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Research Article

Educational competition and reduced family size in China

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Contents

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Educational competition and reduced family size in China

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Abstract

BACKGROUND
The economic burden of educational competition is widely recognized. However, its potential correlation with family size remains largely unexplored, particularly how this correlation varies across birth parities and is associated with declining fertility rates.

OBJECTIVE
We investigate how the intensity of educational competition is associated with fertility outcomes at the household level, using China as a case study. Particular attention is paid to the heterogeneous correlations across different socioeconomic groups and the broader implications for fertility trends and inequality in low-fertility settings.

METHODS
We measure the number of private tutoring centers near schools as a proxy for educational competition intensity. We examine the relationship between local educational competition and the number of younger siblings among surveyed students.

RESULTS
Results indicate that having one or more tutoring centers within 800 meters of a school is associated with a 0.04-child reduction in the number of younger siblings, with this correlation being most prominent among low- and middle-income families.

CONCLUSIONS
Excessive educational competition may ultimately undermine population reproduction on a societal scale. East Asian societies such as China provide empirical evidence for this phenomenon.

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CONTRIBUTION
Our study extends the quantity–quality trade-off framework by showing that resource constraints associated with family size are correlated not only with household dynamics but also with broader societal competition.

1. Introduction

Globally, educational competition is intensifying at an unprecedented pace, particularly in East Asian countries such as China, where families' investments in their children's education have taken on a highly 'arms race–like' character. As higher education becomes more widespread and the job market grows increasingly competitive, more and more families view education as a core means of achieving or maintaining social status, leading them to commit substantial financial and time resources to this end (Marginson 2016; Mirowsky and Ross 2003). Private tutoring programs, international curricula, and overseas study have become routine expenditures for middle- and upper-class families, giving rise to a large-scale and continuously expanding education training market (Bray 2013).

Although the costs of educational competition at the individual and family levels have received widespread attention, the broader social consequences they entail remain a relatively new area of research. The soaring economic cost of education has discouraged many families from having multiple children, while the intense parenting anxiety and long-term resource investment required by child-rearing amid fierce educational competition have led many young couples to reconsider whether to have children at all. In China, this phenomenon is especially pronounced. Low fertility rates have become one of the major challenges facing societal development (Huang, Lei, and Sun 2021), and excessive educational competition is often regarded as a key factor suppressing fertility levels (Kim, Tertilt, and Yum 2024). Therefore, educational competition is not merely an issue within the education system, but also a critical variable that affects national population policies, labor markets, and even long-term social stability.

Fertility decisions, including family size and fertility intentions, are among the central topics in the study of family behavior, involving a complex interplay of economic, social, cultural, and institutional factors. The quantity–quality (Q–Q) model has emerged as one of the most influential theoretical frameworks due to its insightful explanation of the relationship between educational investment and fertility decisions. Originally proposed by Becker and Lewis (1973), the model posits that parents make trade-offs between the number of children they have and the level of resources – such as education, healthcare, and living conditions – each child can receive. As the returns to human capital increase, families tend to have fewer children in order to invest more intensively in each child's development, thereby maximizing long-term household utility (Becker, Murphy, and Tamura 1990). This theory provides a powerful analytical tool for understanding the link between educational expansion and declining fertility rates (Gillespie, Russell, and Lummaa 2008; Lawson and Borgerhoff Mulder 2016).

In addition to the Q–Q model, the opportunity cost theory is another important theoretical perspective for explaining changes in fertility levels. According to this theory, as women invest more in human capital – such as pursuing higher education – the income they stand to lose by leaving or reducing participation in the labor force to care for children increases accordingly. This rise in opportunity costs often leads women to delay childbearing or opt for fewer children – or even no children at all (Happel, Hill, and Low 1984; Joshi 1998; Raymo, Musick, and Iwasawa 2015). In China, with the acceleration of urbanization and the rising social status of women, an increasing number of women of childbearing age face a difficult choice between career advancement and family life (Yu and Xie 2021). Particularly under the context of intense educational competition, parenting not only entails significant financial investment but also demands substantial time and energy (Doepke and Kindermann 2019). Ruth Mace's "runaway parental investment" concept aptly captures this: Educational competition creates a self-reinforcing cycle of more parental investment, where each family's efforts to gain educational advantages prompt others to follow suit, ultimately using up resources for additional children (Mace 2008). This further raises the opportunity cost of childbearing and consequently suppresses individuals' fertility intentions.[4]

From a theoretical perspective, the Q–Q trade-off theory frames fertility decisions as a household-centered resource allocation problem, in which parents make rational trade-offs between the number of children and the level of educational investment in order to maximize utility. This theory emphasizes the role of internal family constraints – particularly economic resources – and the logic of utility maximization (Liu 2014). In contrast, the opportunity cost theory focuses more on how individuals, especially women, are shaped by changing roles within the social structure and constrained by external factors such as career trajectories, rising returns to education, and the lack of supportive childcare policies. Thus, it highlights the broader socioeconomic environment's influence on family size.

[4] Recent studies also suggest that the applicability of the opportunity cost theory varies across different sociopolitical and cultural contexts. For example, in countries lacking comprehensive childcare support policies – such as China – the risk of career interruption due to childbearing is much higher for women, making the opportunity costs of childbearing even more pronounced (Raymo, Musick, and Iwasawa. 2015). In contrast, in European countries with better-developed childcare systems and gender equality policies, women's fertility decisions are relatively less affected by opportunity costs (Andersson 2004). These comparative studies highlight the important role that institutional environments play in shaping individual fertility behaviors.

To date, there have been very few studies that directly quantify the correlation between educational competition and family size. In this study, we take China as a case and construct a spatially based educational competition indicator by using the number of subject-specific private tutoring centers (PTCs) within an 800-meter radius of schools as a key proxy for external educational competition intensity. We then examine how this environmental factor is correlated with the fertility decisions of students' families. Empirical results indicate that, after controlling for family income, parental education levels, regional disparities, and other covariates, families with at least one child enrolled in a school near PTCs have, on average, 0.04 fewer younger siblings than comparable families without nearby PTCs. These findings indicate that the external educational competitive environment is significantly correlated with lower household fertility decisions.

This finding not only provides new empirical support for the Q–Q trade-off theory, but also extends its explanatory boundaries. Unlike traditional models that view fertility decisions as purely rational choices based on internal household resource allocation, this study demonstrates that the intensity of external social competition is significantly correlated with families' actual expectations regarding investments in child quality, thereby being associated with the tendency toward having fewer children. Therefore, while our theoretical framework inherits the logical structure of the Q–Q trade-off theory, its underlying driving mechanism is more closely aligned with the social processes identified by the opportunity cost theory. Particularly noteworthy is the fact that disparities in access to educational resources and socioeconomic status can be correlated with amplified differences in fertility decisions across social groups, further intensifying underlying social inequalities.

It is important to note that a limitation of this study is that we discuss the relationship between educational competition and family size in only a correlational rather than causal sense. Due to data constraints, this paper cannot address the potential self-selection problem – specifically, some families may have a strong preference for education and proactively reduce their family size. While our analysis establishes only a correlational relationship, we have conducted a series of robustness tests and heterogeneity analyses. These efforts help align our observed findings with real-world contexts, and the empirical results thus merit attention and further research.

The paper is structured as follows. In Section 2, we introduce China's demographic background, the tradition of educational competition, and the private tutoring industry across the country. In Section 3, we present the data, variables, and methods used in this study. Section 4 reports the empirical analysis, which examines the relationship between the density of PTCs around schools and family size. We also conduct a series of heterogeneity analyses and robustness checks. In Section 5, we summarize the findings, discuss the study's limitations, and explore its policy implications.

2. The China context

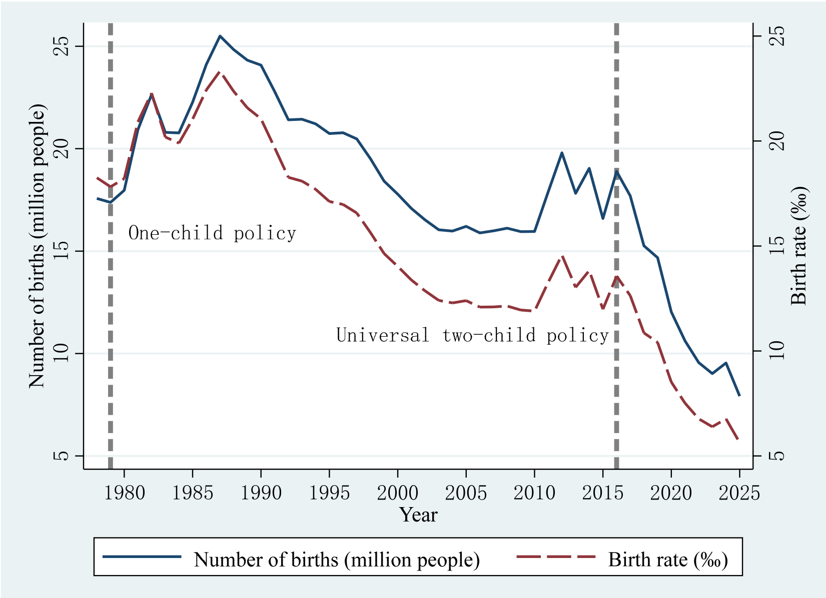
2.1 A population giant and its declining birth rate

China, once a population giant, is now facing an unprecedented demographic challenge. Over the decades, China's population policies and socioeconomic development have profoundly influenced the structure of its population. From the "demographic dividend" of the mid-20th century to the current "demographic crisis," China is transitioning from a phase of quantitative advantage to one of qualitative improvement (Cai 2014). However, accompanying this transition is a sustained decline in birth and fertility rates, which has had far-reaching impacts on the nation's economic and social development.

In the mid-20th century, with improvements in healthcare and increased social stability, China's birth rate and population growth rate saw significant increases. When the People's Republic of China was founded in 1949, the national population was about 540 million, but by 1982, it had rapidly grown to 1 billion. This period is considered China's "demographic dividend" phase (Cai 2014; Wang et al. 2018), where the large and growing population provided abundant labor resources and a vast market for economic development. However, alongside this rapid population growth, China faced challenges such as resource scarcity and increased environmental pressure. To control population growth, the government implemented its one-child policy in 1979 (Cai and Feng 2021; Feng et al. 2012).

Figure 1 shows the trends in China's number of births and birth rate since 1978. In the more than 20 years before 2000, China's annual number of births remained above 16 million. Particularly around 1987, the number reached a post-reform peak of 25.5 million. However, China's one-child policy soon began to show its effect, and after 1990, the number of births started a sharp downward trend. After 2016, the Chinese government began gradually relaxing birth controls, implementing the 'two-child policy,' which allows each family to have up to two children (Zeng and Hesketh 2016). As a result, the number of births exhibited a certain degree of fluctuation and a modest recovery around 2016. However, after a brief rise, the number has continued its previous downward trend. The latest statistics show that China's number of births in 2025 was 7.92 million, which is equivalent to only 31% of the 1987 post-reform peak.

Figure 1: China's number of births and birth rate (1978–2025)



Notes: The data are sourced from the China Statistical Yearbook 2023 (NBSC 2024) and Statistical Communiqué on the 2024 National Economic and Social Development of China, with data for 2025 sourced from the official website of the National Bureau of Statistics of China. China's one-child policy was implemented in 1979 and abolished in 2015. The universal two-child policy was implemented in 2016.

Between 2020 and 2022, China's number of births sharply declined due to the impact of the COVID-19 pandemic. There had been an expectation that the birth rate would significantly rebound after the pandemic, but it now appears that this view was overly optimistic. With a total fertility rate of around 1.2, it is significantly lower than the population replacement level of 2.1. Demographic forecasts generally agree that, against the backdrop of low fertility rates, China's population will decline to nearly 500 million by 2100 (Chen et al. 2020), approximately 35% of the current size. Even more concerning, the age structure of the population will then take on a severely inverted pyramid shape, with the elderly aged 65 and above making up the majority of the 500 million people. This means that 1 in every 2 to 2.5 individuals will be an older adult.

As mentioned earlier, the continuous decline in China's fertility rate may result from the combined effects of multiple social, economic, and cultural factors. We expect that the rising costs of childbearing and child-rearing have become a key factor in the suppression of individuals' fertility intentions. We hypothesize that parents' heightened anxiety over their children's education may lead many to opt for fewer children or even no children at all, in order to ensure high-quality investment in their existing children. Accordingly, we expect that the high cost of education represents not only an economic burden but also significant psychological pressure, which would further exacerbate the risks of demographic imbalance.

2.2 Educational competition and meritocracy

China has long been characterized by intense educational competition, rooted in a Confucian tradition that emphasizes academic excellence as a pathway to personal success and social mobility. In contemporary society, this cultural legacy has evolved into a highly stratified and meritocratic education system, where students are assessed through standardized examinations – most notably the *gaokao* (national college entrance exam) – that largely determine their future life trajectories. The widespread belief that academic achievement is the primary route to upward mobility has fueled a competitive environment in which families invest heavily in private tutoring, elite schools, and extracurricular enrichment programs to secure educational advantages for their children (Jin and Ball 2020).

Interestingly, in political science research, Paul Pierson introduces the concept of "lock-in" to describe a policy or institution that, although initially established due to incidental or temporary factors, becomes difficult to change or abolish over time, leading to a state of 'lock-in' (Pierson 2000). This could be the result of resistance from vested interests, resource constraints, sociocultural factors, or other institutional reasons. Such a lock-in often constrains or even backfires on decision-makers, making it difficult for them to drive reforms or adopt new policy directions. Exley applies the lock-in concept to analyze South Korea's private tutoring system, which has become so entrenched that it exhibits a form of "irreversibility" in Korean society (Exley 2021). We believe the situation in China is strikingly similar; whether wealthy or poor, families have little time to reflect, becoming deeply engaged in fierce educational competition and committing excessive economic resources to it.

A substantial body of literature has conducted in-depth analyses of the short-term negative consequences associated with intense educational competition. However, much of this research focuses on issues such as increased family burdens, heightened psychological stress among students, and the reinforcement of exam-oriented learning tendencies. For example, numerous studies have shown that fierce academic competition exposes students to widespread mental health challenges, including anxiety and depression (Li 2017), while an overemphasis on test scores and rote memorization could undermine creativity and critical thinking skills. At the same time, families often invest significant financial and emotional resources in pursuing 'educational advantages,' which not only intensifies intergenerational pressure but also imposes heavy living burdens (Xue et al. 2025).

In comparison, scholarly attention to the medium- and long-term effects of this competitive system remains limited. In particular, there is insufficient research on how educational competition is correlated with fertility levels and whether the exam-centered meritocratic system may instead be correlated with reinforced social stratification rather than promoted equal opportunity. As a result, although current understanding of these symptomatic problems caused by educational competition is relatively clear, deeper insights into its underlying structural and long-term consequences remain underdeveloped and require further investigation.

2.3 Private tutoring centers: A proxy for educational competition

The Chinese government has long been aware of the excessive educational burden on students' families and has been committed to alleviating it, but with limited success. A recent prominent example of this effort is the double reduction policy, which was officially introduced in July 2021 (MOE 2021). This policy aims to reduce the academic burden on students by restricting private tutoring and limiting the amount of homework assigned to primary and secondary school students. It had a profound impact on the private tutoring industry, forcing many PTCs to either transform or exit the market.[5]

In China, PTCs emerged in the late 1990s. With rapid economic growth and rising personal income, parents became increasingly willing to invest in their children's education (Lu, Zhou, and Wei 2022; Zhang and Bray 2018). Early tutoring classes were mostly small-scale, home-based tutoring sessions. However, as demand grew, they evolved into large chain training centers. These centers typically offer courses covering all subjects from elementary to high school, with various tutoring options designed for different age groups, such as one-on-one tutoring and group lessons (Zhang and Bray 2021; Zhang et al. 2021). Appendix Figure A-1 shows the distribution of PTCs at the prefecture level across China in 2019, with a clear advantage in absolute numbers in the eastern coastal regions.[6] Appendix Figure A-2 further illustrates the number of tutoring

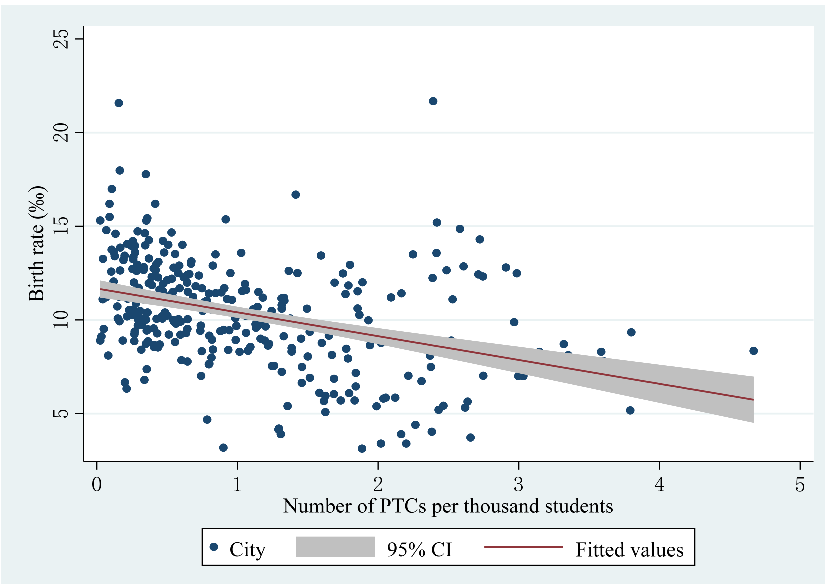
[5] Some tutoring centers have transitioned to nonacademic training or quality-oriented education programs, such as art and sports, in order to continue operating. However, the double reduction policy has not entirely eliminated the demand for private tutoring. Some parents continue to provide additional educational resources for their children by hiring private tutors or joining small study groups. This indicates that despite the unprecedented strength of the policy, the demand for high-quality educational resources remains strong in society.

[6] We believe that using 2019 data is more accurate for the following reasons: (1) The COVID-19 pandemic after 2020 may have had an exogenous impact on the operations of tutoring centers, and (2) the double reduction policy implemented by the Chinese government in 2021 greatly affected the operation of these centers, leading to the closure of many.

centers per student. It is evident that the distribution density of such centers is relatively high in East China, Northeast China, and several provincial capitals, while the density in the central and western regions is comparatively lower.

Although urban middle-class families have an advantage in participating in private tutoring, which provides their children with a competitive edge in the admissions process, there is another cost that has rarely been studied or mentioned aside from the economic burden – the impact on fertility. Appendix Figure A-3 shows the birth rate at the prefecture level in China in 2019. In areas where PTCs are densely distributed, the birth rate is lower, and vice versa. Figure 2 below further illustrates the potential linear correlation between the two.

Figure 2: The relationship between the number of PTCs per thousand students and the birth rate at the prefecture-level cities in China



Notes: The birth rate data for prefecture-level cities in 2019 were manually collected by the authors. The sources included the National Economic and Social Development Statistical Bulletins of various regions, city yearbooks or city statistical yearbooks, and the websites of local statistical bureaus. Data on PTCs were collected by the authors from Dianping.com in May 2019. The students refer to those enrolled in primary, middle, and high schools in 2019, and these data were obtained from the 2020 China City Statistical Yearbook and various regional economic and social development reports.

It should be noted that while the birth rate can show the proportion of new births in the total population each year, it is influenced by the age structure of the population and does not directly reflect changes in fertility behavior. Therefore, a more prudent approach is to further examine the relationship between the intensity of PTC distribution and family size at the micro level. In other words, does the intensified educational competition suppress family size? This will be the central topic explored in the following discussion.

3. Data, variables, and methods

3.1 Data sources

The data sources for our study are primarily from two sources: Dianping.com and the 2022 Survey on the Usage of Educational Informatization in Primary and Secondary Schools in China.

First, Dianping.com, established in 2003, is China's leading local service platform. It offers a wide range of services, including reviews and recommendations for restaurants, hotels, leisure activities, and private tutoring. Users can browse reviews and ratings from other users on Dianping.com, similar to Google Reviews or Yelp, to make more informed consumer decisions. The "Education & Tutoring" section of the site gathers information about PTCs across various cities in China, including institution names, specific addresses, customer reviews, and category affiliations.

In May 2019, we collected information from Dianping.com on approximately 186,200 academic PTCs. Academic PTCs refer to those categorized under academic tutoring and focus on primary and secondary school education. These PTCs are spread across 31 provinces, 324 prefecture-level cities, and 2,246 districts and counties in China.[7]

Second, the Survey on the Usage of Educational Informatization in Primary and Secondary Schools in China was initiated and completed by the China Institute for Educational Finance Research at Peking University in July 2022. This large-scale online survey used a three-stage sampling design: In the first stage, more than 300 counties were selected from 29 provinces; in the second stage, 8 primary schools and 4 middle schools were randomly selected from each district and county; and in the third stage, all fourth-grade and eighth-grade students in the randomly selected schools were cluster sampled. In principle, all students in the corresponding grades were included in the sample, resulting in approximately 670,000 student samples.

In the survey, we collected detailed demographic variables, including the student's gender, birth date, number of siblings, and ethnicity. We also gathered information on

[7] However, following the implementation of the double reduction education reform by the Chinese government in July 2021, Dianping.com closed its Education & Tutoring section. Currently, we can no longer find information about PTCs in this category.

the students' parents' educational background, occupation, annual total household income, and other family variables. This information provides a solid data foundation for analyzing the research questions in our study. It should be noted that this is not a specialized demographic survey, so we cannot obtain more information about the students' mothers, such as age and specific childbearing time.

3.2 Data matching

We collected the address information of the PTCs and also knew the address information of all the schools in the questionnaire survey – these addresses can be converted into latitude and longitude through geocoding. Specifically, we used the geocoding API of the Gaode Open Platform to perform the latitude and longitude conversion.[8] Once we obtained the latitude and longitude of the PTCs or schools, the spherical distance between the two locations could be calculated using the haversine formula (Robusto 1957). Therefore, knowing the student population of the schools, we can calculate the density of PTCs within a certain radius around the surveyed schools by using the school location as the center of the circle and defining a specific radius distance.

3.3 Variables and descriptive statistics

Dependent variable. This study operationalizes the dependent variable as family size – specifically, the total count of younger siblings residing in the respondent's household. The survey instrument separately queried students about their number of biological older brothers, older sisters, younger brothers, and younger sisters. The latter two categories are summed to construct the younger sibling count. Our focus on younger siblings is motivated by two principal considerations: First, this measure temporally aligns with China's post-2015 universal two-child policy liberalization, and second, these recently born children are more likely to be affected by educational competition intensity, as proxied by PTC density.[9]

Independent variable. The independent variable is whether there are academic PTCs within the vicinity of the school (≤ 800 m). We use two methods to measure the variation in the number of PTCs. First, we construct a binary variable, assigning a value of 1 if

[8] Gaode, comparable to Google outside of China, provides users with a wide range of web services. Geocoding, the tool exploited here, is a process of converting a location into a pair of geographic coordinates (latitude and longitude) that are used to evaluate distances.
[9] We also implemented checks using the total number of children in the household as the dependent variable, yielding very similar conclusions. Interested readers may obtain these supplementary results from the authors upon request.

there is at least one PTC and 0 otherwise. Second, we construct an ordinal variable, assigning values from 1 to 4 for the scenarios of none, 1 to 3 PTCs, 4 to 10 PTCs, and more than 10 PTCs, respectively.

It is worth noting that we set the vicinity distance around the school to 800 meters, which is a standard based on everyday life experience. According to the spherical distance measurement method used in the study, this distance is closer to a straight-line distance rather than the actual walking distance, which would be longer than 800 meters due to detours in reality. In the empirical analysis, we also adjust the radius of the distance between the school and the PTCs to further demonstrate the sensitivity of the empirical results to distance.

Control variable. The control variables primarily focus on the household level. They include (1) ethnicity (minority = 1, Han = 0); (2) parents' highest educational attainment (university degree or higher = 1, otherwise = 0); (3) parents' job type (working in public sectors = 1, other = 0); (4) annual household income level (below 50,000 RMB = 1, between 50,000 and 300,000 RMB = 2, above 300,000 RMB = 3); (5) number of older siblings; and (6) region (rural = 1; urban = 0). Additionally, county fixed effects are included in all regressions to control for the impact of unobservable heterogeneity at the regional level on the results. We present the descriptive statistics of all variables in Table A-1 of the Appendix.

3.4 Analytical strategies

In terms of empirical analysis strategies, most analyses in this study are based on linear probability regression, which can be simply described as follows:

$$F_{ij} = \alpha + \beta_1 * PTCs_j + \gamma X_i + county + \varepsilon_{ij},$$

where F_{ij} indicates the number of younger siblings of student i in school j; PTC_{sj} denotes whether there are academic PTCs (or the number of such centers) within 800 meters around school j;[10] X_i is a vector of household characteristics, including variables such as ethnicity, parents' highest educational level, and household income; *county* refers to

[10] Due to data limitations, we are unable to obtain specific family community locations; however, given the prevalence of nearby enrollment during the compulsory education stage, the geographical distance between a family's community and their child's school is usually very close. To verify this rationality, we analyzed the school district information and corresponding real estate project data published by the education departments of multiple cities in China – even in large provincial capital cities such as Hangzhou, the walking distance between a real estate project and its designated school district is typically within 2 kilometers, and the straight-line spherical distance (the distance measure used in this paper) is even shorter. Therefore, we consider the 800-meter radius around schools a reasonable estimate.

county fixed effects; and ε_{ij} is a random disturbance term. In the regression, 95% confidence intervals are calculated using cluster-robust standard errors clustered at the school level.

Two empirical issues require clarification. First is the potential self-selection problem: Some families may inherently value education and prefer having fewer children, leading them to proactively choose to live in areas with a higher density of PTCs. Second, regarding the relationship between educational competition (proxied by PTC density) and family size, the former should temporally precede the latter – meaning PTCs should be established before the birth of the children in question.

In the Chinese context, families rarely relocate to areas with higher PTC density to increase their children's educational investment; instead, PTCs tend to cluster around high-quality school districts where education-valuing families are concentrated, as these families are more willing to invest in after-school tutoring. While such families may intentionally have fewer children to focus resources on a single child, this does not negate that excessive educational competition further restricts family size. Supporting this, Meng et al. (2025) used questionnaires and a randomized controlled trial to find that China's double reduction policy improved fertility intentions by reducing educational competition pressure, and Zhou and Chen (2023) show that reduced private tutoring was associated with higher second-child intentions, especially among urban residents. Therefore, we acknowledge the potential existence of self-selection, but argue that this is not the mainstream scenario and does not undermine the validity of our hypothesis.

To address the temporal order issue, we adjusted the dependent variable to include only the number of children younger than the surveyed students. Since these children were born later, most of their birth years should postdate the establishment of most PTCs. However, we cannot guarantee that every single child was born after every PTC's founding – a limitation that needs explicit acknowledgment. To mitigate this, we designed several robustness checks to verify the reliability of our findings. For instance, we split the sample based on the age structure of the family's children and performed a sensitivity analysis: One subsample consists of students who are the oldest sibling in their family, while the other includes students who already have multiple elder siblings. The results were consistent with our expectations: The negative correlation between educational competition and family size was observed only in the former group. In contrast, among students with multiple elder siblings – for whom the theoretical probability of having additional younger siblings is apparently lower – this negative correlation was not detectable. These robustness check results further validate the rationality of our research design.

4. Results

4.1 The relationship between educational competition and family size

Table 1 presents the relationship between the distribution of PTCs within 800 meters of schools and the family size of surveyed students. It is important to clarify that 'family size' herein refers specifically to the number of younger siblings, rather than the total number of children in the family. This definition is adopted to mitigate a potential logical flaw – that is, the establishment time of PTCs should precede the birth of the children. In fact, when we set the dependent variable as the total number of children in the family, the results remain consistent. Interested readers may request these supplementary results from the authors.

Column 1 focuses on a binary variable indicating whether there are PTCs within 800 meters of the school. In column 2, the independent variable is an ordinal variable that describes the number of PTCs within 800 meters of the school. The control group is the absence of such centers, followed by categories of 1 to 3 centers, 4 to 10 centers, and more than 10 centers. We weight the results by the number of primary and middle school students enrolled in 2019 at the county level to better reflect national circumstances.

As shown in Table 1, keeping other variables constant, the presence of at least one PTC within this radius is associated with a decrease of approximately 0.04 children (95% CI [–0.046, –0.025]) per household, relative to areas without any PTCs. From the perspective of the ordinal variable, we find that the correlation between educational competition and fewer younger siblings shows a certain degree of linear change. Younger siblings are fewer by 0.02 children (95% CI [–0.032, –0.010]) in areas with 1 to 3 PTCs, by approximately 0.04 children (95% CI [–0.051, –0.025]) where 4 to 10 PTCs are present, and by 0.06 children (95% CI [–0.072, –0.044]) in locations with more than 10 PTCs, relative to PTC-free areas.[11] The narrow width of the intervals suggests that the effect sizes are estimated with reasonably high precision, supporting a more confident interpretation of the magnitudes.

[11] Due to data limitations, we cannot determine the heterogeneity of the PTCs themselves—such as their size, quality, or fee standards—and can characterize only the educational competition environment based on the number of centers. However, we believe this still provides valuable insights.

Table 1: The relationship between educational competition and family size

	(1)	(2)
Variables	Number of younger siblings	
PTCs within 800 m around schools	–0.036	
(Yes = 1)	[–0.046, –0.025]	
Number of PTCs within 800 m around schools		
1–3 PTCs		–0.021
		[–0.032, –0.010]
4–10 PTCs		–0.038
		[–0.051, –0.025]
More than 10 PTCs		–0.058
		[–0.072, –0.044]
Minority (Yes = 1)	0.071	0.071
	[0.060, 0.082]	[0.060, 0.082]
Mother's highest education	–0.021	–0.020
(bachelor's degree or higher = 1)	[–0.028, –0.014]	[–0.026, –0.013]
Father's highest education	–0.012	–0.010
(bachelor's degree or higher = 1)	[–0.018, –0.005]	[–0.017, –0.004]
Mother's occupation	–0.026	–0.025
(public sector job = 1)	[–0.036, –0.015]	[–0.035, –0.015]
Father's occupation	–0.018	–0.017
(public sector job = 1)	[–0.027, –0.009]	[–0.026, –0.009]
Household annual income level		
> 50k and <= 300k RMB	–0.007	–0.007
	[–0.012, –0.002]	[–0.011, –0.002]
> 300k RMB	0.084	0.085
	[0.074, 0.094]	[0.075, 0.094]
Number of older siblings	–0.102	–0.102
	[–0.113, –0.091]	[–0.113, –0.091]
Region (rural = 1)	0.051	0.045
	[0.037, 0.065]	[0.031, 0.060]
County FE	Yes	Yes
Observations	629,841	629,841
R-squared	0.078	0.079

Notes: When the independent variable is the ordinal variable, the control group consists of schools with 0 PTCs. Robust 95% confidence intervals in square brackets. Column 1 uses a binary indicator for the presence of PTCs, whereas Column 2 uses categorical measures of the number of PTCs.

4.2 Heterogeneity analysis by income stratification

So far our baseline regressions estimate the average effect of educational competition on family size but do not yet validate the resource constraint mechanism. We therefore conduct heterogeneity analyses in this section, using household income as the key grouping variable to estimate the elasticity of family size with respect to educational competition across different income strata. We expect that households with different income levels will respond differently to the same intensity of educational competition: High-income households are less deterred by rising educational investment given greater affordability, while low-income households are significantly more sensitive, in line with prior evidence from South Korea (Kim, Tertilt, and Yum 2024).

Prior to conducting the regression analysis, we first describe the basic characteristics of these three groups. We define households with an annual income below 50,000 RMB as the low-income group, those with an annual income between 50,000 and 300,000 RMB as the middle-income group, and those with an annual income above 300,000 RMB as the high-income group. As shown in Table 2, the average family size (i.e., the total number of children) for low-income households is approximately 2.08, and the average number of younger siblings relative to the respondent is about 0.52. The means for middle- and high-income groups are very close, but both are lower than that of the low-income group.

Table 2: Average family sizes of households with different income levels

	Low income	Middle income	High income
Number of total children	2.08 (0.94)	1.77 (0.75)	1.73 (0.77)
Number of younger siblings	0.52 (0.78)	0.45 (0.66)	0.48 (0.70)
Observations	292,052	288,398	49,962

Note: Standard deviation in parentheses.

Interestingly, as shown in Table 3, the negative correlation between educational competition intensity and family size exhibits distinct heterogeneity. We observe this negative relationship among low- and middle-income households; yet it disappears among high-income households. For example, when treating PTC presence as a binary variable, low-income households see a 0.04 reduction in the number of younger siblings (95% CI [–0.056, –0.033]), with a narrow interval indicating a clear negative association, while middle-income households experience a 0.03 reduction (95% CI [–0.039, –0.016]) that still points to a meaningful negative link. In contrast, high-income households show a much smaller estimated reduction of 0.02 (95% CI [–0.054, 0.012]); the wide confidence interval here means the effect is not meaningfully different from zero, suggesting no substantive impact of educational competition on family size in this group. This pattern holds consistently across the categorical measures of PTC density in Panel B.

The results above indicate that facing the same level of educational competition, low-income groups have greater fertility elasticity. Although in absolute terms, the average fertility level of high-income groups is lower – which may of course be due to their higher educational attainment and thus delayed childbearing – they are less sensitive to educational competition. Low-income groups have higher family sizes, but if they become involved in educational competition, they may passively abandon some fertility opportunities.

Table 3: Heterogeneity analysis by income stratification

	(1)	(2)	(3)
	Low income	Middle income	High income
Variables	Number of younger siblings		
Panel A: binary			
PTCs within 800 m around school (Yes = 1)	–0.044	–0.028	–0.021
	[–0.056, –0.033]	[–0.039, –0.016]	[–0.054, 0.012]
Observations	291,756	288,272	49,813
Panel B: categorical			
1–3 PTCs	–0.031	–0.009	–0.004
	[–0.045, –0.018]	[–0.021, 0.004]	[–0.039, 0.032]
4–10 PTCs	–0.052	–0.029	–0.014
	[–0.067, –0.036]	[–0.042, –0.015]	[–0.052, 0.024]
More than 10 PTCs	–0.062	–0.052	–0.039
	[–0.079, –0.045]	[–0.066, –0.038]	[–0.078, –0.001]
Observations	291,756	288,272	49,813

Notes: This table presents subsample regressions. Column 1 corresponds to the low-income household group with an annual household income below 50,000 RMB; Column 2 to the middle-income group with an annual household income between 50,000 and 300,000 RMB; and Column 3 to the high-income group with an annual household income above 300,000 RMB. In Panel A, the key independent variable is treated as a binary variable; in Panel B, we use an ordinal independent variable, where the control group consists of schools with 0 PTCs. All regressions incorporate control variables such as minority, mother's highest education, and father's highest education (same as those in Table 1). Robust 95% confidence intervals in square brackets.

4.3 Robustness checks

4.3.1 Sensitivity test

First, in the baseline regression, we employed the OLS model as it offers straightforward and intuitive interpretation of coefficients. Given that the dependent variable is also a count variable, we respecified the model using Poisson regression to test the sensitivity of the above results to model specification. As shown in Column 1 of Table 4, the average marginal effect coefficients from the Poisson estimation are highly close to those from the OLS estimation, indicating that our findings are insensitive to model specification.

Second, while the effective sample size in the survey is approximately 680,000, only 629,841 observations were included in the baseline regression, representing a reduction of around 7.3%. This is primarily due to a large number of missing values in the control variable 'household annual income level.' We excluded this control variable and reconducted the analysis using a more complete sample. As presented in Column 2 of Table 4, the estimation results are highly consistent with those from the baseline regression, demonstrating that our findings are not sensitive to this sample loss.

Table 4: Sensitivity analysis of model specification and sample exclusion

	(1)	(2)
	Poisson model	Without income level (OLS)
Variables	Number of younger siblings	
Panel A: binary		
PTCs within 800 m around school (Yes = 1)	–0.034 [–0.043, –0.024]	–0.037 [–0.047, –0.026]
Observations	629,841	679,810
Panel B: categorical		
1–3 PTCs	–0.019 [–0.029, –0.008]	–0.022 [–0.033, –0.010]
4–10 PTCs	–0.037 [–0.050, –0.025]	–0.039 [–0.052, –0.027]
More than 10 PTCs	–0.058 [–0.071, –0.044]	–0.058 [–0.071, –0.044]
Observations	629,841	679,810

Notes: In Panel A, the key independent variable is treated as a binary variable; in Panel B, we use an ordinal independent variable, where the control group consists of schools with 0 PTCs. The first column uses Poisson estimation, with the coefficients presented as average marginal effects. In the second column, the variable 'Household annual income level,' which has a significant number of missing values, is not included as a control variable. All regressions include control variables, such as minority, mother's highest education, and father's highest education (same as in Table 1). Robust 95% confidence intervals in square brackets.

Third, in the previous analysis, we used an 800-meter search radius around schools. As we explained earlier, the adoption of 800 meters is based on an analysis of school districts and community distances across multiple Chinese cities: A spherical distance of 800 meters typically corresponds to a walking distance of around 2 to 3 kilometers, which aligns with the commuting range of most domestic students who walk to nearby schools from their homes. In this section, we attempt to relax this distance criterion to test the sensitivity of the analysis results to distance. As shown in Appendix Table A-2, when we delimit the scope with a radius of 1,000 meters or 1,200 meters around schools and construct the PTC density indicator with the same definition, we obtained nearly consistent findings with the benchmark regression.

4.3.2 Birth order-based test

The dependent variable analyzed in this paper is the number of younger siblings of the respondent within the family. As we have explained earlier, this design aims to ensure that the educational competition – proxied by the density of PTCs – occurs prior to the family's fertility decision-making, thereby aligning with basic empirical logic in terms of temporal sequence. A further approach to verify the validity of the aforementioned logic is to split the family sample based on the birth order of the surveyed students, including families where the surveyed student is the first-born child, families where the surveyed student is the second child, and families where the surveyed student is the third or later-born child.

Theoretically, if educational competition may exert an impact on family size, this impact should be the strongest in the first type of families, whereas it should be negligible if the family already has three or more children. As shown in Table 5, consistent with our expectations, the negative correlation between educational competition and family size is the strongest in the subsample where respondents are the first-born children in their families. For second-born children, the negative relationship persists but is attenuated. In contrast, for third or later-born children, the estimated association is a negligible 0.01; the confidence interval spans both positive and negative values, indicating no meaningful effect of educational competition on family size in this subgroup.

Table 5: Birth order-based test

	(1)	(2)	(3)
	First-born children	Second-born children	Third- or later-born children
Variables	Number of younger siblings		
Panel A: binary			
PTCs within 800 m around school (Yes = 1)	–0.053	–0.027	0.013
	[–0.066, –0.040]	[–0.037, –0.016]	[–0.033, 0.060]
Observations	401,737	185,350	42,754
Panel B: categorical			
1–3 PTCs	–0.036	–0.021	0.021
	[–0.050, –0.022]	[–0.033, –0.009]	[–0.023, 0.064]
4–10 PTCs	–0.054	–0.031	0.003
	[–0.071, –0.038]	[–0.044, –0.018]	[–0.049, 0.056]
More than 10 PTCs	–0.076	–0.033	0.008
	[–0.093, –0.059]	[–0.048, –0.018]	[–0.082, 0.098]
Observations	401,737	185,350	42,754

Notes: This table presents subsample regressions. Column 1 includes respondents who are the first-born children in their families; Column 2 includes second-born children; and Column 3 includes third- or later-born children. In Panel A, the key independent variable is treated as a binary variable; in Panel B, we use an ordinal independent variable, where the control group consists of schools with 0 PTCs. All regressions incorporate control variables such as minority, mother's highest education, and father's highest education (same as those in Table 1). Robust 95% confidence intervals in square brackets.

5. Conclusions and limitations

This study uses the distribution of PTCs as a proxy indicator for educational competition and empirically examines the relationship between educational competition and family size in the context of China. Specifically, we collected geographic information on approximately 180,000 academic PTCs from a major online review platform in China and matched it with a nationally representative large-scale online survey. This survey included over 620,000 fourth-grade elementary and second-grade middle school students nationwide, providing information on family size, family background, school geographic information, and more. After calculating the number of PTCs within a specified radius around schools, we constructed an indicator of educational competition intensity to examine whether more intense educational competition correlates with fewer younger siblings among surveyed students.

The results demonstrate that the more intense the educational competition – measured by PTC density within an 800-meter radius of schools – the fewer younger siblings surveyed students have. However, heterogeneity analyses reveal that this effect is concentrated in middle- and low-income households, while virtually disappearing for families with annual incomes exceeding 300,000 yuan. The findings address a critical gap in the empirical literature. The existing studies have begun examining how educational burdens affect fertility rates, but none have yet investigated this relationship through the lens of educational competition. Our analysis reveals that family size is correlated not only with internal resource constraints but also with broader societal competition culture. The escalating intensity of educational competition is correlated with households allocating greater current economic resources to education, which is ultimately correlated with the sacrifice of potential fertility opportunities.

This study still has several limitations that warrant supplementation and refinement in future research. First, the study establishes only a correlational rather than a causal relationship between educational competition and family size. Due to family self-selection – that is, education-oriented families may proactively choose to reside in regions with an intense educational competition environment and simultaneously opt for fewer children – whether educational competition directly inhibits fertility requires further verification using more rigorous longitudinal data. Second, as the survey employed in this research is not a specialized demographic survey, our access to detailed information about the children's mothers remains insufficient, which hinders an in-depth analysis of fertility issues. Third, due to the rigorous enforcement of China's double reduction policy, a substantial amount of information regarding PTCs is no longer publicly available. This has made it challenging to trace the potential establishment dates of these PTCs, consequently preventing us from fully ensuring that all PTCs were founded before the birth of the children in our sample.

In conclusion, the link between educational competition and family size remains a noteworthy academic puzzle. The classic Q–Q trade-off theory centers on the household level, framing smaller family size with concentrated offspring investment as a rational, proactive pattern of household resource allocation. However, our analysis reveals that in a highly competition-focused system, this outcome could be passively shaped. It is driven not solely by proactive household resource allocation, but also by households' involuntary escalation of educational investment amid intergenerational competition, which tightens resource constraints and reduces family size.

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References

Andersson, G. (2004). Childbearing after migration: Fertility patterns of foreign-born women in Sweden. *International Migration Review* 38(2): 747–775. doi:10.1111/j.1747-7379.2004.tb00216.x.

Becker, G.S. and Lewis, H.G. (1973). On the interaction between the quantity and quality of children. *Journal of Political Economy* 81: s279–s288. doi:10.1086/260166.

Becker, G.S., Murphy, K.M., and Tamura, R. (1990). Human capital, fertility, and economic growth. *Journal of Political Economy* 98(5): S12–S37. doi:10.3386/w3414.

Bray, M. (2013). Shadow education: Comparative perspectives on the expansion and implications of private supplementary tutoring. *Procedia – Social and Behavioral Sciences* 77: 412–420. doi:10.1016/j.sbspro.2013.03.096.

Cai, F. (2014). Demographic transition, demographic dividend, and Lewis turning point in China. In: Huang, Y. and Cai, F. (eds.). *Debating the Lewis turning point in China*. Abingdon: Routledge: 17–29.

Cai, Y. and Feng, W. (2021). The social and sociological consequences of China's one-child policy. *Annual Review of Sociology* 47: 587–606. doi:10.1146/annurev-soc-090220-032839.

Chen, Y., Guo, F., Wang, J., Cai, W., Wang, C., and Wang, K. (2020). Provincial and gridded population projection for China under shared socioeconomic pathways from 2010 to 2100. *Scientific Data* 7(1). doi:10.1038/s41597-020-0421-y.

Doepke, M. and Kindermann, F. (2019). Bargaining over babies: Theory, evidence, and policy implications. *American Economic Review* 109(9): 3264–3306. doi:10.1257/aer.20160328.

Exley, S. (2021). Open policy making in the UK – To whom might policy formulation be "opening up"? *Journal of Social Policy* 50(3): 451–469. doi:10.1017/S0047279420000215.

Feng, Z., Liu, C., Guan, X., and Mor, V. (2012). China's rapidly aging population creates policy challenges in shaping a viable long-term care system. *Health Affairs* 31(12): 2764–2773. doi:10.1377/hlthaff.2012.0535.

Gillespie, D.O.S., Russell, A.F., and Lummaa, V. (2008). When fecundity does not equal fitness: Evidence of an offspring quantity versus quality trade-off in pre-industrial humans. *Proceedings of the Royal Society B: Biological Sciences* 275(1635): 713–722. doi:10.1098/rspb.2007.1000.

Happel, S.K., Hill, J.K., and Low, S.A. (1984). An economic analysis of the timing of childbirth*. *Population Studies* 38(2): 299–311. doi:10.1080/00324728.1984.10410291.

Huang, W., Lei, X., and Sun, A. (2021). Fertility restrictions and life cycle outcomes: Evidence from the one-child policy in China. *The Review of Economics and Statistics* 103(4): 694–710. doi:10.1162/rest_a_00921.

Jin, J. and Ball, S.J. (2020). Meritocracy, social mobility and a new form of class domination. *British Journal of Sociology of Education* 41(1): 64–79. doi:10.1080/01425692.2019.1665496.

Joshi, H. (1998). The opportunity costs of childbearing: More than mothers' business. *Journal of Population Economics* 11: 161–183. doi:10.1007/s001480050063.

Kim, S., Tertilt, M., and Yum, M. (2024). Status externalities in education and low birth rates in Korea. *American Economic Review* 114(6): 1576–1611. doi:10.1257/aer.20220583.

Lawson, D.W. and Borgerhoff Mulder, M. (2016). The offspring quantity-quality trade-off and human fertility variation. *Philosophical Transactions of the Royal Society B: Biological Sciences* 371(1692): 20150145. doi:10.1098/rstb.2015.0145.

Li, H. (2017). The 'secrets' of Chinese students' academic success: Academic resilience among students from highly competitive academic environments. *Educational Psychology* 37(8): 1001–1014. doi:10.1080/01443410.2017.1322179.

Liu, H. (2014). The quality-quantity trade-off: Evidence from the relaxation of China's one-child policy. *Journal of Population Economics* 27(2): 565–602. doi:10.1007/s00148-013-0478-4.

Lu, W., Zhou, S., and Wei, Y. (2022). Government policies and unintended consequences: Rising demand for private supplementary tutoring in China. *International Journal of Educational Development* 94: 102653. doi:10.1016/j.ijedudev.2022.102653.

Mace, R. (2008). Reproducing in cities. *Science* 319(5864): 764–766. doi:10.1126/science.1153960.

Marginson, S. (2016). The worldwide trend to high participation higher education: dynamics of social stratification in inclusive systems. *Higher Education* 72(4): 413–434. doi:10.1007/s10734-016-0016-x.

Meng, J., Wang, H., Yang, Y., and Zhang, M. (2025). Education competition and fertility intention: Evidence from China's private tutoring ban. *The Economic Journal* ueaf096. doi:10.2139/ssrn.4980022.

Mirowsky, J.E. and Ross, C.E. (2003). *Education, social status, and health*. Berlin: Walter de Gruyter, Inc.

MOE (Ministry of Education) (2021). Further reducing the burden of students' homework and off-campus training in compulsory education [in Chinese]. http://www.moe.gov.cn/jyb_xxgk/moe_1777/moe_1778/202107/t20210724_546576.html.

National Bureau of Statistics of China（NBSC) (2024). *China statistics yearbook* [in Chinese]. Beijing: China Statistics Press.

Pierson, P. (2000). The limits of design: Explaining institutional origins and change. *An International Journal of Policy and Administration* 13(4): 475–499. doi:10.1111/0952-1895.00142.

Raymo, J.M., Musick, K., and Iwasawa, M. (2015). Gender equity, opportunity costs of parenthood, and educational differences in unintended first births: Insights from Japan. *Population Research and Policy Review* 34(2): 179–199. doi:10.1007/s11113-014-9348-3.

Robusto, C.C. (1957). The Cosine–Haversine formula. *The American Mathematical Monthly* 64(1): 38–40. doi:10.2307/2309088.

Wang, F., Cai, Y., Shen, K., and Gietel-Basten, S. (2018). Is demography just a numerical exercise? Numbers, politics, and legacies of China's one-child policy. *Demography* 55(2): 693–719. doi:10.1007/s13524-018-0658-7.

Xue, M., Wang, H., Wang, Y., and Qiao, X. (2025). Decoding the educational illusion: Self-assurance, anxiety, and adaptive strategies in Chinese middle-class parental investment. *British Journal of Sociology of Education* 46(3): 391–407. doi:10.1080/01425692.2025.2472063.

Yu, J. and Xie, Y. (2021). Recent trends in the Chinese family. *Demographic Research* 44(25): 595–608. doi:10.4054/DemRes.2021.44.25.

Zeng, Y. and Hesketh, T. (2016). The effects of China's universal two-child policy. *The Lancet* 388(10054): 1930–1938. doi:10.1016/S0140-6736(16)31405-2.

Zhang, W. and Bray, M. (2018). Equalising schooling, unequalising private supplementary tutoring: Access and tracking through shadow education in China. *Oxford Review of Education* 44(2): 221–238. doi:10.1080/03054985.2017.1389710.

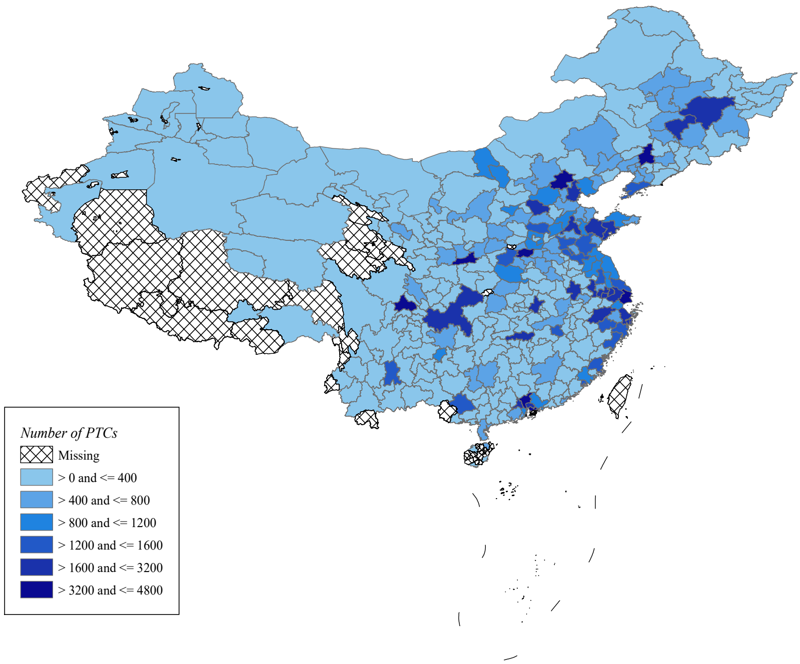
Zhang, W. and Bray, M. (2021). A changing environment of urban education: historical and spatial analysis of private supplementary tutoring in China. *Environment and Urbanization* 33(1): 43–62. doi:10.1177/0956247820981820.

Zhang, Y., Dang, Y., He, Y., Ma, X., and Wang, L. (2021). Is private supplementary tutoring effective? A longitudinally detailed analysis of private tutoring quality in China. *Asia Pacific Education Review* 22(2): 239–259. doi:10.1007/s12564-021-09671-3.

Zhou, J. and Chen, H. (2023). Will reducing the burden of extracurricular tutoring raise fertility willingness in China? Five policy suggestions. *Journal of Policy Modeling* 45(6): 1132–1147. doi:10.1016/j.jpolmod.2023.11.001.

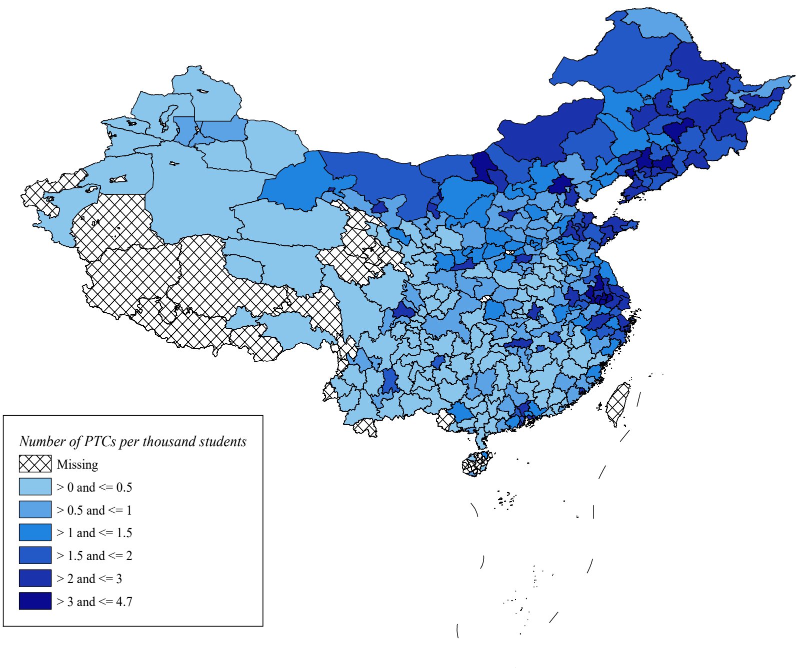
Appendix

Figure A-1: The number of PTCs at the prefecture-level cities in China in 2019



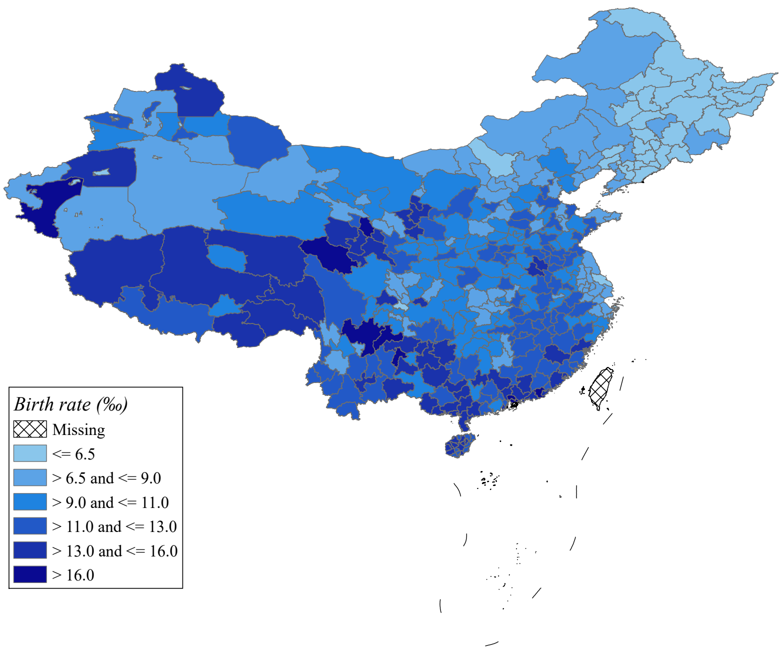
Notes: The data were collected by the authors in May 2019 from Dianping.com, the leading business review platform in China. This platform compiles information on a wide range of businesses, spanning dining, entertainment, and educational services. It includes details such as business addresses, average customer spending, and user reviews.

Figure A-2: The number of PTCs per thousand students at the prefecture-level cities in China in 2019



Notes: Data on PTCs were collected by the authors from Dianping.com in May 2019. The students refer to those enrolled in primary, middle, and high schools in 2019, and these data were obtained from the 2020 China City Statistical Yearbook and various regional economic and social development reports.

Figure A-3: The birth rate at the prefecture-level cities in China in 2019



Notes: The birth rate data for prefecture-level cities in 2019 were manually collected by the authors. The sources included the National Economic and Social Development Statistical Bulletins of various regions, city yearbooks or city statistical yearbooks, and the websites of local statistical bureaus. However, the data for Jinzhou in Liaoning Province, Nujiang Lisu Autonomous Prefecture in Yunnan Province, Shannan and Nagqu in Tibet, and Hotan in Xinjiang were not available. For these cities, we used the provincial-level average birth rate as a substitute.

Table A-1: Descriptive statistics

Variable	Mean/Percent	N
Household-level variables		
Number of younger siblings	0.49 (0.73)	680,022
Minority (Yes = 1)	10.98%	680,437
Mother's highest education (bachelor's degree or higher =1)	23.99%	680,437
Father's highest education (bachelor's degree or higher =1)	25.20%	680,437
Mother's occupation (public sector job = 1)	3.52%	680,437
Father's occupation (public sector job = 1)	5.20%	680,437
Household annual income level		630,412
<= 50k RMB	46.33%	
> 50k and <= 300k RMB	45.75%	
> 300k RMB	7.93%	
Number of older siblings	0.47 (0.77)	680,000
Region (rural = 1)	40.99%	680,437
School-level variables		
PTCs within 800 m around schools (Yes = 1)	48.89%	3,753
PTCs within 1,000 m around schools (Yes = 1)	51.53%	3,753
PTCs within 1,200 m around schools (Yes = 1)	53.48%	3,753
Number of PTCs within 800 m around schools		3,753
None	51.11%	
1–3 PTCs	15.27%	
4–10 PTCs	13.35%	
More than 10 PTCs	20.28%	

Notes: The standard deviations of continuous variables are presented in parentheses. For categorical variables, only percentages are reported. The sample sizes vary slightly across different variables due to missing values.

Table A-2: Sensitivity analysis of results to PTC distance relative to schools

	(1)	(2)
	1,000 m	1,200 m
Variables	Number of younger siblings	
PTCs within a specific radius around schools	–0.037	–0.040
(Yes = 1)	[–0.047, –0.026]	[–0.050, –0.029]
Observations	629,841	629,841

Notes: In the first column, the search radius for the number of institutions around schools is expanded to 1,000 meters; in the second column, it is expanded to 1,200 meters. Both regressions include control variables such as minority, mother's highest education, and father's highest education (same as in Table 1). Robust 95% confidence intervals in square brackets.