The Impact of Extracurricular Tutoring Time Investment on Academic Performance of Secondary School Students: An Empirical Analysis Based on PISA2015 Data of Four Provincial Administrative Regions in China

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Abstract*: We use the Hierarchical Linear Model to analyze the current state of extracurricular tutoring time for secondary school students and its impact on academic performance using PISA2015 data from four provincial administrative regions in China. The study discovered that the effect of extracurricular tutoring time on academic performance is a non-linear relationship that initially declines and then increases, indicating that subject-specific tutoring have a threshold effect. When tutoring time exceeds a certain threshold, academic performance improves qualitatively. However, when mathematics tutoring time exceeds a certain threshold, the gap in mathematics scores between students from different family backgrounds widens, resulting in educational inequality. The effect of school curriculum time on student achievement is a non-linear relationship that begins with an increase and then declines. When compared to off-campus tutoring time, in-school curriculum time can more effectively improve student academic performance.*

Song & Xue. (China). Extracurricular Tutoring and Performance in Secondary School.

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Conflict of Interests: *None*

Introduction

EXTRACURRICULAR tutoring, dubbed "shadow education" in international academic circles (Bray, 1999), has grown rapidly in China's urban and rural areas over the last two decades, with approximately 200,000 extracurricular tutoring institutions, 137 million students enrolled in tutoring, and 7-8.5 million teachers employed by tutoring institutions (Yang, 2018). With the implementation of the balanced compulsory education policy and the burden reduction policy, the time spent in school by primary and secondary school students has been reduced significantly, while after-school homework has been significantly reduced, and after-school time has been significantly increased. This incentivizes an increasing number of compulsory education students to engage in extracurricular tutoring after school and during the holidays in order to enhance their academic performance or develop their talents in order to gain an advantage in future competition for higher education or employment, thereby expanding the on-campus competition to off-campus tutoring institutions (Xue & Li, 2016).

Learning time is critical in educational activities, and extracurricular tutoring time is becoming an increasingly significant part of students' learning time. However, nothing is known about the effect of students' extracurricular tutoring time on their academic achievement. Therefore, who devotes the most time to after-school tutoring? How does extracurricular tutoring time affect kids' academic performance? Is spending more time on extracurricular tutoring beneficial? Does the discrepancy in the amount of time spent on extracurricular tutoring by secondary school students exacerbate the inequality in educational outcomes? To address the above questions, we use the results of the 2015 Program for International Student Assessment (PISA) in Beijing, Shanghai, Jiangsu, and Guangdong to examine the current state of secondary school students' tutoring time and the impact of tutoring time investment on academic achievement using statistical descriptions and a hierarchical linear model. We then make recommendations based on the findings of the study.

A Literature Review

Studies conducted in China and other countries have primarily focused on the influence of extracurricular tutoring on academic attainment, with varying conclusions (Byun, 2014; Lee, 2013; Zhang et al., 2015; Hu et al., 2015; Xue, 2016). Fewer studies have been undertaken on the time commitment of students to extracurricular tutoring and its effect on academic progress. Although some experts have researched the association between extracurricular tutoring time and student progress, their conclusions are inconsistent (Song & Xue, 2017). Several studies have discovered a positive effect on academic attainment of students' extracurricular tutoring time commitment. Liu (2012) discovered that tutoring has a considerable favorable influence on students' reasoning and deductive abilities and mathematics achievement, but that this benefit diminishes with increasing tutoring duration. Fang et al. (2018) discovered a statistically significant

favorable effect of tutoring time spent on primary school students' achievement. More-over, several studies have discovered that extracurricular tutoring time commitment has a detrimental influence on academic attainment. Shen (2014) discovers a negative link between students' extracurricular tutoring time and their mathematical performance. Additionally, Hao (2016) observed a negative association between tutoring duration and math achievement.

Other studies have discovered a nonlinear link between the time spent on extra-curricular tutoring and academic attainment. Li et al. (2016) observed a non-linear asso-ciation between extracurricular tutoring time and academic achievement, with an initial increase and later a decrease. Specifically, students who receive 0-3 hours and 3-6 hours of tutoring per week demonstrate a significant upward trend in academic achievement when compared to students who do not receive extracurricular tutoring, while students who receive 6-8 hours of tutoring per week demonstrate a slight decline in academic performance, and students who receive more than 8 hours of tutoring per week demon-strate a significant decline in academic achievement. Ma and Zheng (2017) discovered that extracurricular tutoring time has a considerable effect on students' academic devel-opment, but only when a particular threshold level is exceeded can a qualitative gain in academic achievement occur. According to Hu et al. (2017), mathematics tutoring time has a significant favorable influence on the academic accomplishment of Korean sec-ondary school students in mathematics, but has a significant detrimental effect on the mathematics literacy scores of Hong Kong secondary school students. Additionally, mathematics tutoring time has a considerable positive influence on the mathematical literacy scores of Japanese secondary school pupils, indicating a non-linear relationship.

The majority of recent studies focus on the overall status of extracurricular tu-toring and its relationship to academic accomplishment, and the conclusions are incon-sistent. There are few studies that focus exclusively on extracurricular tutoring time. Simultaneously, few researchers have investigated the topic of how discrepancies in extracurricular tutoring time amongst students from diverse family origins result in dif-ferences in academic achievement, which leads to educational inequality and even edu-cational equity (Xue & Song, 2018). To address this gap, this study undertakes pertinent research on extracurricular tutoring time and systematic investigations into the dispari-ties in students' extracurricular tutoring time investments in various subjects and their impacts on academic achievement, followed by a detailed analysis. Additionally, the impact of extracurricular tutoring time on educational equity is discussed in order to broaden the scope of extracurricular tutoring studies.

Methodology

Variable and Data Source Description

The data for this study came from the Organization for Economic Cooperation and De-velopment's (OECD) 2015 PISA results. PISA is a triennial assessment that aims to enhance educational policies and the quality of education in a country through world-

Table 1. Variable Description.

Variable Type	Variable (Abbr.)	Description
Dependent Variable	Science Literacy Scores (SCILS)	Continuous Variable, Means of the Plausible value (1-10) in Science, Mathematics, or Reading
	Mathematics Literacy Scores (MATLS)	
	Reading Literacy Scores (REALS)	
Independent Variable	**Student Level**	
	Science Extracurricular Tutoring Time (SCIETT)	Continuous Variable, Hours per Week
	Mathematics Extracurricular Tutoring Time (MATETT)	
	Chinese Extracurricular Tutoring Time (CHIETT)	
	Gender (GE)	0=Female, 1=Male
	Schooling Stage (SS)	0=Middle School; 1=High School
	Self-Educational Expectations (SEE)	Classified by ISCED standard education level
	Index of Economic, Social and Cultural Status (ESCS)	Continuous Variable
	School Level	
	Science Curriculum Time (SCICT)	Continuous Variable, Hours per Week
	Mathematics Curriculum Time (MATCT)	
	Chinese Curriculum Time (CHICT)	
	School Location (SL)	0= Rural Area; 1=County/town Area; 2=Urban Area
	School Ownership (SO)	0=Private; 1=Public
	Class Size (CS)	Continuous Variable
	Student-Teacher Ratio (STR)	Continuous Variable
	Shortage of Educational Material (SEM)	Continuous Variable
	Index Proportion of all Teachers Fully Certified (PTFC)	Continuous Variable

wide comparisons. PISA 2015 examined a total of 9,841 schoolchildren from 268 schools in Beijing, Shanghai, Jiangsu, and Guangdong. Science was the primary subject, while reading and mathematics were secondary. This study uses data from the PISA2015 student and school questionnaires. **Table 1** lists the variables used in this investigation.

Research Methods

The academic performance of students is influenced by a variety of factors, including school, classroom, individual, and family. Due to the layered nature of the PISA data, this study employs a hierarchical linear model to examine the effect of secondary school

students' extracurricular tutoring time investment on academic achievement. The Hierarchical Linear Model is capable of examining random mistakes across variables from various schools while also conceiving the cross-level data structure, showing the true intrinsic link between the variables.

Zero Model

The zero model has no explanatory variables at the student or school level. It focuses on the individual and contextual differences within the sample under investigation. The zero model is used to calculate the academic performance of each subject for a student i-th attending school j-th (Zhou & Wu, 2008). :

$$\text{Student level: } Y_{ij} = \beta_{0j} + e_{ij}, \; e_{ij} \sim N(0, \delta^2) \tag{1}$$
$$\text{School level: } \beta_{0j} = \gamma_{00} + u_{0j}, \; u_{0j} \sim N(0, \tau_{00}) \tag{2}$$

j denotes a school, i denotes a secondary school student, Y_{ij} denotes the academic performance of secondary student i-th in school j-th, B_{0j} denotes the average academic performance of secondary students in school j, and e_{ij} denotes the student-level random error, defined as the difference between the academic performance of secondary student i-th in school j-th and the school's average performance. γ_{00} denotes the average academic performance of secondary students in each subject across all schools, and U_{0j} denotes the random error at the school level (Xue et al., 2011).

Full Model

A full hierarchical linear model is one in which explanatory or predictive factors are incorporated at the student and school levels of the linear model of student academic performance. This study employs a two-tiered model:

$$\text{Student level: } Y_{ij} = \beta_{0j} + \beta_{1j}\,GE + \beta_{2j}\,SS + \beta_{3j}\,SEE + \beta_{4j}\,ESCS + \beta_{5j}\,ETT + \beta_{6j}\,ETT^2 + \beta_{7j}(ETT*ESCS) + e_{ij}, \; e_{ij} \sim N(0, \delta^2) \tag{3}$$
$$\text{School level: } \beta_{0j} = \gamma_{00} + \gamma_{01}CT + \gamma_{02}CT^2 + \gamma_{03}SL + \gamma_{04}SO + \gamma_{05}CS + \gamma_{06}CS^2 + \gamma_{07}STR + \gamma_{08}SEM + \gamma_{09}PTFC + u_{0j}, \; u_{0j} \sim N(0, \tau_{00}) \tag{4}$$

Results

The Group Differences in Extracurricular Tutoring Time Investment among Secondary School Students

In China, the average weekly extracurricular tutoring time for secondary school students studying science is 2.24 hours, less than the OECD average (2.53 hours). Chinese students spend 3.56 hours per week tutoring in mathematics and 3.14 hours per week

Table 2. Analysis of the Differences in Extracurricular Tutoring Time Investment among Different Groups of Secondary School Students.

Variable Name		SCIETT		MATETT		CHIETT	
		Mean	T-test	Mean	T-test	Mean	T-test
GE	Female	2.22	-4.710***	3.38	-3.808***	2.92	-4.357***
	Male	2.60		3.73		3.34	
SS	Middle School	2.77	10.486***	3.96	9.835***	3.69	13.754***
	High School	1.94		3.02		2.38	
ESCS	Low SES[1]	2.38	-1.339	3.02	-5.048**	3.12	-3.140
	High SES	2.46		3.87		3.15	
SO	Private	2.49	0.703	3.74	1.397	3.28	1.180
	Public	2.40		3.52		3.10	

Note: 1.*, **, *** indicate significant at the level of 10%, 5%, and 1%, respectively

tutoring in the Chinese language, both of which are much more than the OECD average (3.03 hours and 2.61 hours). **Table 2** illustrates the group disparities in the amount of time spent on extracurricular tutoring by secondary school students. Girls spend 2.22, 3.38, and 2.92 hours per week on extracurricular tutoring in science, mathematics, and Chinese, respectively, significantly less than boys do (2.6, 3.73, and 3.34 hours); junior secondary school students spend 2.77, 3.96, and 3.69 hours per week on extracurricular tutoring in science, mathematics, and Chinese, respectively, significantly more than senior secondary school students do (1.94, 3.02, and 2.38 hours); students whose family socioeconomic status is lower than the average (referred to as "low SES" students)[1] spend 3.02 hours per week on mathematics extracurricular tutoring, which is significantly less than that of students (3.87 hours) with above-average family socioeconomic status (referred to as "high SES" students). High SES students receive 2.46 and 3.15 hours of extracurricular tutoring in science and Chinese language per week, respectively, which is comparable to the 2.38 and 3.12 hours received by low SES students. Students in private schools receive 2.49, 3.74, and 3.28 hours of extracurricular tutoring in science, mathematics, and Chinese language per week, respectively, while students in public schools receive 2.4, 3.52, and 3.10 hours of extracurricular tutoring per week, respectively, but none of the differences are statistically significant.

Regression Analysis

According to established guidelines for empirical judgment, an intraclass correlation coefficient (ICC) greater than 0.059 indicates significant inter-school variation, necessitating consideration of the between-group effect during statistical modeling treatment. The ICCs are all greater than 0.059 in the zero model of secondary school pupils' academic achievement in science, mathematics, and reading. As a result, it is important to

Table 3. Hierarchical Linear Model Analysis of the Effect of Science Extracurricular Tutoring Time Investment on the Science Literacy Score of Secondary School Students.

Variable	Model 1	Model 2	Model 3
Student Level			
SCIETT	-2.747*** (0.194)	-4.414*** (0.437)	-4.351*** (0.469)
SCIETT^2		0.187*** (0.030)	0.186*** (0.030)
SCIETT*ESCS			0.065 (0.174)
Female (Male as a Reference)	-16.292*** (1.320)	-16.221*** (1.319)	-16.209*** (1.320)
Middle school (High School as a Reference)	-25.124** (2.625)	-25.022*** (2.621)	-25.036*** (2.621)
SEE	17.876*** (0.493)	17.863*** (0.492)	17.863*** (0.492)
ESCS	1.812** (0.817)	1.841** (0.816)	1.689* (0.913)
School Level			
SCICT	7.466*** (0.479)	7.535*** (0.479)	7.529*** (0.479)
SCICT^2	-0.281*** (0.024)	-0.285*** (0.024)	-0.284*** (0.024)
SL	1.743 (1.904)	1.695 (1.894)	1.694 (1.894)
Private School (Public School as a Reference)	1.958 (7.154)	2.094 (7.118)	2.114 (7.118)
CS	5.015** (1.752)	4.965** (1.744)	4.963** (1.744)
CS^2	-0.058** (0.022)	-0.058** (0.022)	-0.058** (0.022)
STR	-0.096 (0.282)	-0.092 (0.281)	-0.092 (0.281)
SEM	-4.833** (1.618)	-4.830** (1.609)	-4.834** (1.609)
PTFC	69.264** (29.263)	68.914** (29.121)	68.915** (29.119)
Intercept	369.855*** (34.019)	371.952*** (33.855)	371.808*** (33.855)
Model Significance	0.000	0.000	0.000
Observed Value	7663	7663	7663

Note: 1.*, **, *** indicate significant at the level of 10%, 5%, and 1%, respectively. 2. Standard errors are in parentheses.

analyze the nested data using the Hierarchical Linear Model in order to precisely explore the correlations between variables (Zhou & Wu, 2008).

The Effect of Extracurricular Tutoring Time Investment on the Academic Performance of Secondary School Students

The effect of science extracurricular tutoring time[2] investment on secondary school students' science literacy scores is seen in **Table 3**. After controlling for other variables, Model 1 indicates that extracurricular tutoring time has a significant negative influence on students' science literacy scores; for every additional hour of science extracurricular tutoring time, students' science scores decline by around 2.7 points. Further analysis of

Table 4. Hierarchical Linear Model Analysis of the Effect of Mathematics Extracurricular Tutoring Time Investment on the Mathematics Literacy Score of Secondary School Students.

Variable	Model 4	Model 5	Model 6
Student Level			
MATETT	-2.408*** (0.154)	-5.355*** (0.401)	-5.650*** (0.427)
MATETT^2		0.192*** (0.024)	0.194*** (0.024)
MATETT*ESCS			0.280** (0.139)
Female (Male as a Reference)	-15.272*** (1.285)	-15.159*** (1.281)	-15.174*** (1.280)
Middle school (High School as a Reference)	-25.300*** (2.616)	-24.565*** (2.609)	-24.494*** (2.608)
SEE	19.288*** (0.476)	19.292*** (0.474)	19.290*** (0.474)
ESCS	2.576** (0.793)	2.733** (0.790)	3.736*** (0.933)
School Level			
MATCT	5.429*** (0.860)	5.457*** (0.856)	5.475*** (0.856)
MATCT^2	-0.304*** (0.046)	-0.316*** (0.046)	-0.316*** (0.046)
SL	-0.830 (2.129)	-0.960 (2.123)	-0.964 (2.123)
Private School (Public School as a Reference)	-2.320 (8.006)	-2.314 (7.984)	-2.379 (7.985)
CS	5.740** (1.958)	5.686** (1.952)	5.672** (1.951)
CS^2	-0.065** (0.025)	-0.064** (0.025)	-0.064** (0.025)
STR	-0.297 (0.309)	-0.296 (0.308)	-0.296 (0.308)
SEM	-4.201** (1.809)	-4.228** (1.804)	-4.201** (1.804)
PTFC	62.242*** (32.505)	61.430*** (32.418)	61.176*** (32.418)
Intercept	374.087*** (37.968)	379.613*** (37.873)	380.586*** (37.877)
Model Significance	0.000	0.000	0.000
Observed Value	8178	8178	8178

Note: 1.*, **, *** indicate significant at the level of 10%, 5%, and 1%, respectively. 2. Standard errors are in parentheses.

Model 2 (obtained by incorporating the quadratic term of science extracurricular tutoring time into Model 1) reveals that science extracurricular tutoring time has a significant nonlinear effect on students' science scores in the form of a U-shaped curve—in other words, science extracurricular tutoring has a negative effect on students' science scores when science tutoring time is less than 12 hours per week, but a positive effect when science tutoring time exceeds 12 hours per week. This implies that scientific extracurricular tutoring has a clear threshold impact, and it is difficult for science tutoring to have a clear influence on academic performance improvement in science without a significant time investment. This suggests that students must receive more than 12 hours of scientific tutoring per week (an average of more than 1.71 hours of science tutoring per day) in order to see a significant increase in their science performance.

Table 5. Hierarchical Linear Model Analysis of the Effect of Chinese Extracurricular Tutoring Time Investment on the Reading Literacy Score of Secondary School Students.

Variable	Model 7	Model 8	Model 9
Student Level			
CHIETT	-3.542*** (0.163)	-7.763*** (0.407)	-7.899*** (0.433)
CHIETT^2		0.288*** (0.026)	0.289*** (0.026)
CHIETT*ESCS			0.132 (0.145)
Female (Male as a Reference)	8.760*** (1.319)	8.497*** (1.309)	8.463*** (1.309)
Middle school (High School as a Reference)	-24.833*** (2.686)	-23.863*** (2.665)	-23.828*** (2.666)
SEE	17.195*** (0.485)	17.112*** (0.481)	17.116*** (0.481)
ESCS	4.741*** (0.813)	4.686*** (0.807)	5.098*** (0.924)
School Level			
CHICT	6.887*** (0.959)	6.788*** (0.952)	6.816*** (0.952)
CHICT^2	-0.374*** (0.054)	-0.384*** (0.054)	-0.386*** (0.054)
SL	1.412 (2.066)	1.193 (2.048)	1.186 (2.048)
Private School (Public School as a Reference)	1.468 (7.762)	1.001 (7.694)	0.946 (7.696)
CS	5.571** (1.904)	5.474** (1.887)	5.463** (1.887)
CS^2	-0.063** (0.024)	-0.062** (0.024)	-0.062** (0.024)
STR	-0.270 (0.302)	-0.269 (0.299)	-0.269 (0.300)
SEM	-4.763** (1.754)	-4.763** (1.739)	-4.755** (1.739)
PTFC	68.176*** (31.523)	64.521*** (31.249)	64.275*** (31.259)
Intercept	324.625*** (36.828)	335.837*** (36.519)	336.350*** (36.533)
Model Significance	0.000	0.000	0.000
Observed Value	7830	7830	7830

Note: 1.*, **, *** indicate significant at the level of 10%, 5%, and 1%, respectively. 2. Standard errors are in parentheses.

Table 4 illustrates the influence of mathematics extracurricular tutoring time invested on secondary school students' mathematical literacy results. After controlling for other variables, mathematics extracurricular tutoring time has a significant negative influence on mathematics scores; with each additional hour of mathematics tutoring time, students' mathematics scores decline by around 2.4 points. Further analysis of model 5 (by including the quadratic term for mathematics extracurricular tutoring time in model 4) reveals that mathematics tutoring time has a significant nonlinear effect on mathematics scores, exhibiting a U-shaped curve, when weekly mathematics tutoring time is less than 14 hours, tutoring has a negative effect on mathematics scores; however, when weekly mathematics tutoring time is greater than 14 hours, tutoring significantly improves mathematics scores. This demonstrates that mathematics extracurricular tutoring has a clear threshold effect, and it is difficult to get a meaningful positive

effect with insufficient time of mathematics tutoring. Students require more than 14 hours of mathematics coaching each week (on average, more than 2 hours per day) to significantly enhance their mathematics performance.

Table 5 shows the effect of extracurricular Chinese language tutoring on the reading literacy scores of secondary school pupils. After controlling for other variables, Model 7 demonstrates that, after controlling for other variables, Chinese extracurricular tutoring time has a significant negative influence on students' reading scores; for each additional hour of Chinese extracurricular tutoring time, students' reading scores decline by around 2.8 points. Further analysis of model 8 (which is obtained by adding the quadratic term for Chinese extracurricular tutoring time) reveals that Chinese tutoring time has a significant non-linear effect on students' reading scores, exhibiting a U-shaped curve; that is, when weekly Chinese tutoring time is less than 13 hours, there is no significant effect on students' reading scores; however, when weekly tutoring time exceeds 13 hours, there is a significant effect on students' reading scores. To enhance their reading scores, students must receive at least 13 hours of Chinese language instruction each week (or an average of more than 1.86 hours of tutoring per day).

To further examine the heterogeneity of the effect of extracurricular tutoring time investment on secondary school students' test results, the interaction variables of extracurricular tutoring time and ESCS (economic, social, and cultural status) are added to obtain Models 3, 6, and 9. After controlling for other variables, the results show that family ESCS contributes positively to the effect of mathematics tutoring time on mathematics scores and passes the significance test; students' family ESCS contributes significantly to the effect of science tutoring time on science literacy scores, but does not pass the significance test; and family ESCS significantly contributes to the effect of Chinese tutoring time on student reading results, but does not pass the significance test.

Meanwhile, Tables 3, 4, and 5 demonstrate that school curriculum time has a considerable beneficial influence on students' scores and that the effect is non-linear, following an inverted U-shaped curve that ascends first and then declines. The most significant improvement in pupils' science literacy scores occurs when the school science curriculum is approximately 13 hours per week. Approximately 9 hours of school mathematics curriculum time each week greatly boost pupils' academic achievement in mathematics. The most substantial improvement in students' reading performance occurs when the weekly school curriculum time for Chinese is approximately 9 hours.

Conclusions and Discussion

This study examined the effects of extracurricular tutoring time investment on secondary school students' academic performance and came to the following conclusions:

First, there is a significant nonlinear relationship between extracurricular tutoring time and the academic performance of secondary school students in the form of a U-shaped curve, indicating that extracurricular tutoring has a significant threshold effect and that it is difficult to achieve a significant positive effect on student academic performance with too little tutoring time. Only when a certain threshold is exceeded can a

qualitative improvement in academic performance occur, i.e., when students attend more than 12 hours, 14 hours, or 13 hours of weekly tutoring in science, mathematics, or Chinese, respectively (i.e., more than 1.71 hours, 2 hours, or 1.86 hours of tutoring for the three subjects per day).

Time is a critical input in the educational process (Ma & Zheng, 2017). The majority of kids devote significant time after school to extracurricular tutoring in order to improve their exam scores. Extracurricular tutoring, being a supplement to school education, presumably has a similar substance to the school curriculum. As a result, the content of extracurricular tutoring courses during the early stages is repetitious and un-focused, which may contribute to students' aversion and resistance to learning. Thus, coaching may appear to be unsuccessful after a brief duration. However, as the semester progresses, the extracurricular tutoring becomes more targeted, the cumulative effect of learning increases, and students attain improved academic performance. Likewise, the quality of extracurricular tutoring institutions varies throughout China, and the majority of students (75%) receive extracurricular tutoring from private tutors[3]. As a result, the tutors' quality and the tutoring sites' circumstances cannot be guaranteed. Tutoring's effect is further limited by the fragmentation of tutoring time and the decentralization of tutoring venues. At the same time, learning is a cumulative process, and tutoring's effects cannot be felt immediately. The influence of tutoring on academic performance improvement may not become apparent until the student's tutoring time hits a certain threshold.

Second, the influence of extracurricular mathematics tutoring time on mathematics achievement varies dramatically among secondary school students with varying household ESCS. Students with a higher family ESCS devote more time to mathematics tutoring. Thus, mathematics extracurricular tutoring time contributes to the widening of the achievement gap between students from diverse family situations, resulting in inequitable educational outcomes.

The conclusion is adequately described by the Maximally Maintained Inequality (MMI) theory (Raftery & Hout, 1993) and the Effectively Maintained Inequality (EMI) theory (Lucas, 2001). According to the MMI hypothesis, when a certain stage of education is not universally available, educational rivalry is oriented toward acquiring an edge in accessing that stage, hence maximizing the maintenance of educational disparity. According to the EMI theory, once a particular stage of education becomes universally accessible, the focus of educational rivalry switches to the quality of education at that stage in order to effectively preserve educational inequality. With the promotion of balanced compulsory education in China and the implementation of numerous aid programs for underprivileged schools in recent years, the connection between family background and access to a high-quality education has decreased. The disparity in educational quality achieved on the "initial battlefield" (i.e., the classroom) of educational rivalry between children from diverse familial origins is steadily closing. As a result, in order to preserve their competitiveness in obtaining a high-quality education, advantaged families turn to the "second battlefield" of educational rivalry, namely extracurricular tutoring. In today's commercialized market for extracurricular tutoring, finan-

cially advantaged families are better equipped to pay for their children's costly extra-curricular tutoring. Thus, the disparity in extracurricular tutoring among students with disparate family ESCS exacerbates the disparity in educational acquisition, and it has developed into an alternative mode of intergenerational transmission of family capital, which serves as a social reproduction mechanism for education and also has an effect on the equity of compulsory education.

Third, the effect of school curriculum time on student academic performance follows an inverted U-shaped curve, with the positive effect on student academic achievement improvement peaking at 13, 9, and 9 hours per week for science, mathematics, and Chinese, respectively. In comparison to extracurricular tutoring, curriculum time during the school day may be more helpful in improving student academic achievement.

This demonstrates the vital importance of school curriculum time in ensuring student achievement progress. Because the school serves as the primary location for student learning, where students' schedules are consistent and predictable, and the quality of school teachers is more reliable. Additionally, schoolteachers are typically more familiar with their students' educational circumstances and may provide more relevant tutoring. Additionally, the school's learning environment and atmosphere are more conducive to student learning, resulting in more productive in-school learning time. However, China has been implementing a "burden reduction" program in recent years, decreasing students' in-school and homework time to guarantee that kids have adequate time for sleep and hobbies. While students' in-class learning time is reduced, the majority of students and parents devote additional time to after-school tutoring. As a result, the "burden reduction" policy is ineffective. Therefore, we should approach policy intelligently, particularly when it comes to minimizing students' in-school burden. Returning student learning to campus and optimizing the function of school education can significantly boost student academic achievement.

Limitations

The data in this study was processed using the Hierarchical Linear Model. It is capable of precisely calculating the coefficients of the two levels of variables' effects on academic performance. However, because the PISA data is cross-sectional, it is not possible to determine students' academic levels prior to their participation in extracurricular tutoring. Thus, even while we control for students' personal and familial traits, the exclusion of certain factors may result in biased statistical findings. Additionally, the method through which tutoring time affects student academic achievement is regulated by a number of variables. For example, student factors such as motivation and attitude toward extracurricular tutoring, as well as academic foundation, interest, and effort in learning, all have a significant impact on academic achievement; tutor factors such as tutor quality, competence, patience, and responsibility all have a significant impact on student achievement. A mixed-methods study with high-quality qualitative interviews and quantitative analysis will enable us to gain a better understanding of the process and

logic underlying the influence of extracurricular tutoring on student academic progress. It is a subject worthy of further investigation.

Notes

1. *SES is a discrete variable derived from the ESCS variable, with 1 indicating a level of social and economic status above the mean for students in the participating countries and defined as "High SES"; 0 indicating a level of social and economic status below the mean for students in the participating countries and defined as Low SES.*
2. *In this study, the term "science extracurricular tutoring time" refers to the total amount of time spent instructing students in science courses (including physics, chemistry, biology, and earth science).*
3. *According to the 2017 China Financial Household Survey conducted by Peking University's China Institute of Educational Finance Research, less than 20% of students participate exclusively in extracurricular tutoring provided by commercial institutions, while more than 75% participate exclusively in extracurricular tutoring provided by individuals.*

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