income and health and ultimately shortens life expectancy (Kenkel et al., 2006, Lleras-Muney, 2005).

- In Korea, high school students attended school on average 104 days in 2020, which is much less than the average of 190 days in 2019.
  - Compared to the previous year, students could not attend school for 86 days (approximately 17 weeks) on average.
  - Days attended school varied among schools, ranging from less than 50 days to more than 150 days.

Restriction on school days (2020-2021)



Source: UNESCO (2022)

Research objective

- We study the impacts of reduced in-person school days due to school closure in 2020 on the level and distribution of students' academic achievement among high school students in South Korea.

- South Korea provided an online education program during the period when the schools were closed.

  – Our estimates are the impacts of in-person school education compared to the online class.
  – The results observed in our setting are likely to be lower bound estimates, relative to a setting with limited alternative education.

Conceptual framework

- Students learn less when schools are closed
  - Summer learning loss (Cooper 2003)

- Whether school closure leads to loss of educational attainment varies by the quality of alternative education methods
  - The magnitude of school closure effect will depend on which alternative education one would've got instead of attending school (counterfactually).
  - European nations, where multiple studies are done, tend to have short school closure periods and a well-equipped online education system.
  - However, some countries (including Sri Lanka, Philippines, Mexico, and Indonesia) lack online education availability. Many families are not equipped with TVs or radios either.

Conceptual framework

- The loss of education attainment will be concentrated to a specific group
  - Highly educated and high-income individuals are much more likely to be able to work from home (Yasenov (2020) and Bick et al., (2020))

- Available substitutes (e.g. tutoring) may differ by socioeconomic status, which has distributional consequences

Related literature

- Most studies compare the student achievement before and after the pandemic (See Svaleryd & Vlachos 2022 for a review)
  - Maldonado and De Witte (2021): 9 weeks of closure (Belgium grade 6). Loss in test score by 0.17-0.19 SDs. Learning inequalities increased within/between schools.
  - Engzell et al. (2021): 8 weeks of closure (Dutch grades 4-7). Using diff between mid- and end-year test results 2020 relative to the same diff in during 2017-2019, find a decrease in test score by 0.08 SDs. Closure also increased the socio-economic gradients in learning outcomes.

- First study to examine the effect of school closure in Korea

- Lack of evidence using the actual school attendance days in 2020 to examine the *marginal* impact of an additional day of school closures
  - Hard to disentangle the effect of the overall pandemic from the decreased number of schooling days

Data

- National Assessment of Educational Achievement (NAEA)
- High school students in grade 2, 2015-2020
  - Entire 11th graders (High school grade 2) in 2015-16
  - A sample of 3% for 2017-20
    - Apply the weight of 33.3 (=1/0.03) for 2017-2020
  - Assessed June in 2015-19. November in 2020
  - Specialized schools (in science and foreign language) and international schools are excluded (about 2.76%)

- Test score and student survey (from KICE) merged with school attendance days in 2020 for each school

Comparison between full sample vs. sample in 2020 (School days)

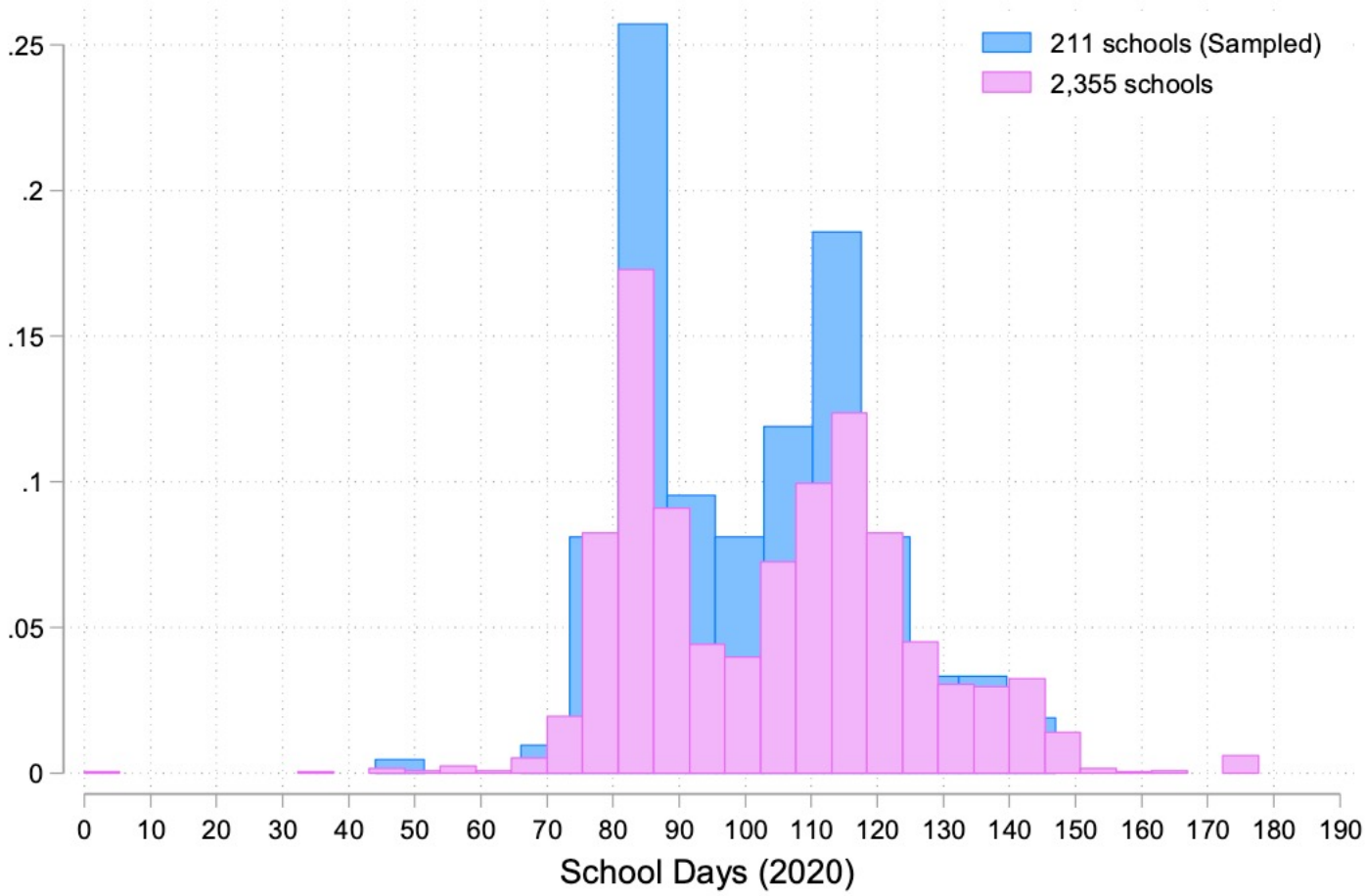
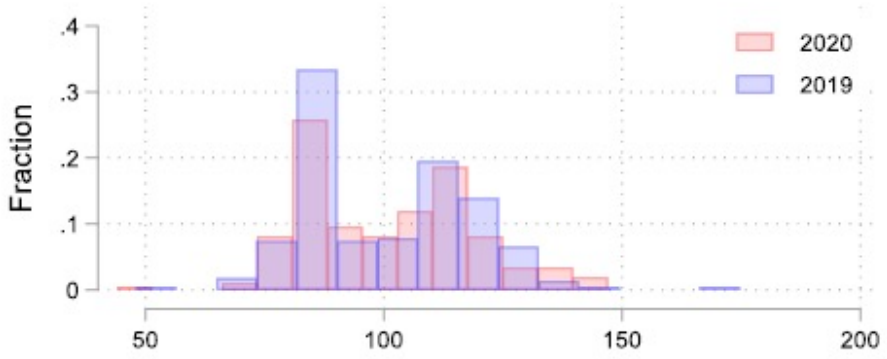
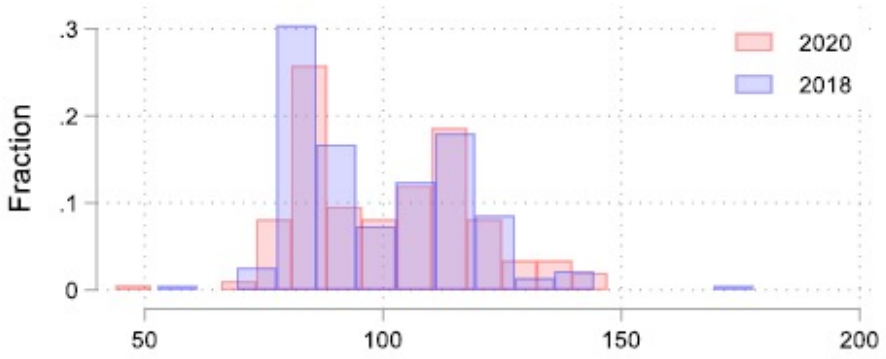
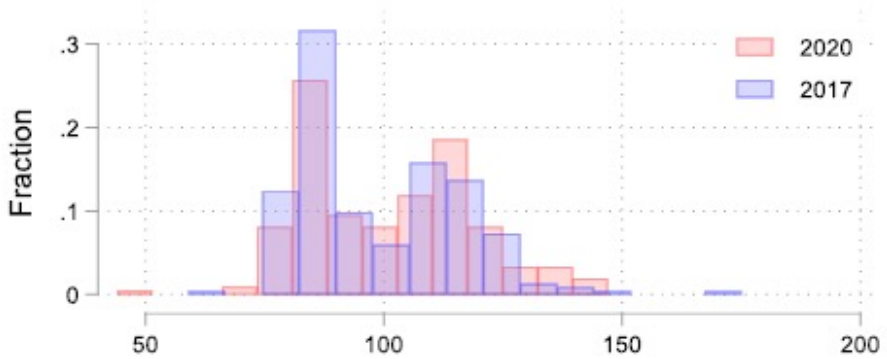
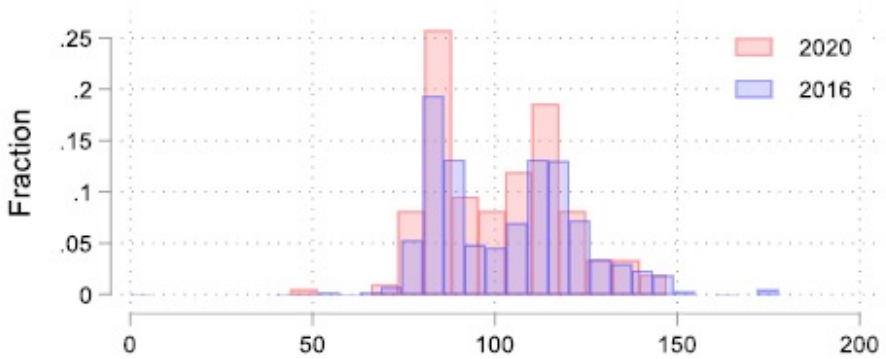


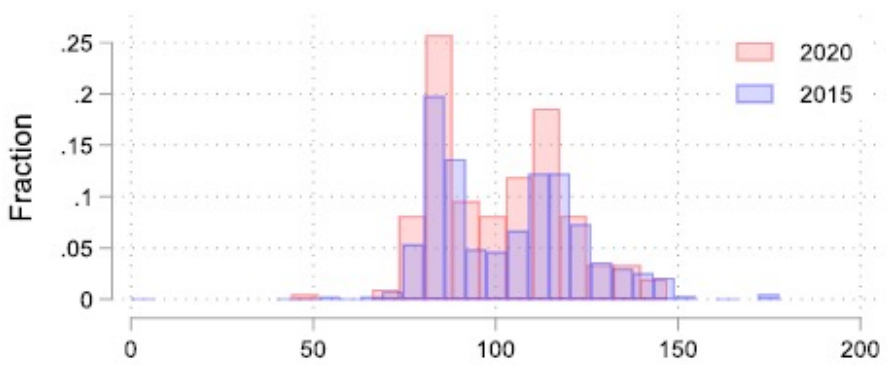
Figure A2: Distribution of school days











Empirical strategies

$$Y_{ist} = \sum_{\substack{\tau=2015 \\ \tau\neq 2019}}^{\tau=2020} \beta_\tau \, 1[t=\tau] \times SchoolDays_s + \lambda \, SchoolDays_s + \theta \, X_{ist} + \gamma_j + \delta_t + \varepsilon_{it}$$

- Even within the region, school days differ by school in 2020
- Full event-study: Control for the unobserved difference in school between those who had greater attendance days vs. not in 2020 by using the difference in earlier years. Can offer test for pre-trends.
- Y_{ist} is the outcome of interest for student i, school s, year t
- $SchoolDays_s$: School attendance day in 2020 for school s, divided by 10
- γ_j: 58 Living zone (LZ) fixed effects (similar to commuting zone in the U.S.)
- δ_t: Year fixed effects
- X: student gender, school type (autonomous, single-sex, public), confirmed Covid-19 cases (Si/gun/gu), dummies for metropolitan, small towns, and rural
- Standard errors are clustered by LZs. Reference year: 2019

Outcome of interests

- Standardized test score for Korean, Math, English
  - Standardized by each subject and year to account for difference in difficulty levels across subjects and years
- Indicator for high, middle and low grades
  - High (low) grade is defined by having a test score higher (lower) than 1.5 SDs of the average. About top 4-8% (bottom 4-8%)
- Other educational outcomes (school life, career aspiration, and study behavior, etc)

What causes variations in school days?

- The number of school days in Korea in 2020 was 104 days on average at the high school level, which was 86 days (about 17 weeks) less than the school days of previous years (190 days).

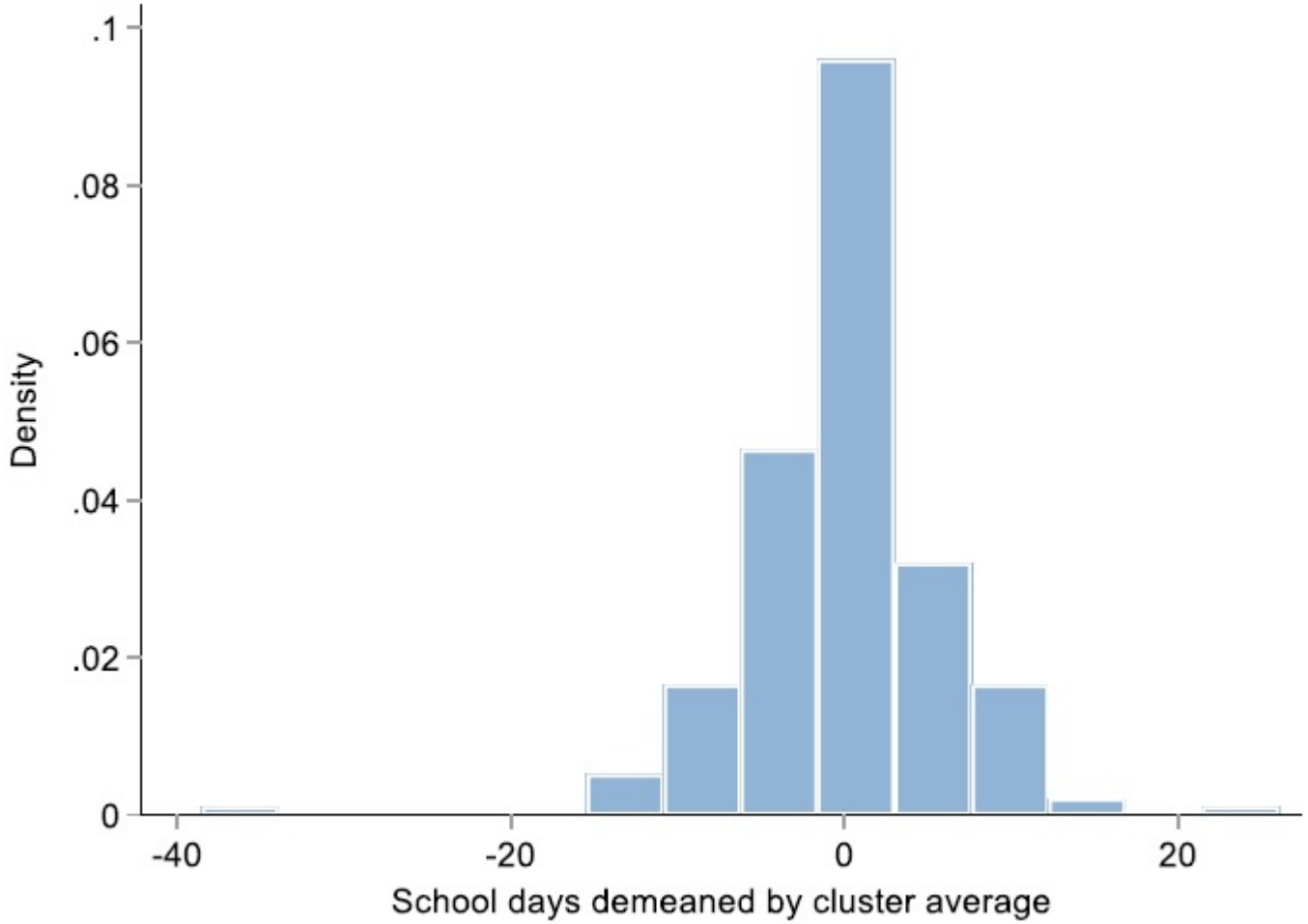
- School closure days during the pandemic differed significantly across regions level, and even within the regions.

- Sources of across- and within-district variation include: 1) confirmed COVID-19 positive cases within the school, 2) the social distancing policies at the regional level, 3) class size and density, 4) school size, 5) discretion of principals, and 6) superintendents and disease control authorities.

	(1) Without region FEs	(2) With region FEs
Parent's education (College diploma or higher)	15.55	1.346
	(11.89)	(7.462)
Parent's education (High school diploma)	-5.395	-3.694
	(15.46)	(8.541)
Proportion of female students	9.621	-4.782
	(9.628)	(6.007)
Number of Students	-0.108***	-0.0337***
	(0.0221)	(0.00823)
Public School	-1.849	1.680
	(2.635)	(1.798)
Autonomous School	1.672	-2.347
	(6.216)	(3.682)
Public*Autonomous Dummy	-4.523	-0.352
	(6.944)	(3.933)
Female School	-0.677	1.311
	(5.539)	(3.383)
Male School	8.196	-2.159
	(5.568)	(3.462)
Metropolitan City	-10.57**	6.034*
	(4.408)	(3.231)
Small town	-4.844	-1.650
	(3.546)	(1.736)
COVID-19 cases	-0.00981	-0.00311
	(0.00973)	(0.00272)
Observations	209	209
R-squared	0.363	0.906

Demeaned school days (by LZ fixed effects)

Figure A2: School days



Results on test score

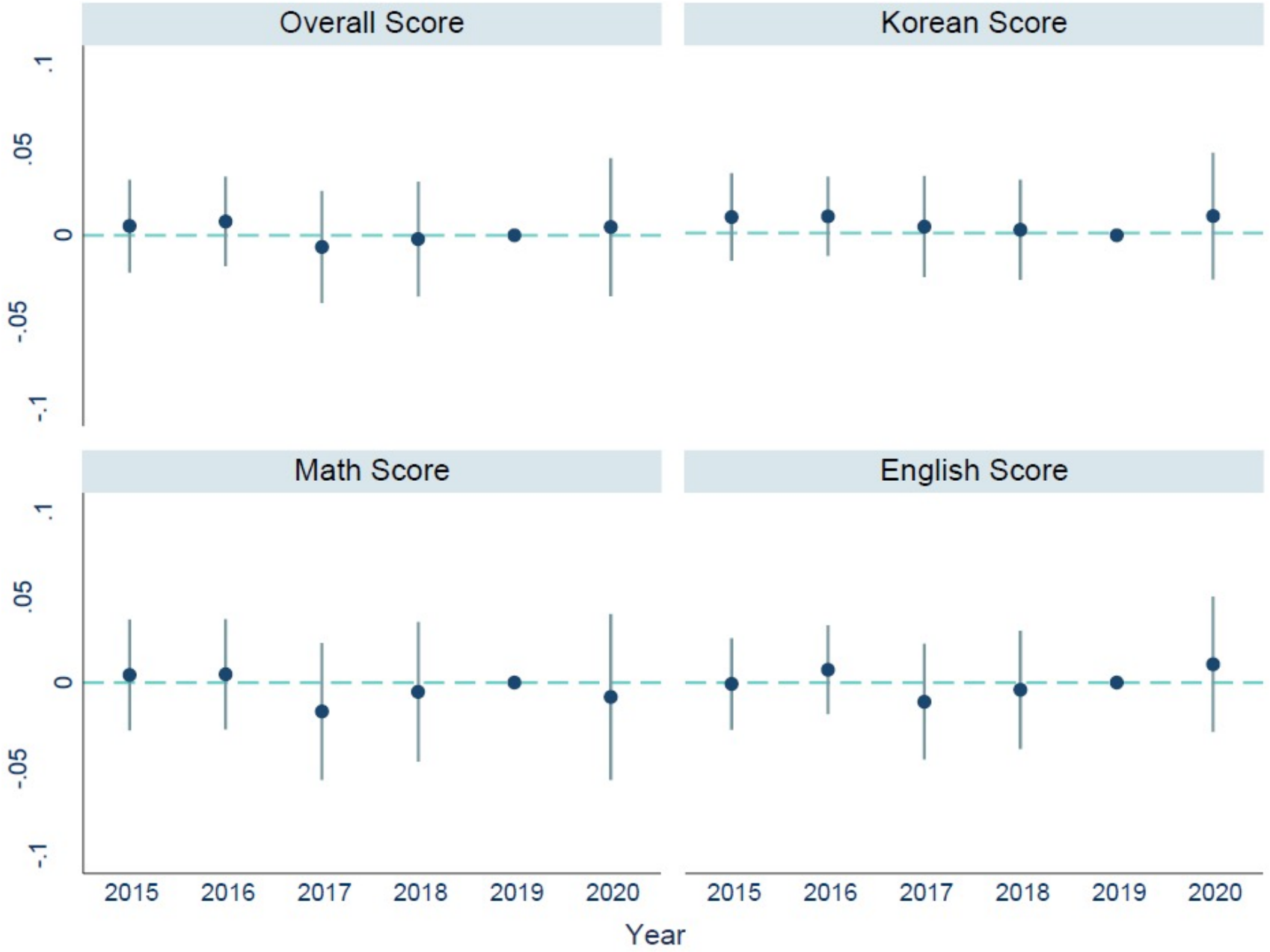
- No evidence that school days affect average test score in Korean, Math, and English
  - The coef. estimate is small and not statistically significant

Variables	(1) Overall score	(2) Korean score	(3) Math score	(4) English score
School days × 2020	0.008	0.016	-0.004	0.015
	(0.023)	(0.021)	(0.027)	(0.022)
	[0.721]	[0.469]	[0.872]	[0.506]
		{1.000}	{1.000}	{1.000}
Observations	893,955	892,925	891,656	893,476
R-squared	0.109	0.097	0.080	0.098

Traditional p-value

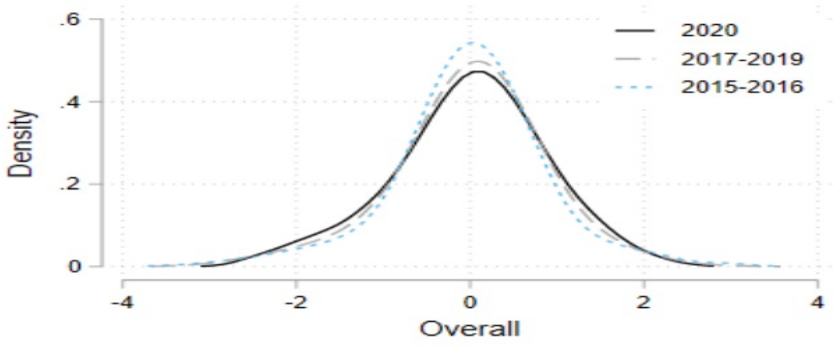
False Discovery Rate (FDR) q-value (Anderson 2008)

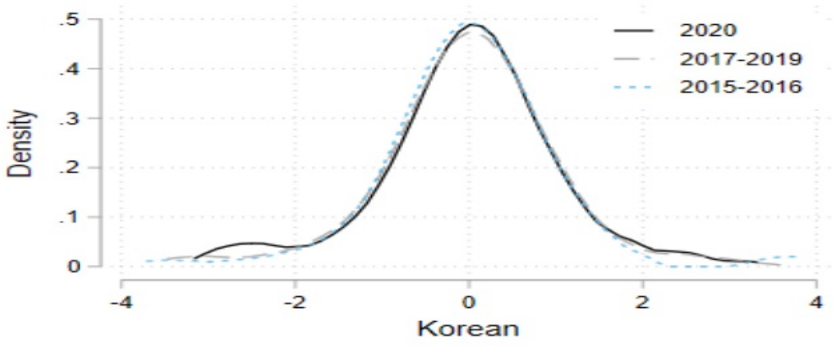
Figure 2: Effect of School Days on Standardized Test Scores

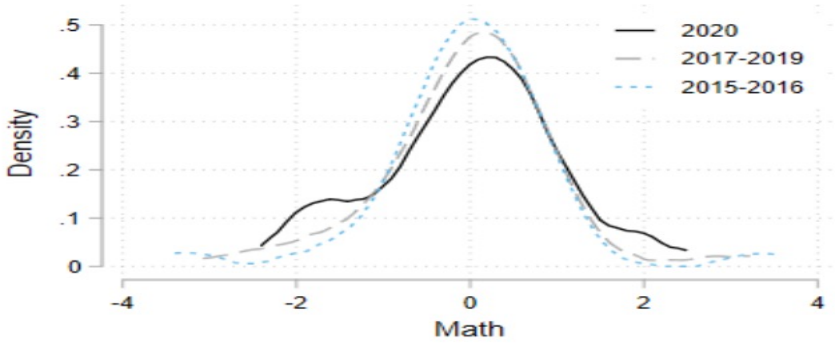


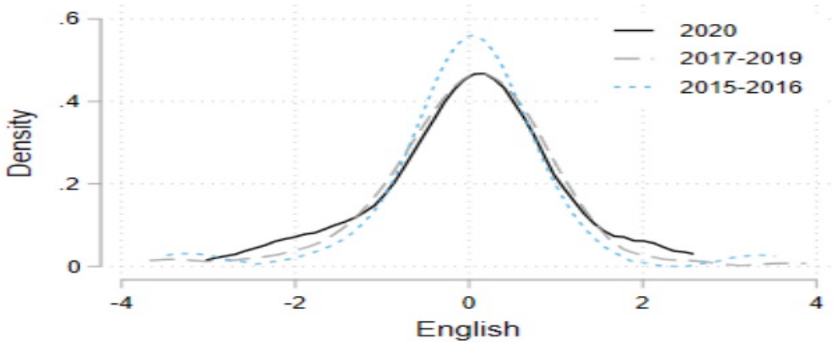
Distribution of test score

- The increase in inequality is observed in 2020, particularly for the bottom tail of the distribution.
  - Could be due to overall effect of the pandemic, rather than the school closure.
  - Investigate whether the school days affect the inequality of test score

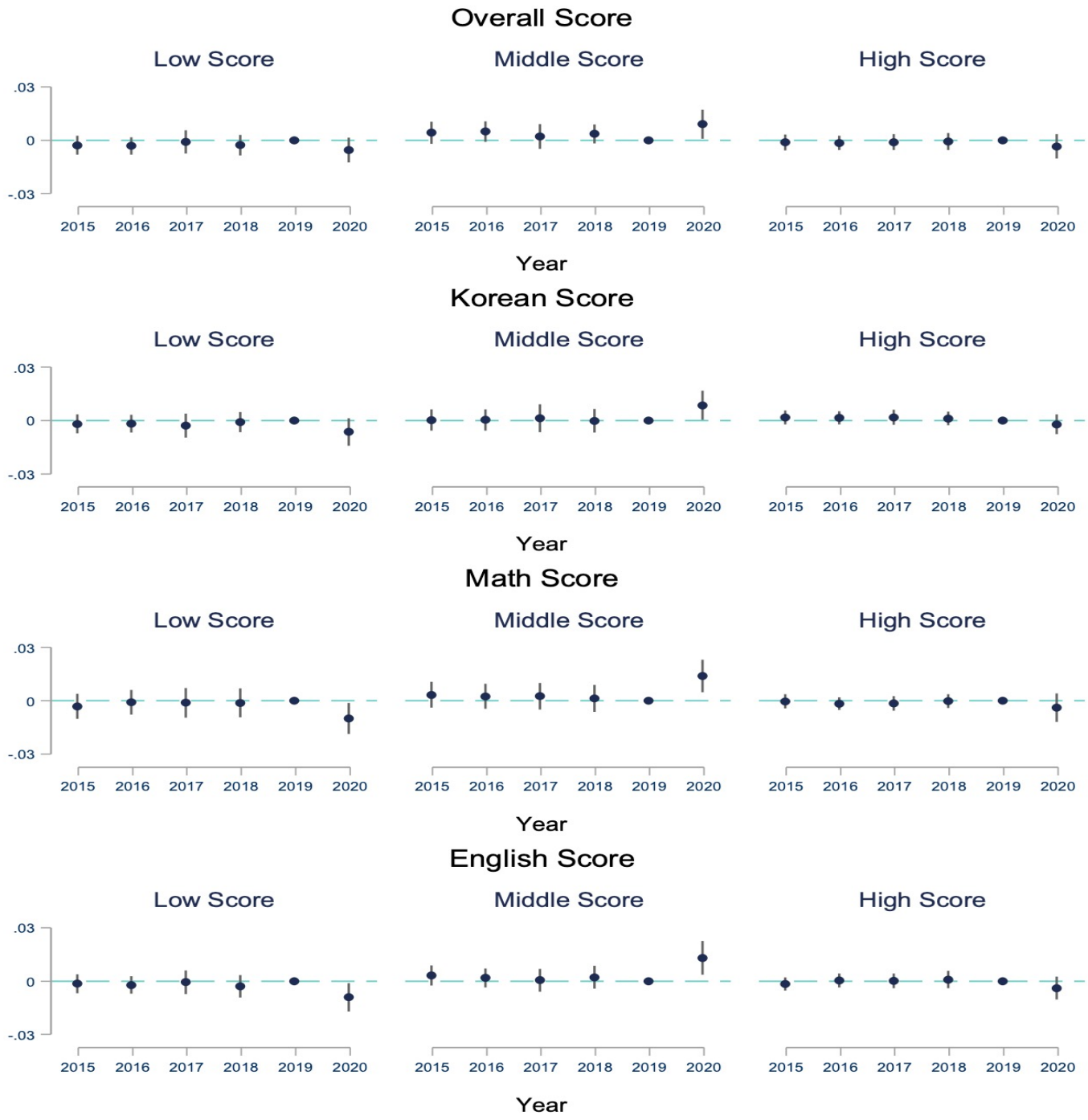








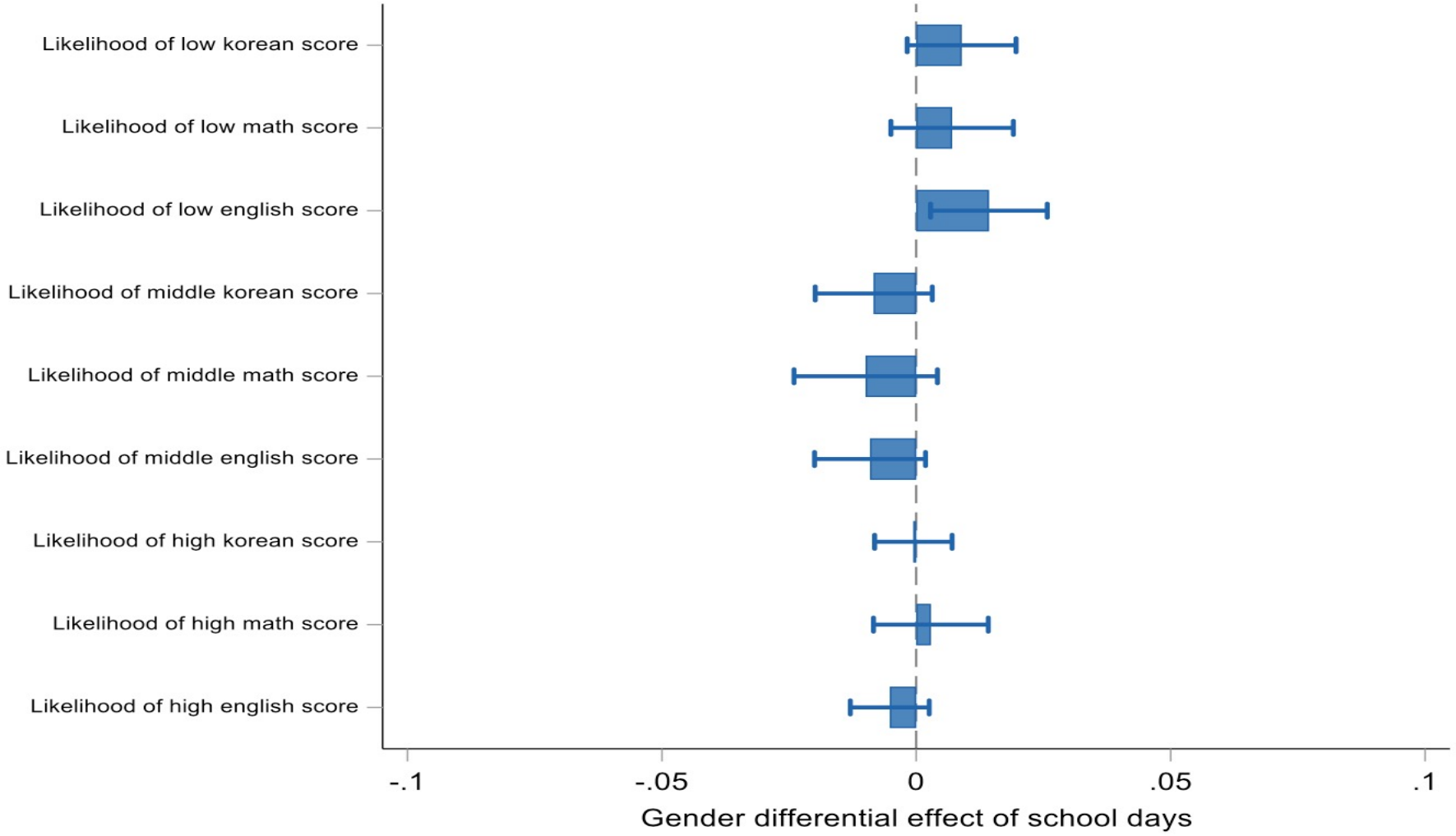
	(1) Overall score	(2) Korean score	(3) Math score	(3) English score
		Panel A: P(Score ≤ -1.5 SDs)		
School days× 2020	-0.006 (0.004) [0.172]	-0.006 (0.005) [0.162] {0.090}	-0.010* (0.005) [0.053] {0.090}	-0.009* (0.005) [0.055] {0.090}
Mean of dep. variable	0.057	0.060	0.071	0.062
R-squared	0.040	0.043	0.031	0.041
		Panel B: P(-1.5 SD ≤ Score ≤1.5 SDs)		
School days× 2020	0.009* (0.005) [0.065]	0.009* (0.005) [0.086] {0.036}	0.014** (0.005) [0.013] {0.036}	0.013** (0.006) [0.023] {0.036}
Mean of dep. variable	0.901	0.900	0.889	0.892
R-squared	0.025	0.020	0.032	0.030
		Panel C: P(1.5 SDs≤ Score)		
School days× 2020	-0.003 (0.004) [0.398]	-0.002 (0.003) [0.539] {1.000}	-0.004 (0.005) [0.428] {1.000}	-0.004 (0.004) [0.303] {1.000}
Mean of dep. variable	0.0422	0.0406	0.0401	0.0458
R-squared	0.035	0.024	0.032	0.039
Observations	893,955	892,925	891,656	893,476


Overall Score
Low Score
Middle Score
High Score
.03
0
-.03
2015
2016
2017
2018
2019
2020
Year
Korean Score
Low Score
Middle Score
High Score
.03
0
-.03
2015
2016
2017
2018
2019
2020
Year
Math Score
Low Score
Middle Score
High Score
.03
0
-.03
2015
2016
2017
2018
2019
2020
Year
English Score
Low Score
Middle Score
High Score
.03
0
-.03
2015
2016
2017
2018
2019
2020
Year

Effect of school days by parental education (using 2018-2020 only)

Variables	Highly Educated Parents (College Diploma or Higher)				Less Educated Parents (High school Diploma or Lower)			
	(1) Overall score	(2) Korean score	(3) Math score	(4) English score	(5) Overall score	(6) Korean score	(7) Math score	(8) English score
School days× 2020	0.007	0.015	-0.006	0.013	0.035	0.044*	0.018	0.042*
	(0.021)	(0.021)	(0.025)	(0.019)	(0.023)	(0.025)	(0.025)	(0.025)
	[0.738]	[0.471]	[0.805]	[0.495]	[0.125]	[0.082]	[0.472]	[0.100]
		{1.000}	{1.000}	{1.000}		{0.177}	{0.187}	{0.177}
Triple diff p-value	0.168	0.151	0.279	0.240	0.168	0.151	0.279	0.240
Mean of dep. variable	0.173	0.150	0.170	0.201	-0.215	-0.158	-0.214	-0.268
Observations	21,232	21,198	21,215	21,214	6,454	6,432	6,442	6,448
R-squared	0.097	0.090	0.074	0.087	0.088	0.086	0.066	0.082

Heterogeneous effect by gender: Diff in coeff (female – male)



School participation and satisfaction

Panel A: Effect on School Participation and Satisfaction				
Variables	(1) Participation in Class [0~1]	(2) Satisfaction in Studying [0~1]	(3) Career Concern [0~1]	(4) Study Behavior [0~1]
School days × 2020	0.009*** (0.003) [0.004] {0.007}	0.009*** (0.002) [0.00001] {0.001}	0.005** (0.002) [0.037] {0.026}	0.002 (0.004) [0.650] {0.196}
Mean of dep. variable	0.757	0.855	0.800	0.753
SD of dep. variable	0.261	0.202	0.264	0.337
Observations	891,801	889,715	891,200	891,123
R-squared	0.020	0.008	0.011	0.028

"Participation" is created by taking the average of the several dummies, where each dummy variable takes value 1 if the student "strongly agree" or "agree", and 0 if "strongly disagree" or "disagree" to the following questions.

(1) the student takes good care of the study materials and supplies necessary for class
(2) the student tends to focus in class
(3) the student asks questions in class
(4) the student actively participates in class activities such as discussion and lab experiments

Example

수업참여도	나는 수업에 필요한 학습 자료, 준비물 등을 잘 챙긴다 나는 수업 시간에 집중하는 편이다 나는 수업에서 배울 내용을 미리 예습한다 나는 수업에서 배운 내용을 복습한다 나는 수업 내용과 관련하여 선생님께 질문을 잘 하는 편이다 나는 수업 시간에 토론, 모둠활동, 실험 실습 등에 적극적으로 참여한다
학업만족도	우리 학교에는 나를 인정해주는 선생님이 계신다 우리 학교에는 나에게 관심을 갖고 따뜻하게 대해주는 선생님이 계신다 나는 학교에서 친구들과 잘 어울려 지낸다 나는 학교에 속마음을 이야기할 수 있는 친구가 있다 나는 학교생활을 잘 하고 있다 나는 학교에 가는 것이 즐겁다 나는 학교를 다니면서 내 자신이 계속 나아지고 있다고 생각한다 내 친구들은 내가 도움이 필요할 때 나를 도와준다
진로 고민	나는 장래에 어떤 일을 하고 싶은지 분명한 목표가 있다 나는 교과 공부, 취미 생활, 봉사 활동 등을 통해 나의 흥미나 적성이 무엇인지 잘 알고 있다 나의 진로를 선택할 때 주위 사람(부모님, 선생님, 형제자매 등)의 생각보다 내 의지가 가장 중요하다 나는 진로를 선택하기 위해 필요한 정보(적성과 흥미, 필요한 공부, 자격증 등)를 스스로 찾는다 나는 내가 관심 있는 분야에 구체적으로 어떤 직업들이 있는지 잘 알고 있다 나는 여러 직업의 장점과 단점을 파악하여 진로를 결정할 수 있다

Figure 4: Effect of School Days on School Participation and Satisfaction

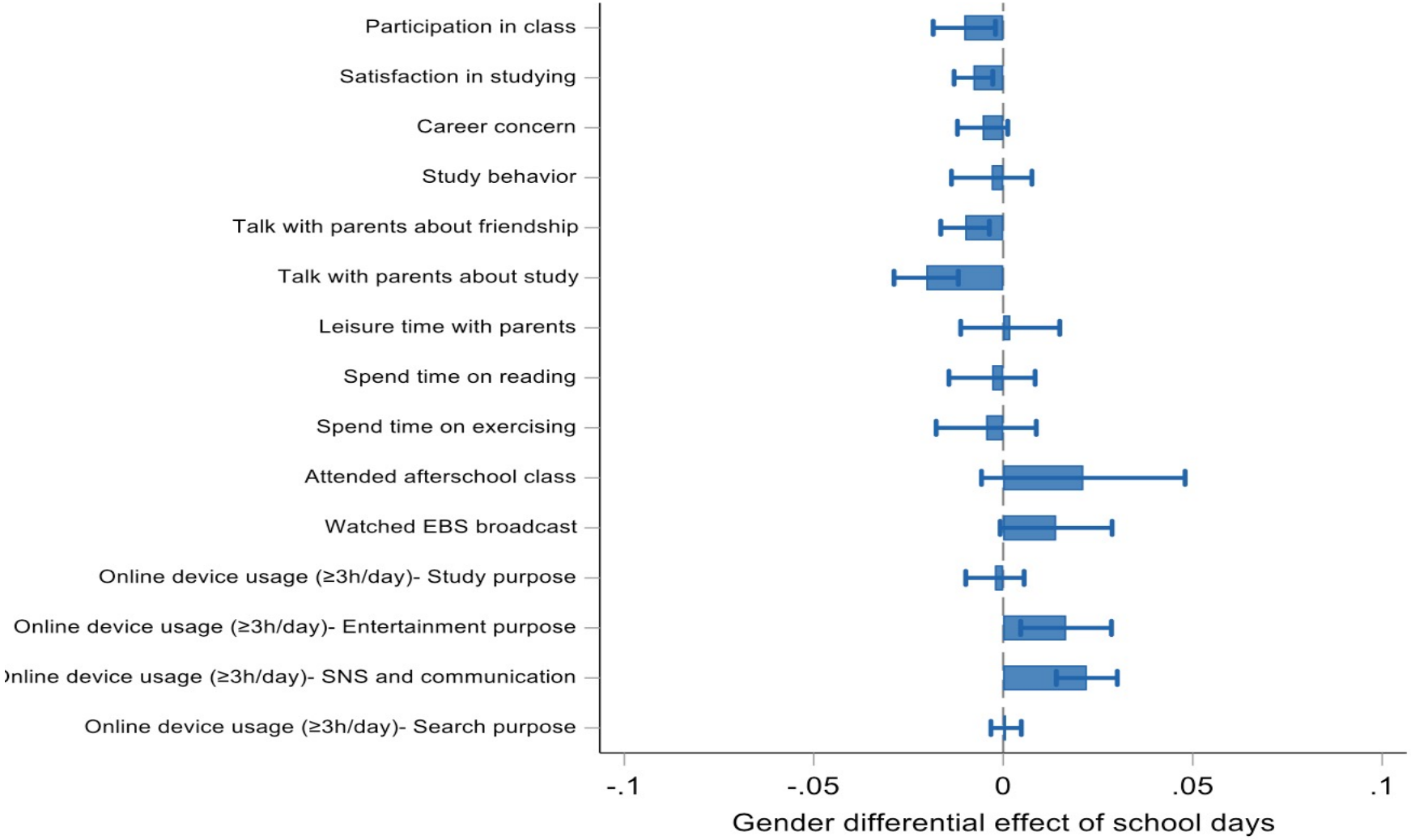
Effects on time use

Panel B: Effect on Time Management							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Talk with parents about friendship (≥ once a week)	Talk with parents about study (≥ once a week)	Leisure time with parents (≥ once a week)	Spend time on Reading (≥ 30 min /day)	Spend time on Exercising (≥ 30 min /day)	Attended Afterschool Class [binary]	Watched EBS Broadcast [binary]
School days × 2020	-0.001	0.002	-0.002	-0.005	-0.003	-0.007	0.010*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.015)	(0.005)
	[0.766]	[0.680]	[0.647]	[0.128]	[0.154]	[0.658]	[0.056]
	{0.779}	{0.779}	{0.779}	{0.561}	{0.561}	{0.779}	{0.561}
Mean of dep var	0.813	0.746	0.305	0.236	0.563	0.504	0.342
SD of dep var	0.390	0.435	0.461	0.424	0.496	0.500	0.474
Observations	892,498	892,408	892,285	892,385	892,039	883,941	884,588
R-squared	0.016	0.013	0.013	0.009	0.103	0.251	0.030

Effects on online device usage

Panel C: Effect on Online Device Usage								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Study (≥ 1 hour/day)	Entertainment (≥ 1 hour/day)	SNS (≥ 1 hour/day)	Search (≥ 1 hour/day)	Study (≥ 3 hour/day)	Entertainment (≥ 3 hour/day)	SNS (≥ 3 hour/day)	Search (≥ 3 hour/day)
School days × 2020	-0.012*	0.005	-0.002	-0.003	-0.007**	-0.005	-0.003	-0.001
	(0.007)	(0.005)	(0.007)	(0.004)	(0.003)	(0.004)	(0.003)	(0.001)
	[0.078]	[0.318]	[0.816]	[0.385]	[0.015]	[0.224]	[0.386]	[0.453]
	{0.454}	{0.627}	{1.000}	{0.627}	{0.064}	{0.507}	{0.515}	{0.515}
Mean of dep var	0.365	0.666	0.553	0.274	0.045	0.160	0.116	0.025
SD of dep var	0.482	0.472	0.497	0.446	0.207	0.367	0.320	0.157
Observations	49,174	49,250	891,938	891,856	49,174	49,250	891,938	891,856
R-squared	0.030	0.047	0.041	0.008	0.013	0.029	0.025	0.004

Heterogeneous effect by gender: Diff in coeff (female – male)



Conclusion

- This study examines the academic gap between students who had a relatively high number of school days during the pandemic and those who did not.
- The decrease in the number of school days did not significantly change the average grade. However, the decrease in the number of school days increased the inequality in academic achievement.
- A decrease in the number of school days negatively affects school satisfaction.
- The effect of the reduction in the number of school days in 2021 was not reflected in the results of this study. Reflecting this, the negative effect of school restrictions is expected to be greater.

Thank you !

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