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Essays on human capital development:

The impact of teachers, peers, and higher education

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Submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy

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Abstract

This thesis contributes to understanding three aspects of educational determinants of human capital developments. Chapter 1 examines the effects of teachers' attitudes toward internal migrant students' academic ability relative to local students on their test scores in host schools. Making use of the random assignment of students to teachers, this chapter finds that having teachers with positive attitudes towards migrant students could improve their test scores. Importantly, these gains do not come at the expense of local students. The positive effects are driven by improvements in the feelings and emotions of migrant students, teachers' behaviours in favour of them, and supportive responses from parents. Chapter 2 investigates the effects of peers' sports preference on students' exercise participation, health, mental health, cognitive performance in the short term, as well as on schooling years and labour market outcomes in the long term. This chapter finds that having peers who favour sports could improve students' probability of participating in vigorous exercise and not being obese. Meanwhile, sports-oriented peers do not affect students' cognitive performance, mental health, schooling years and labour market outcomes. The positive effects on exercise and health are driven by social comparison pressure related to body management. Chapter 3 analyses the long-term effects of higher education on individuals' Big Five personality traits, risk aversion, mental health, confidence, life satisfaction, and trust, examining outcomes 10 years after graduation on average. Building on the differences in exposure to higher education expansion policy in China and constructs an instrumental variable, this chapter finds that finishing higher

education improves individuals' conscientiousness while decreasing risk aversion, confidence, and trust levels in general. No significant effect on the other four dimensions of Big Five personality traits, mental health, and life satisfaction is found. One channel through which higher education improves conscientiousness is the induced improvement in work environments.

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Declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution

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Xinyi Chen

Chapter 0

Introduction

In recent decades, the economics of education has gone beyond test scores to encompass broader human capital outcomes, including cognitive skills, non-cognitive skills, and health. Improving these human capital outcomes is a key objective for education systems worldwide. At the individual level, better human capital outcomes translate into many individuals' life-cycle outcomes, including higher wages, better employment opportunities, and overall well-being (Anelli, 2020; Fu et al., 2022; Smith et al., 2025; Zimmerman, 2014). From the perspective of economic and social development, improving human capital outcomes could promote productivity, innovation, economic growth, equalities, crime reduction, and social security (Acemoglu and Autor, 2012; Si, 2022; Wang, Liu, Yan and Zhao, 2022). Understanding the determinants of human capital outcomes, especially those incorporated in education systems, is crucial for researchers and policymakers to foster individual and social welfare. This thesis addresses three potential contributing factors to human capital development: teachers, peers, and higher education experience.

In the first chapter, the study examines how subject teachers' attitudes towards the study abilities of internal migrant students, relative to local students, influence their academic performance. This chapter is set in Chinese middle schools and uses data from nationally representative surveys—China Education Panel Survey (CEPS). Restricting the sample to schools that randomly assign students to classes, this chapter begins by outlining the undervaluation of teachers regarding the relative performance of migrant students at the class level. Then, this chapter uses a value-added specification with school fixed effects and investigates the effects of such biased attitudes of teachers on migrant students' test scores in the follow-up academic year, relative to those of local students. This study finds that having teachers with positive attitudes towards migrant students could improve their test scores. There is no harmful effect on local students. There are several channels through which teachers' attitudes play a role. First, teachers' attitudes induce differentiated behaviours of teachers. A teacher with favourable attitudes towards migrant students is more likely to praise them and criticise local students. Second, migrant students taught by teachers with positive attitudes towards them are less likely to feel blue and more likely to report positive feelings about their classmates and schools. Additionally, teachers' favourable attitudes can be conveyed to parents, improving their beliefs about student ability and adjusting their parenting styles accordingly.

The second chapter explores the spillover effects of sports-oriented peers. Using data from the Taiwan Education Panel Survey (TEPS), this chapter aims to identify the impact of classroom peers' pre-determined sports preferences on students' outcomes. Making use of the random assignments of students to class peers within selected track in Taiwanese high schools, this chapter finds that having sports-oriented peers in the classroom could increase students' probability of moderate sports participation. At the same time, stu-

dents exposed to a higher share of peers who like sports are less likely to be obese. This chapter does not find any significant effect of peers' pre-determined sports preferences on students' mental health, cognitive performance, as well as long-term educational and labour market outcomes. The positive health impact of sports-oriented peers is driven by social comparison pressure regarding body management.

The third chapter investigates the impact of finishing higher education (HE) on non-cognitive skills and several behavioural traits, including the Big Five personality traits. The datasets used come from the China Family Panel Study (CFPS) 2018 wave and the National Bureau of Statistics. This chapter makes use of the higher education expansion (HEE) policy in 1999 in China and constructs an instrumental variable to deal with the endogeneity issue caused by selection to HE. The HEE policy sharply increased HE enrolment in China, with varying impacts across provinces and cohorts. The instrumental variable is constructed based on this heterogeneity. By employing an instrumental variable method, this study captures the effect for students affected by the HEE policy, i.e., the academically marginal students. This chapter finds that HE completion improves individuals' conscientiousness and reduces their risk aversion, confidence, and general trust in the long term. In contrast, no significant effect of HE on other dimensions of the Big Five personality traits, mental health, and life satisfaction is found. There are heterogeneous effects by gender: males experience decreases in agreeableness and depression after graduation from HE relative to females. There is evidence of one potential channel: HE-induced changes in work conditions are a channel through which conscientiousness is shaped in the long term. By contrast, major-specific programme design does not drive the main results in this chapter.

Chapter 1

Bridging the social divide: Teacher attitudes and the academic achievement of internal migrant students

Abstract

With the rapid growth of internal migration, migrant students in developing countries often face challenges integrating into host schools. Whereas previous evidence points to the effects of school-level institutional arrangements, only limited attention has been paid to the impacts of teachers on local-migrant achievement gaps. This study investigates the effects of teachers' attitudes toward internal migrant students' academic ability relative to local students on their test scores in host schools. Making use of the random assignment of students to teachers, this study finds that having teachers with positive attitudes towards migrant students could improve their test scores. Importantly, these gains do not come at the expense of local students. The positive effects are driven by improvements in the feelings and emotions of migrant students, teachers' behaviour in favour of them, and supportive responses from parents. This study contributes to the literature on migrant student integration by showing the role of teachers attitudes' in shaping migrant students' outcomes. This study extends the literature on teachers' attitudes by documenting how attitudes shaped by institutions operate within a two-tier society and focusing on a student group at risk of stereotyping due to their families' socioeconomic background.

1.1 Introduction

Migrant integration is crucial for social stability and cohesion (Andrews, 2015; Loch, 2014; Taylor and Foster, 2015). While education is regarded as a pathway to promote the integration of migrants by improving human capital, labour market outcomes, and social mobility among migrant families, migrant students face academic disadvantages in host schools (Oberdabernig and Schneebaum, 2017; Schneeweis, 2011). According to the Programme for International Student Assessment (PISA), attainment gaps favouring local students relative to their immigrant counterparts in all PISA subjects are observed in most countries (OECD, 2023).[1] Understanding the factors contributing to this disparity in host regions has important implications for both research on migrant integration and policies designed to promote it. This is especially true for China, where the number of internal migrant children aged 0 to 17 rose from 19.82 million in 2000 to 71.09 million in 2020, achieving a 3-fold increase (National Bureau of Statistics of China, 2023*b*). A body of studies exploring either international or internal migration finds that pre-primary education, time in local schools, use of external assessments, and school quality influence migrant students' performance (Chen and Feng, 2013, 2019; Chen et al., 2020). In addition to those factors mostly related to educational institutions, increasing studies show that teachers' attitudes and stereotypes play a role in shaping between-group attainment gaps. Most of the relevant literature regarding the impacts of teachers' attitudes focuses on

1. See Colding et al. (2009); Lüdemann and Schwerdt (2013); Oberdabernig and Schneebaum (2017); Schneeweis (2011); Seynhaeve et al. (2024) for examples of research evidence on local-migrant gaps. However, OECD (2023) points out that the local-migrant gap reported should be interpreted carefully since the local-immigrant disparities disappear if the socioeconomic status of students is considered. This is consistent with the ambiguity regarding the existence and direction of local-immigrant gaps in current literature. The existing research evidence suggests that the performance of migrant students relative to local students may show heterogeneity across the distribution of family socioeconomic backgrounds.

teachers' gender attitudes, with one study examining teachers' perceptions of refugee students (Alan et al., 2023, 2018; Carlana, 2019; Lavy and Megalokonomou, 2024; Lavy and Sand, 2018). However, little is known about how such attitudes operate in contexts characterized by institutional divides, such as the local–nonlocal distinction.

This paper investigates the effects of teachers' attitudes towards internal migrant students on the test scores of those non-local students compared with local students. The dataset employed in this study is the China Education Panel Survey (CEPS), which collects information on middle school students, teachers, and schools in China. The attitude measure is a class-level attitude index of relative academic ability between migrant and local students in three core subjects. The index is generated by taking the difference between the teacher's subjective perceptions of migrant students' academic ability and their actual test-based performance relative to local students in the baseline wave. This study takes several steps to alleviate the potential endogeneity bias arising from students sorting into classes with different peers and teachers. First, the sample is restricted to schools that randomly assign students to classes so that the endogeneity bias caused by confounders on teachers' and students' characteristics can be largely eliminated. Extensive balance tests are conducted to show that the assignment of students to teachers is quasi-random. Second, a value-added model is employed to control for students' baseline ability and extract the impacts of teachers' attitudes on students' improvements. Third, school fixed effects are included to control for common environmental factors. Fourth, this study addresses concerns about reverse causality by examining the impact of baseline teacher attitudes on subsequent student achievement. This study compares the performance of migrant students relative to local students in various classes with differing subject

teachers' attitudes within the same school, controlling for other teachers' characteristics. One potential concern is that the teachers' attitudes are reported after exposure to students, which may reflect the teachers' observations of specific students rather than their general beliefs. This study addresses this through several robustness checks.[2]

This study finds that having teachers with positive attitudes towards migrant students could improve their test scores. A one standard deviation increase in the teachers' attitude index (in favour of migrant students) is associated with an increase in migrant students' test scores by 0.1290 standard deviation. There is no harmful effect on local students. This highlights the potential role of teachers' attitudes in shaping migrant students' academic performance. The rich information on students, teachers, and parents in CEPS allows this study to provide evidence of potential mechanisms. Channels related to teachers' behaviours, students' mental states, and parents' responses are considered. This study finds that a teacher with more positive attitudes towards migrant students is more likely to praise them. At the same time, migrant students taught by teachers with positive attitudes towards them are less likely to feel blue, sad and more likely to report positive feelings about their classmates and schools. Additionally, parents tend to perceive the favourable attitudes of teachers, thereby improving their beliefs about student ability and adjusting their parenting styles accordingly.

This study contributes to several strands of the existing literature. First, this study is relevant to the literature on the integration problems of migrant students and the interrelationship between local and migrant children. A modest body of literature shows that there are noticeable educational disparities between migrant and local students in

2. See Section 1.6.1 for more details.

host regions. However, much less effort has been devoted to investigating why those gaps exist and under what conditions the gaps can be narrowed. Limited evidence on migrant students in host regions shows that educational factors within local educational institutions, such as school quality, the frequency of using external assessments, and school time, could impact the integration of migrant students (Chen and Feng, 2013, 2019; Chen et al., 2020). However, no study investigates the potential of teachers and teachers' attitudes, as an important component of school institutions, in reducing local-migrant achievement gaps. This study fills the evidence gap by showing that teachers' positive attitudes improve the academic performance of migrant students relative to local students, contributing to a reduction in local-migrant achievement gaps.

Second, the effects of teachers' attitudes towards migrant students documented in this study are related to a body of recent studies on the effects of teachers' characteristics and stereotypical attitudes toward disadvantaged students on between-group gaps among students (Alan et al., 2023; Alesina et al., 2024; Lavy and Megalokonomou, 2024; Lavy and Sand, 2018; Papageorge et al., 2020; Rakshit and Sahoo, 2023). Typically, studies in this literature exploit across-class within-school variation to estimate the impact of teachers' attitudes on a variety of student outcomes. These studies have documented teachers' biased attitudes based on students' gender and refugee status. However, there is no evidence on teachers' attitudes towards internal migrants. One closely related study is Alesina et al. (2024), which examines how to reduce teachers' stereotypes towards immigrant students. They find that teachers who have negative stereotypes towards immigrant students tend to underevaluate them in the non-blindly graded exams, conditioning on their performance in blindly graded exams. That is, teachers' stereotypes towards immigrant students can lead to grading bias. Compared with Alesina et al. (2024), this study exam-

ines whether and how teachers' potentially prejudiced attitudes towards migrant students affect migrant students' academic attainment in the following year, rather than focusing on grading bias.[3] Distinguishing teachers' perceptions of internal migrant students from other attitudes is meaningful in that potential biases against internal migrant students mainly come from fixed mindsets about families with low socioeconomic backgrounds in a society constrained by institutional divides. Given this speciality, this study contributes to the literature on the effects of teachers and teachers' attitudes by further investigating the role of teachers' preconceived notions formed under institutional transitions. It highlights how teachers' preconceived notions, shaped by institutional transitions, reinforce persistent social stratification and between-group inequality. Additionally, this study contributes to the literature by further singling out the role of preconceived notions about students with disadvantaged socioeconomic backgrounds from other factors that may lead to teachers' biases, such as racial differences.

The third contribution lies in the rich information on students, teachers, and, in particular, parents available in the datasets. This allows this study to explore mechanisms specifically related to teachers, students, and parent-teacher interactions through which teachers' attitudes may influence students' scores. Particularly, previous studies on teacher attitudes do not provide relevant evidence from the perspective of parents in response to teachers with different levels of bias.

---

3. The grading behaviours of stereotypical teachers can be a possible channel through which teachers' attitudes play a role. However, this study cannot address this issue since the grading method of test scores is unavailable. In the context of migration, existing studies show that providing information on individual own stereotypes and interactions with minorities could be helpful in reducing stereotypes (Alesina et al., 2024; Corno et al., 2022). While this is an important question for future investigation, this study cannot provide any definitive conclusions on the potential contributors to the decrease in stereotypes.

The rest of this study is structured as follows. Section 1.2 presents the institutional setting for this study. Section 1.3 describes the data, sample, and presents some descriptive analysis. Section 1.4 conducts a series of checks for the validity of the randomisation of students and presents the empirical strategy. Section 1.5 states the main findings and outlines three mechanisms. Section 1.6 presents robustness tests. Section 1.7 concludes.

1.2 Institutional background

1.2.1 Hukou system and migrant students in China

Migrant status has long been regarded as a social identity for the disadvantaged in contemporary China. This perception stems from the hukou system (or household registration system) established in the 1950s. Hukou registration records individual basic characteristics, including name, gender, birthday, ethnicity, location or address (usually passed from one's parents) (Buzinkai and Škvrnda, 2014; Song, 2014). The hukou system creates two forms of stratification according to residents' place of household registration: rural versus urban status and local versus migrant status (Song, 2014). Closely relevant to this study, migrant people are easily identified under the hukou system: they live in regions (such as cities, towns, or villages) that are different from their registered address in the hukou system (Song, 2014).[4]

4. Migrant people in this study are defined as individuals from nonlocal districts or counties in local urban area, see Section 1.3 for how it is defined by the survey questions.

The roots of non-local hukou as a social identity are the differentiating resource allocations between local and non-local hukou holders during the planning period.[5] Under the planned economy, wages, goods allocation, and public services varied across regions, but people could only access benefits in their registered locality (Cheng and Selden, 1994). Migration was tightly controlled through food rationing systems that restricted non-locals' survival without official permits.[6] By doing this, the government maintained the "still" population structure, which is easier for the government to implement strict rationing and assignments.

Since the country's transition to a market economy, the Chinese government has been loosening controls over the hukou restrictions by enforcing several reforms (Song, 2014). Migration today is legal and relatively free: people could move to other regions to make a living and transfer their hukou to the local area. However, there are still institutional barriers to migration: acquiring a local hukou is not easy, and it normally requires non-locals to have a decent job for several years. Local hukou is still tied to welfare provision

5. The hukou system was initially imposed to figure out the population size and its changes, as well as to maintain social security, peace, and order in the context of the establishment of a new regime (Cheng and Selden, 1994). It gradually developed into a means to implement a planned economy.
6. For instance, during the planning period, urban residents could obtain food only with locally-issued ration stamps. Migrants needed official approval to exchange stamps, making travel across cities difficult.

and public services as a result of the historical planning model stated above, hindering migrants from accessing local welfare.[7] Additionally, migrant residents also face social discrimination in host cities.[8] Overall, migrant status remains associated with socioeconomic disadvantage due to persistent institutional barriers and social stigma.

These disadvantaged conditions also apply to migrant students. Since migrant children have nonlocal hukou, they are not entitled to enter local public schools during the planning period (Afridi et al., 2015). Since market reform in 1980s, migrant children are provided with some spaces in local public schools. However, these positions are limited.[9] And migrant parents are required to pay for considerable "out-of-district" fees, get a variety of documents and certificates for these positions (Chen and Feng, 2013, 2017). These requirements are difficult for migrant parents who have informal or short-term occupations in destination cities. In fact, a lot of migrant families thus cannot send their children to local public schools and have to turn to migrant schools that is privately ran, built at

7. The conflicts between the increasing number of nonlocal people and access to local public services mainly exist in large and booming cities where most migrants in the country live, and where local welfare is generous (Song, 2014). Nonlocal hukou holders are typically not eligible for local housing subsidies for low-income workers provided by provincial governments (such as housing purchase or rental subsidies), nor for low-rent and low-price public housing (lianzufang and jingjishiyongfang in Chinese). See the following content in this section for how migrant children are hindered from the public educational system. Nonlocal workers are not covered by social relief such as minimum living guaranties or social welfare such as disability benefits. They are weakly covered by social insurance. For example, in most cases, migrant workers can receive reimbursement for medical expenses covered by public health insurance only in their place of hukou registration.

8. See Song (2014) for a detailed review regarding how hukou restricts the access of nonlocal dwellers to public services in host cities and the labour discrimination against nonlocals in current China. For instance, discrimination against migrant workers in the labour market, such as differentiating hiring requirements and wages, has been found by many studies. These studies compare and decompose the earnings of individuals with different hukou types and locations. They found earning gaps attributed to hukou differences. See Gagnon et al. (2009); Knight et al. (1999); Lee (2012); Song (2015); Zhu (2016*a*,*b*) for examples of these studies. See Gagnon et al. (2009); Zhao (2005) etc. for examples of studies suggesting discrimination in hiring. These studies find that nonlocal hukou holders are less likely to get formal jobs particularly in state-owned enterprises that are covered by social insurance, due to their hukou status.

9. Positions for migrant children are available when local students do not fully occupy the enrolment positions or when there are extra spaces (Chen and Feng, 2017). The scarcity of the available positions for migrant students in local public schools is caused by how the central governments determine funding allocation for local budgets, which is one of the remnants of the planning model. Usually, funding for public schools in locality is allocated by the number of children of school age with local hukou and is not easily adjusted within a year and across administrative units (Chen and Feng, 2019).

low cost, usually of low quality and unstable (Song, 2014). Even after enrolment, it seems that migrant students may not get same benefits as their local counterparts. Since many migrant students have to go back to the hukou location to take important high school and college entrance examinations and their scores are not taken accounted into the performance of teachers in local schools in many regions, it is likely that teachers pay less attention to migrant children (He and Li, 2014; Jia et al., 2021; Xu, 2009).[10]

After the year of 2000, the situations of migrant children have improved substantially, owing to the government's support and the society's donation. The number of required documents for parents declines and there are more available positions in public schools. In 2020, 85.8% of national migrant students can enrol in public schools in destination cities or enjoy degree services purchased by the government across all stages of compulsory education (Chen et al., 2024). Nevertheless, the improvement is gradual and in process, there are still obvious barriers. And the barriers vary substantially across cities, the barriers are particularly high for large cities where migrants gather (Song, 2014). Additionally, the enrolment rate in post-compulsory education for migrant students in destination cities is

10. Since 2012, the State Council released a document named the Opinions about How to Make Sure that Migrant Students Can Take Entrance Exams in Destination Cities after Compulsory Education and required that local government should take measures to gradually break the barriers not only for the enrolment of public schools for compulsory education but also for the path to post-compulsory education. Currently, the reforms on allowing migrant students to take the entrances exams in destination cities are still in progress and cities release limited positions for the exam permit. Migrant students are usually allowed to take entrance exams in destination cities only with additional requirements for a series of documents and conditions for migrant parents and students, such as residence permit, certification for social insurance participation of parents and written certification to prove that it is difficult to go back to hukou location place (Chen et al., 2024). Even some of the additional document requirements are overlapped with the requirements for the enrolment in local public schools for migrant students, it does not mean that most of migrant students enroled could get the exam permit. First, the overlapped documents are the double checks of the states and conditions of migrant parents, which do not allow temporary unemployment. Second, the requirements in addition to the overlapped parts is detailed and hard to be satisfied for some migrant students. For instance, in some cities, it is necessary for migrant students not only to enrol in public schools in destination cities but also meet the requirements on the number of years of enrolment in local schools. Additionally, there are restrictions on the type of high school that migrant children can enter in some cities (Chen et al., 2024; Jia et al., 2021). For instance, migrant students in Beijing and Tianjin are not allowed to enter local general high school, and they are only allowed to enter vocational high schools in locality (Jia et al., 2021).

plainly low: only 7.25% of migrant students have access to the general high schools in 2021 (Han and Zhang, 2023). Two main reasons can explain the low enrolment rate of migrant students in high schools. First, they may score lower on average than local students in college entrance exams. Second, they face additional administrative requirements for both taking entrance exams and transferring to schools in destination cities.[11] Consequently, many migrant students drop out, enter the workforce, or return to their hukou locality for schooling (becoming left-behind children). Overall, there still a long way to break the institutional barriers and remove the educational inequality between local and nonlocal students.

1.2.2 Chinese middle schools and context for identification

The site of this study is middle schools in China. Since secondary education is the key stage deciding students' enrolment in high schools, focusing on middle school stage interventions for migrant children may be particularly remedial in eliminating the low enrolment rates of migrant students in high schools. Students in Chinese middle schools usually progress from grade 7 to grade 9 (i.e., aged 12 to 14). The classes are assigned before the beginning of 7th grade, and correspondingly, the teachers are appointed to different classes at that time. The assignment of classes remains constant throughout middle school for most students. There are 3 core subjects: Chinese, Mathematics, and English.[12] Students sit in the classroom, and different teachers come to teach.

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11. See the requirements for migrant students to attend local high schools in Hunan Province at `https://www.pingjiang.gov.cn/34911/34914/34961/36362/content_1070053.html`.
12. In addition to the three core courses, middle school students usually study physics, chemistry, biology, history, politics, and geography.

The empirical strategy of this study is powered by the random assignment of classes in most Chinese middle schools. Some schools assign students to classes based on entrance exam scores or tests taken after students enter middle school. However, most of the middle schools in China randomly assign students to different classes, normally using computer program to ensure balance based on class size, gender, migrant status, and other characteristics (Gong et al., 2018). Correspondingly, teachers are randomly appointed to the classes in most of the middle schools. The random assignment is greatly promoted by the government to avoid different levels of classes and teacher sorting in order to advance equity. The random assignment provides an opportunity for this study to largely eliminate the confounding effects of teacher sorting problems. How the sample is restricted to classes that have been randomly assigned is stated in Section 1.3.1.

1.3 Data and descriptive analysis

1.3.1 Data and sample

This study uses data from the China Education Panel Survey (CEPS). CEPS is designed to be representative of the Chinese population in mainland China. The dataset collects information on students, one of the student's parents, teachers, and school administrative staff (National Survey Research Center at Renmin University of China, 2014). Available data covers two waves of the survey, which were conducted in the 2013-2014 and 2014-2015 academic years, respectively. The baseline survey collects data for students in grade 7 (i.e., aged 12) and grade 9 (i.e., aged 14). Only students in grade 7 in the baseline year (i.e., students in grade 8 in the 2014-2015 wave) are retained in the next wave.

This study employs both waves and focuses on the traced students in grade 7 in the baseline survey to utilise the panel features of the dataset. A student is defined as a migrant or non-local student who currently enter schools in urban areas and their hukou registration district or county differ from their current district or county of residence.[13] The sample in this study include only students who currently enter school in urban areas. This allows this study to eliminate the potential left-behind children who do not migrate with parents and face the challenges of parental absence. In this study, the sample is restricted to grade 7 students in the baseline survey (i.e., the grade 8 students in the 2014-2015 wave) in schools where the class assignment is reported to be random. In China, students are assigned to classes when they first enter middle school in grade 7. The assignment remains constant from grade 7 to grade 9 in most schools. To ensure that the class assignment is random across waves, the sample is further restricted to classes where there is no reassignment in the 2014-2015 academic year (these are reported in the questionnaires for school principals or other school managers).[14] The random assignment of students to classes in CEPS is well documented and validated by previous studies, see Gong et al. (2018) and Hu (2018) as examples. Following these studies, checks on random assignment are conducted in Section 1.4.1. The analysis sample includes 2755 local and 648 migrant students in 127 classes across 71 schools. Summary statistics of students and their teacher-related variables in the analysis sample are presented in Table 1.1 and Table 1.2.

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13. In CEPS, students are asked about their registered place in the hukou system by "The location of your hukou at present is: 1. In the local county/ district 2. Not in the local county /district" in both waves.

14. Principals and other administrative staff are asked, "Which of the following criteria are used for the school to allocate students into classes (multiple choices)?" The answers are: "1. Entrance exam scores 2. Students' hukou locality 3. Random or equal allocation 4. Others". The sample in this study is restricted to schools whose staff only report option 3. Regarding any reassignment after enrolment, principals are asked, "After the start of the new semester, does the school reassign the students in grade 8/9?" The answer is "1. Yes 2. No". The sample is restricted to schools whose staff chose "2. No".

Summary statistics presented in Table 1.1 illustrate the characteristics of migrant and local students. Consistent with Section 1.2, migrant students seems to come from relatively disadvantaged families: their parents are less educated and have relatively lower income within community, and they are more likely to live in communities with more locals. Additionally, these migrant students tend to have lower non-cognitive skills, report experience of having serious disease, grade repetition and school transfer before entering the middle school.

Table 1.2 presents summary statistics for the teacher sample. 23.7% of the teachers in the main sample are male, with a mean age of 38.6 years. Teachers have an average of 16.1 years of education and 16.4 years of teaching experience. Most teachers (92.2%) attended pedagogical universities or majored in education, while 63.2% have worked in other schools. On average, teachers have spent 10.3 years in their current schools, suggesting that the sample includes teachers with substantial professional experience.

1.3.2 Outcome variable

The main outcome that this study focuses on is the academic performance of students after their exposure to the teachers in middle school for 1 year. CEPS provides students' test scores on three main subjects, including mathematics, Chinese, and English, in midterm exams in both waves.[15] The test scores in the second wave are the main outcome of interest in this study. Based on the raw test scores provided, the key outcome variable is calculated by averaging the scores from the 3 core subjects.[16] Both the baseline and second wave test

15. Specifically, data on test scores are collected from school staff rather than reported by students themselves. Two versions of test scores are provided in the first wave: raw scores and standardised scores with a mean value of 70 and a standard deviation of 10. In the second wave, only raw scores are provided.
16. In the regression specifications, subject fixed effects are controlled for to consider the potential differences in test scores across subjects.

scores are standardised at the school and subject level to make scores comparable across subjects and schools. Then, the scores are standardised again at the overall sample level to have a mean value of 0 and a standardised deviation of 1 to facilitate the comparability of regression coefficients with other studies.

1.3.3 Control variables

As shown in Table 1.1 and Table 1.2, a variety of student and teacher characteristics are available in CEPS, which are employed in the subsequent regressions of the present study. The student-related controls include demographic characteristics covering student gender, age, ethnicity (whether the student is an ethnic minority or not), parental education (in years), low-income family status (a dummy variable indicating a relative low level of household income within community based on parental reports), parents-reported neighbours' migrant status (locals vs non-locals), and parents-reported neighbours' social class (lower class, middle class, and upper class).

Additionally, CEPS provides information on student's experiences before they enter middle school so that this study can control for students' cognitive and non-cognitive abilities, as well as other relevant factors, prior to their enrolment in middle school. These pre-middle-school variables include an indicator for whether this child was brought up by parents[17], self-reported class rank in 6th grade (in primary school), the number of classmates in primary school, self-reported diseases before primary school (i.e. whether the student had a serious illness before school age), dummies for transfer school, skip grade, repeat grade,

17. Parents are asked: "who mainly took care of the child during the pre-primary school period?". The answers are: "1. Parents 2. Grandparents 3. Maternal grandparents 4. Nurse 5. Other relatives of the child 6. Non-relatives except the nurse". Here, a dummy variable is generated by distinguishing parental care (which has the value of 1) from care provided by others.

variables for non-cognitive skills in primary school: insisted on going to school even if not felt very well or had other reasons to stay at home; tried to finish homework even disliked; tried to finish homework even if it would take quite a long time; expressed opinions clearly in primary school; responded quickly in primary school; learned quickly in primary school; curious about new stuff in primary school.[18] Meanwhile, to control for the academic performance of students in the baseline year, a standardised index for baseline test scores (i.e., averaged test score in the first wave using test scores of the 3 core subjects) is also created.[19]

A series of teachers' characteristics is also provided in CEPS. The available variables include teacher gender, age, dummies for marital status (married, unmarried, divorced, or separated), education (in years), pedagogical universities or pedagogical majors, professional ranks and titles, years of experience in the current school, years of experience as a teacher, a dummy for career track, and a dummy for having worked in other schools.

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18. All the non-cognitive related questions are answered by the students themselves. Students are asked to recall their life in 6th grade and choose the extent to which they agree with the relevant descriptions. They should choose from "1. Completely disagree 2. Somewhat disagree 3. Somewhat agree 4. Completely agree".
19. The test scores of mid-term exams are also used to capture the performance gap between local and migrant students at the class level in the first wave in CEPS as described in Section 1.3.4.1.

Table 1.1: Summary statistics for migrant and local students

	Migrant students		Local students		
	Mean	S.D.	Mean	S.D.	Difference
Male student (1=male)	0.5289	0.4993	0.5107	0.4999	0.0182
Age	13.5393	0.6905	13.4111	0.5958	0.1282***
Han	0.9238	0.2654	0.9339	0.2485	-0.0101
Mothers' education	9.5817	3.5273	11.1432	3.5826	-1.5615***
Fathers' education	10.3438	3.2428	11.5022	3.4164	-1.1584***
Low income	0.0504	0.2189	0.0369	0.1886	0.0134***
Go to school	3.3645	0.8733	3.3783	0.8367	-0.0138
Dislike but do	3.3404	0.8613	3.4449	0.7481	-0.1045***
Spend time but do	3.4791	0.8005	3.5555	0.7183	-0.0764***
Clearly express	3.0951	0.8014	3.2222	0.7767	-0.1271***
Respond quickly	3.0579	0.7749	3.1572	0.7644	-0.0993***
Learn quickly	3.0642	0.8009	3.1274	0.7904	-0.0632***
Curious	3.5375	0.7788	3.5600	0.7408	-0.0225
Neighbourhood: locals or non-locals (1=locals)	0.6516	0.4766	0.9226	0.2673	-0.2710***
Neighbourhood: social class (1=low; 2=middle, 3=upper)	1.8487	0.4230	1.8465	0.4113	0.0022
Live with parents in primary school (1=yes)	0.7238	0.4473	0.7091	0.4542	0.0147
Rank in primary school	14.1885	11.0851	15.4977	11.7637	-1.3092***
Class size in primary school	44.2074	11.4656	49.3283	12.7872	-5.1209***
Self-reported diseases	1.8745	0.3314	1.8445	0.3624	0.0300***
School transfer	0.4000	0.4900	0.1813	0.3853	0.2187***
Skip a grade	0.0080	0.0892	0.0091	0.0948	-0.0011
Grade repetition	0.1255	0.3314	0.0540	0.2261	0.0715***
Baseline average scores	-0.0171	0.9971	-0.0110	0.9894	-0.0061
Standardised test scores	0.0192	0.9558	-0.0175	1.0144	0.0367
Observations	1745		7607		

Notes: This table reports the summary statistics. Sample means, standard deviations, migrant-local differences of the mean values of each variable, as well as the number of observations are presented. Observations are measured at the student–subject level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.2: Summary statistics for teachers

	Mean	S.D.	Min	Max	Observation
Male teacher (1=male)	0.2365	0.4256	0	1	334
Age	38.6138	7.4405	22	62	334
Married	0.8952	0.3067	0	1	334
Unmarried	0.0898	0.2864	0	1	334
Education (in years)	16.0689	0.7340	15	19	334
Pedagogical universities or pedagogical majors	0.9222	0.2683	0	1	334
Professional ranks and titles	2.7874	0.9616	0	4	334
Years of experience in current school	10.3443	7.0407	0	33	334
Years of experience as a teacher	16.4281	8.5364	1	50	334
Career track	0.9012	0.2988	0	1	334
Have worked in other schools	0.6317	0.4831	0	1	334
Chinese teachers' attitudes (original Responses)	2.2425	0.5063	1	3	334
Math teachers' attitudes (original Responses)	2.2665	0.5236	1	3	334
English teachers' attitudes (original Responses)	2.1257	0.5920	1	3	334

Notes: This table reports the summary statistics. Sample means, standard deviations, minimum and maximum values, as well as the number of observations are presented. The unit of observation is the teacher.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

1.3.4 Measuring teachers' attitudes

1.3.4.1 Construct of measure of teachers' attitudes

This study makes use of an attitudinal question regarding the teachers' opinions about non-local students' study in the baseline wave of CEPS.[20] Specifically, the teachers were asked, "According to your understanding or that of other teachers, how is the academic foundation of students from non-local counties/ districts compared with that of students from local county/district?". Teachers choose from three options: "Far worse" (1), "About the same" (2), and "Better" (3).[21] Higher values of the variable indicate a more positive perception that teachers have of non-local students' academic foundation. The variation in the measure comes from the teachers' tendency to positively evaluate migrant students.

Looking more closely at the survey question, "foundation" here means how teachers feel about the students' performance or ability when they first enter middle school in grade 7. "Foundation" is a common term used in the Chinese education context to refer to static and prior (or baseline) academic ability, as well as academic readiness (in this setting, before or around entering middle school). This measure is conceptually distinct from measures of students' learning progress and academic potential, which capture more dynamic aspects of students' academic development. By using "According to your understanding", this question addresses the subjective perceptions of teachers rather than their one-time observations of current students in the class. Additionally, other questions in

20. Similar questions on teachers' attitudes towards migrant and local students are not available in the second wave.
21. Each teacher answers this question six times, once for each subject: mathematics, Chinese, English, physics, chemistry, and biology. Among all subjects, mathematics, Chinese, and English are core subjects. Only responses from teachers of core subjects regarding students' performance in these subjects are used in this study.

the same module explicitly ask teachers for their opinions (e.g., "What do you think..." and "Please provide your views...") when comparing local and non-local students across different types of classes. Overall, these questions focus on teachers' assessments of student groups rather than the performance of a specific class or individual students at a particular point in time. This context supports interpreting the measure as reflecting teachers' overall subjective perceptions of the relative academic foundations of the two groups, rather than an assessment based on a single observation of students' abilities. This is not to say that these perceptions are not informed by observations made during middle school. It is reasonable to assume that teachers' perceptions reflect their observations of students' academic performance. However, the measure captures more than observations of students' performance at a particular point in time. In this case, this study regards this question in CEPS as a description of attitude or belief, which is normally defined as "the positive or negative evaluation of an object" or "the tendency to evaluate a particular entity with some degree of favour or disfavour" (Eagly and Chaiken, 1993, p.1; Kleen et al., 2019, p.885; Pit-ten Cate and Glock, 2019, p.2).[22]

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22. By asking about teachers' current understanding of students' baseline ability, the measure here is different from measure on teachers' expectations and aspirations. Expectations or aspirations typically refer to one's anticipations about future performance, attainment, and development, such as the expectations about future schooling years, college enrolment and career developments (See, for example Papageorge et al. (2020), for measures on expectations).

Explicit and implicit measures are both used in previous literature to measure teachers' attitudes. Measures that are constructed by self-reported survey questions are explicit measures which this study is in lines with.[23] Literature shows that both types of teachers' attitudes can influence teachers' behaviours in most situations (Kleen et al., 2019; Rakshit and Sahoo, 2023).[24] The associations between implicit and explicit attitudes vary a lot across studies, from no correlation to high positive relationships (Hofmann et al., 2005; Pit-ten Cate and Glock, 2019).

Social desirability bias is a crucial factor leading to the differences between the two types of measures (Hofmann et al., 2005; Kleen et al., 2019).[25] Faced with a socially sensitive topic, people tend to choose the answer that is aligned with mainstream perspectives of traditional society, protecting themselves from negative comments from the society.[26] Psychologists point out that when social desirability bias increases, the correlation between implicit and explicit measures decreases (Hofmann et al., 2005).

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23. Here are some examples of employing explicit measures: Rakshit and Sahoo (2023) use items "boys are able to do better in studies than girls" "gender can predict how well the study can fare"; Alan et al. (2018) ask "men are better at math than women" and "men generally understand money-related issues better than women"; Avitzour et al. (2020): "who is better in math: boys or girls?" "who receives higher grades in math: boys or girls?".
24. As Rakshit and Sahoo (2023) states, usage of Implicit Association Test (IAT) and self-reported survey questions is similar in essence, both measuring stereotypes with noise.
25. See Hofmann et al. (2005) for detailed reviews and discussions about the correlations between implicit and explicit measures and potential reasons causing variations in the correlations cross studies.
26. For instance, when are asked on the racial attitudes, the respondents will be cautious to present racism and negative attitudes towards ethnic minorities, which are unsupported by the majority in society.

Figure 1.1 describes the distributions of the teachers' original responses for the question on teachers' attitudes separately for three core subjects in CEPS. Regardless of subjects they teach, most teachers choose the answer aligning with mainstream values: more than 80 percent of teachers think nonlocal students perform at least as well as local students. In contrast, only a small portion of teachers conclude that nonlocal students are worse than local students.[27]

Given that most teachers report at least equitable attitudes towards migrant students, a question is whether the positive attitudes are caused by social desirability bias or if the positive attitudes are grounded in reality. To investigate this question, this study compares the subjective attitudes of teachers towards migrant students with the actual academic performance of migrant students relative to local students in mid-term exams in the baseline year. That is, the average performance of migrant students in mid-term exams in the first semester after enrolment is used as an objective measure of students' actual performance.

To measure how teachers' perceptions of migrant students deviate from the actual performance of the students they teach, the actual performance of migrant students relative to local students is calculated according to Equation 1.1. For student i on subject j in class c in year t, the actual academic performance of migrant students relative to local students is defined as the difference in the baseline scores at the class level:

$$Gap_{ijct} = Gap_{jct} = \frac{1}{A}\sum_{i=1}^{A} Score_{ijct}^{migrants} - \frac{1}{B}\sum_{i=1}^{B} Score_{ijct}^{locals} \tag{1.1}$$

27. The proportion of teachers choosing this "worse" answer ranges from 3.82 percent (for Chinese teachers) to 10.69 percent (for English teachers).

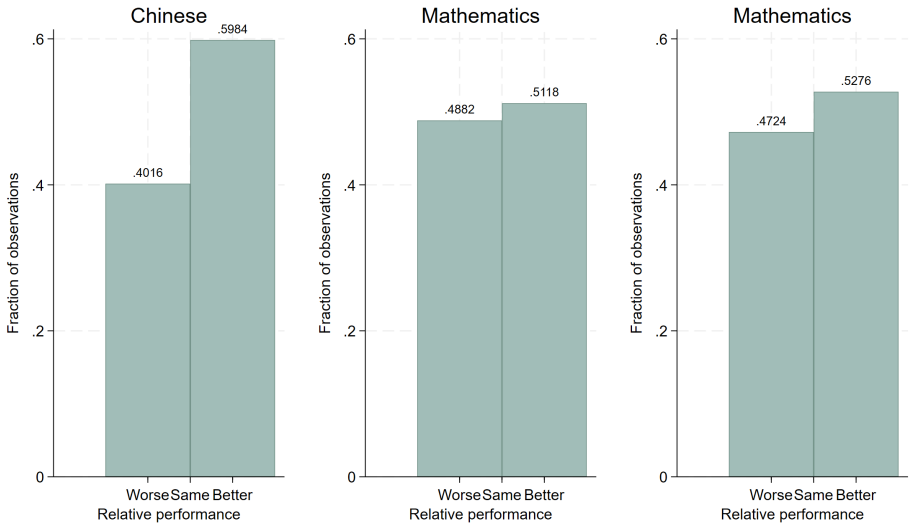


Figure 1.1: Distribution of Teachers' Perceptions of Migrant Students' Academic Foundation

Note: This figure displays the distributions of teachers' perceptions of migrant students' academic foundation in Chinese, Mathematics, and English, relative to local students. Responses are coded as 1 = worse, 2 = the same, and 3 = better.

where A is the total number of migrants and B is the total number of locals in class c. *Score* denotes the baseline test scores (the scores in the midterm examination in the first semester in the 2013-2014 academic year). This relative performance measure is calculated in each subject (Chinese, English, and Math) for each of the 127 classes in the sample.

Based on class-subject specific gaps in test scores Gap_{jct} obtained from Equation 1.1, this study creates a discretized variable as shown in Equation 1.2. This discretization allows the index created on actual relative performance to be comparable with teachers' explicit attitudes provided in CEPS.

$$GapV_{ijct} = GapV_{jct} = \begin{cases} 3, & \text{if } Gap_{jct} > 0 \\ 2, & \text{if } Gap_{jct} = 0 \\ 1, & \text{if } Gap_{jct} < 0 \end{cases} \tag{1.2}$$

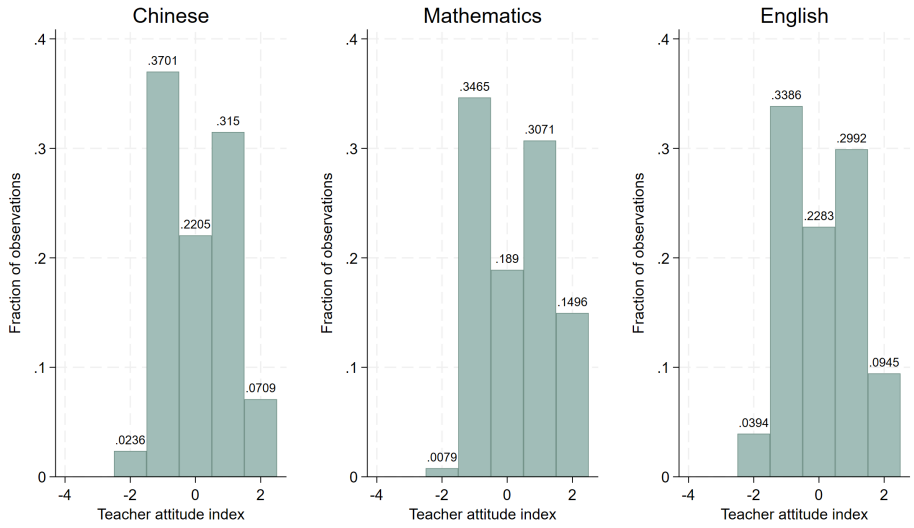


Figure 1.2: Actual performance at class level: migrant students versus local students.
Note: This figure displays the distributions of the actual performance of migrant students' at class level, relative to local students. Actual performance are coded as 1 = worse, 2 = the same, and 3 = better.

The higher the value of the variable, the better the performance of migrant students relative to local students in the class. $GapV_{ijct}$ is created based on precise differences between migrant and local students at the class level. Figure 1.2 presents the distributions of $GapV_{ijct}$.

In Figure 1.2, the actual performance of migrant students that the teachers are currently teaching is better than the local students in the same class. Compared with actual performance, it seems that teachers' explicit attitudes are not positively biased due to potential social desirability bias. On the contrary, performance of migrant students is underrated by teachers. This indicates that at least the social motivation in favour of migrants as minorities does not influence how teachers report their attitudes in CEPS in an exaggerated manner.[28]

28. See Appendix Figure A1, when the definition of the variable regarding the actual performance of migrant students gradually releases, the resulting distributions become increasingly similar to the distribution of teacher-reported attitudes. This suggests that teachers may underestimate migrant students' academic ability by approximately 0.5 to 1 standard deviation (SD).

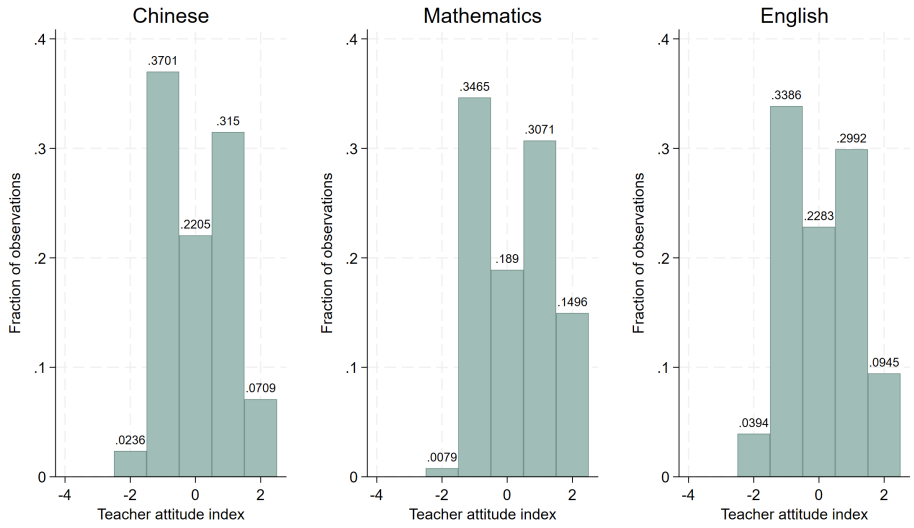


Figure 1.3: Distribution of the index on teachers' biases.
Note: This figure displays the distributions of the teacher bias index. The higher the index, the more positive a teacher's attitudes towards migrant students.

To precisely measure how teachers' perceptions deviate from the actual performance of the students they currently teach and to emphasize the subjective component of the attitudes reported by teachers, this study follows Equations 1.3 to 1.4 to construct the index on deviations of teachers' attitudes from reality.

Based on actual relative performance obtained from Equation 1.2, the variables on teachers' bias (or deviations of attitudes from reality) for student i in subject j in class c in school s in year t are calculated as 1.3:

$$Bias_{ijcst} = Bias_{jcst} = Attitude_{jcst} - GapV_{jcst} \tag{1.3}$$

Specifically, the teachers' biased attitudes index is defined as the differences between teachers' self-reported attitudes and the discretized variables regarding actual academic performance of migrant students relative to local students on subject j in class c in year t. The distributions of the calculated bias index for each subject according to Equation 1.3 are presented in Figure 1.3. Specifically, there is a considerable number of teachers who do not realize, either consciously or unconsciously, that many migrant students have better academic performance than local students in the same class.

To capture the attitudes towards student i at the class level in school s for three core subjects collectively, the index is averaged based on three subjects and calculated as follows:

$$averBias_{icst} = \frac{1}{N}\sum_{j=1}^{N} Bias_{jcst} \tag{1.4}$$

This measure is the simple average of scores of the three core subjects: Chinese, English and mathematics.[29]

Following Equations 1.1 to 1.4, the difference between the variables of objective score and self-reported impression, averaged in 3 subjects, is used to construct an index of teacher attitudes to measure the deviation of teachers' perspectives from students' actual performance. The higher the index is, the more favourable attitudes a teacher explicitly

29. Scores of other subjects covering physics, chemistry, and biology are not available in the CEPS data.

has towards migrant students compared with the actual performance of those migrant students. In essence, using this index is analogous to directly using explicit attitudes and controlling for baseline differences in average test scores between migrant and local students at the class level.

1.3.4.2 Validity of the attitudes measure

There may be a concern that teachers might interpret and respond to the survey questions ambiguously. In the first place, the responses of teachers may not purely measure teachers' subjective attitudes (or beliefs) about non-local students and may partly capture their observations of students' scores in the current semester. Additionally, since teachers were asked about the students' foundation rather than current ability, their responses may also capture their observations of students' performance in primary school. This threat is also shown in other studies with survey-based measures, such as Alan et al. (2018), Carlana (2019) and Rakshit and Sahoo (2023). There are no ambiguous words in the designed survey questions in these studies, but the survey data are collected after the teachers taught the students (as in this study).

Nonetheless, if the responses were entirely driven by observations and did not reflect any stereotypical attitudes of teachers, the measures in this study should also have impacts on local students. That is, the teachers' observation on relative performance between migrant and local students should be correlated with the later performance of both the two groups of students. There should not be significant differences of the effects of teachers' observations across migrant versus local groups. However, as will be shown in Section 1.5, there is insignificant effect for local students. Additionally, to attenuate this concern on

teachers' observations, this study follows Rakshit and Sahoo (2023) and uses students' lagged test scores as a control variable in the main specifications. Students' rank in primary school is also used as a proxy variable for students' primary school performance, following Gong et al. (2018). Additionally, this study removes the difference in the baseline scores between local and migrant students at the class level as shown in Equation (3) during the process of constructing attitudes index, so that the key regression could capture the teachers' attitudes and beliefs in addition to the observation of the individual student and the whole class. This study also does some robustness checks to further confirm that the results are not driven by teachers' observations on students' performance (see Section 1.6.1).[30]

1.3.5 Correlation between teacher's bias and other teacher characteristics

To investigate whether various observable characteristics of the teachers would predict teacher's bias towards migrant students, regressions of teacher's bias on a variety of teacher observables are conducted, as shown in Table 1.3. There is no significant association between the teacher attitude index and teacher gender, age, tenure status, marital status, years of experience in the current school, whether they graduated from a nor-

30. Another interesting question is where the potential teacher bias comes from. According to theoretical literature, there may be two potential sources of discrimination: preferences (or taste) and imperfect information (Bohren et al., 2025; Guryan and Charles, 2013).
By constructing measures of teachers' attitudes that account for the actual performance of migrant students and conducting a robustness check using teachers' responses on less easily observed subjects (see the first robustness check described in Section 1.6.1, with results reported in Appendix Table A1), it seems that the attitudes measured in this study are more consistent with stereotypes driven by animus or taste-based preferences. However, this study cannot rule out the possibility that teachers hold inaccurate information about the ability of migrant students. Distinguishing bias sources based on taste from inaccurate information requires more data on teachers' emotions about migrant students or measures on teachers' attitudes across waves. This study is therefore unable to address this issue.

mal college, years of experience as a teacher, and whether they worked in other schools. However, teachers with more years of education and higher professional job titles exhibit significantly higher levels of positive attitudes towards migrant students. These results are consistent with the literature on the correlation between teacher's bias, education, teacher training, and ability. For instance, Rakshit and Sahoo (2023) finds a negative association between teacher's professional teaching qualifications, ability to speak in English, and their level of gender bias. Similarly, Carlana (2019) presents evidence on the negative correlation between academic degree and teacher's gender bias. In addition to studies on gender stereotypes, Alan et al. (2023) finds negative association between ethnic biases and teachers' cognitive ability. As stated in Rakshit and Sahoo (2023), these associations are interesting and may implicate the potential importance of teacher's education and training in shaping teachers' biased attitudes and behaviours. Nevertheless, the teacher characteristics used as independent variables are controlled in the main specification (see Section 1.4.2) so that the core coefficient could capture the effect of teacher's attitudes rather than the effects of those characteristics.

Table 1.3: Correlation between teacher bias and other teacher characteristics

	Teacher attitude index	S.E.	Observations
Male teacher	−0.1166*	(0.0652)	334
Teacher education (in years)	0.1881***	(0.0686)	334
Age	0.0070	(0.0159)	334
Professional ranks and titles	0.1693***	(0.0617)	334
Career track	0.0438	(0.1486)	334
Married	0.3320	(0.2511)	334
Unmarried	0.4051	(0.3070)	334
Years of experience in current school	-0.0020	(0.0090)	334
Pedagogical universities or pedagogical majors	−0.1873	(0.1338)	334
Years of experience as a teacher	−0.0087	(0.0133)	334
Whether worked in other schools	0.0402	(0.1016)	334

Notes: This table reports results from OLS estimations. The independent variable is teacher attitude, the dependent variables are teacher characteristics listed above. Regressions control for school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

1.4 Methodology

1.4.1 Random assignment checks

A threat to identification in this setting is the potential sorting of students to teachers. For instance, parents with higher income and education may select classes with higher-quality teachers for their children. These children are more likely to have better pre-enrolment abilities compared with their counterparts due to more parental investment in education. As discussed in Section 1.3, sample in this study is restricted to schools where the class assignment is random, and the sorting problem should not exist in principle. Here, to further confirm the random assignment of students to teachers, checks based on three specifications are conducted.

First, Table 1.4 presents the results for checks about sorting based on students' pre-middle school ability. Specifically, the check follows Alan et al. (2018)'s paper and tries to see whether a series of teacher characteristics is correlated with students' academic ability in the primary school (proxied by students' rank in primary school in this study). Table 1.4 shows that most of the coefficients of teacher characteristics have no predictive power on students' prior ability. The only exception is teacher gender. Nevertheless, the magnitude is very small. The coefficient indicate that having a male teacher is associated with an increase in student's prior rank in primary school by only 0.6055 places (for instance, if rank varies from 1st to 3rd, which means rank increases by 2 places and indicates lower positions in class in primary school). This means male teachers have students who are slightly worse in primary school.

Table 1.4: A check on sorting based on students' pre-middle school ability

	Rank in primary school	S.E.	Observations
Male teacher	0.6055**	(0.2688)	9,352
Teacher education (in years)	0.0319	(0.1173)	9,352
Age	-0.0690	(0.0593)	9,352
Professional ranks and titles	0.0070	(0.1818)	9,352
Career track	−0.9558*	(0.5211)	9,352
Married	0.7355	(0.6245)	9,352
Unmarried	0.3133	(0.8712)	9,352
Years of experience in current school	−0.0382*	(0.0200)	9,352
Pedagogical universities or pedagogical majors	−0.4253	(0.3974)	9,352
Years of experience as a teacher	−0.0134	(0.0370)	9,352
Whether worked in other schools	0.3191	(0.3124)	9,352
Teacher attitude index	−0.3059	(0.2574)	9,352

Notes: Reported estimates are from OLS estimation. The dependent variable is students' rank in primary school. Regressions control for student characteristics (students' baseline scores, gender, age, ethnicity, mother's education, father's education, low-income family status, neighbours' migrant status and social class, whether this child was brought up by parents in primary school, self-reported diseases in primary school, the number of classmates in primary school, dummies for transfer school, skip grade, repeat grade, non-cognitive skills in primary school), school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Second, direct check about sorting based on teacher's attitudes are conducted in Table 1.5. There is a possibility that migrant or local parents may directly select teachers who have good attitudes towards their children. This check follows Gong et al. (2018) and regresses teachers' attitudes on a variety of student characteristics. As presented in Table 1.5, most of the student characteristics are not significantly correlated with teachers' attitudes towards migrant students. Although there are correlations between student's non-cognitive skills, diseases, and teachers' attitudes, the correlations are small in terms of magnitude. For instance, a decrease in the variable on quickly learning ability by one unit on a four-point Likert scale is associated with an increase in teachers' attitudes towards migrant students by 0.0353 standard deviations.[31] This is equivalent to saying that an increase in the quickly learning score by one standard deviation is correlated with a decrease in teachers' attitudes by 0.0283 standard deviations.

Third, the allocation of migrant students across classes is checked to see whether migrant students are assigned randomly. Table 1.6 shows the results of the check, and no teacher characteristic is significantly related to the assignment of migrant students across classes. All the coefficients of teachers' characteristics are close to zero. This confirms that there is little evidence that migrant students (or local students) conduct ability sorting across teachers.

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31. As stated in Section 1.3.3, non-cognitive skills are measured by a four-point Likert scale: "1. Completely disagree 2. Somewhat disagree 3. Somewhat agree 4. Completely agree".

Table 1.5: A check on sorting based on teacher attitudes

	Teacher attitude index	S.E.	Observations
Male student	0.0012	(0.0129)	9,352
Child was brought up by parents in primary school	0.0136	(0.0213)	9,352
Insisted on going to school	0.0134	(0.0111)	9,352
Tried to finish homework even disliked	0.0094	(0.0136)	9,352
Tried to finish homework even if it would take quite a long time	-0.0124	(0.0147)	9,352
Expressed opinions clearly	0.0175	(0.0127)	9,352
Respond quickly	0.0243*	(0.0135)	9,352
Learn quickly	-0.0353***	(0.0123)	9,352
Curious	-0.0002	(0.0114)	9,352
Mother education	-0.0029	(0.0026)	9,352
Father education	0.0062	(0.0038)	9,352
Rank in primary school	0.0009	(0.0014)	9,352
Student age	0.0089	(0.0138)	9,352
Neighbours' migrant status (majority migrants = 1)	0.0278	(0.0246)	9,352
Neighbours' social class	0.0024	(0.0218)	9,352
Diseases in primary school	0.0512***	(0.0187)	9,352
Low-income family status	-0.0409	(0.0320)	9,352
Han	0.0352	(0.0384)	9,352
Transfer school	0.0045	(0.0218)	9,352
Skip grade	-0.1293	(0.0888)	9,352
Repeat grade	-0.0303	(0.0264)	9,352
Baseline score	0.0607	(0.0428)	9,352
Class size in primary school	0.0014	(0.0009)	9,352

Notes: Reported estimates are from OLS estimation. The dependent variable is teachers' attitudes index. Regressions control for teachers' characteristics (gender, education, age, professional ranks and titles, dummies for marital status, years of experience in current school, years of experience as a teacher, dummies for career track, pedagogical universities or pedagogical majors, have worked in other schools), school, and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.6: A check on sorting based on the share of migrant students across classrooms

	Ratio of migrant students in a class	S.E.	Observations
Male teacher	−0.0170	(0.0114)	334
Teacher education (in years)	−0.0108	(0.0068)	334
Birth year	−0.0005	(0.0011)	334
Professional ranks and titles	0.0073	(0.0047)	334
Career track	−0.0660	(0.0558)	334
Married	−0.0166	(0.0134)	334
Unmarried	−0.0064	(0.0178)	334
Years of experience in current school	0.0002	(0.0007)	334
Pedagogical universities or pedagogical majors	−0.0125	(0.0134)	334
Years of experience as a teacher	−0.0003	(0.0012)	334
Whether worked in other schools	−0.0067	(0.0073)	334
Teacher attitude index	−0.0040	(0.0094)	334

Notes: Reported estimates are from OLS estimation. The dependent variable is the ratio of migrant students at the class level. All regressions are estimated at the class-teacher level and control for school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
$^{*}p<0.1, ^{**}p<0.05, ^{***}p<0.01$

1.4.2 Empirical strategy

The estimating specification for student-level outcomes is as follows:

$$Y_{icst+1} = \beta_0 + \beta_1 averBias_{icst} + \beta_2 BaselineScore_{icst} + \beta_3 Studentcontrol_{ics} + \beta_4 Teachercontrol_{cs} + \delta_s + \varepsilon_j + \mu_{icst+1} \quad (1.5)$$

Where Y_{icst+1} is the outcome of interest for student i, in class c, school s and year $t+1$ (i.e., the 2014-2015 academic year when the second wave of CEPS is collected). $averBias_{icst}$ is the regressor of interest, the standardised measure of teacher's attitudes towards migrant students at the class level, averaged on attitudes of core subject teachers. β_1 is the coefficient of interest, capturing the effects of teachers' attitudes towards migrant students on students' academic performance.

$BaselineScore_{icst}$ is the standardised test scores (averaged based on 3 core subjects) measured in the baseline year (the 2013-2014 academic year when the first wave of CEPS is collected) when students are in the 7th grade. Inclusion of $BaselineScore_{icst}$ corresponds to a value-added specification so that the previous test scores or teachers' observations of student's test scores at the individual level could be controlled in this study. $Studentcontrol_{ics}$ represents a series of student controls.[32] A series of teachers' characteristics are included in $Teachercontrol_{cs}$.[33] δ_s, ε_j are the school and subject fixed effects respectively. μ_{icst+1} is the error term. Standard errors are clustered at the class level.

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32. As stated in Section 1.3.3, these controls include gender, age, whether the student is an ethnic minority, mother's education (in years), father's education (in years), low-income family status, self-reported neighbours' migrant status (locals vs non-locals), self-reported neighbours' social class, whether this child was brought up by parents before primary school, self-reported class rank in 6th grade (in primary school), self-reported diseases before primary school, the number of classmates in primary school, dummies for transfer school, skip grade, repeat grade, variables for non-cognitive skills in primary school (insisted on going to school even if not felt very well or had other reasons to stay at home; tried to finish homework even disliked; tried to finish homework even if it would take quite a long time; expressed opinions clearly in primary school; responded quickly in primary school; learned quickly in primary school; curious about new stuff in primary school).

33. As stated in Section 1.3.3, these include gender, education (in years), birth year, professional ranks and titles, dummies for marital status, years of experience in the current school, years of experience as a teacher, dummies for career track, pedagogical universities or pedagogical majors, have worked in other schools.

Throughout this study, estimations according to the above empirical model are conducted for local and migrant students, respectively. Equality tests are conducted for all regressions to examine whether the effects of teachers' attitudes differ between local and migrant students.

By controlling for school fixed effects, the identifying variation comes from within-school across-classroom differences. Specifically, all regressions in this study are conducted by regressions with school fixed effects respectively for migrant and local students. This means that the subgroup regressions allow for the differentiated effects of entering certain schools on migrant and local students. This is consistent with results using alternative specifications with interaction terms between schools fixed effects and students' migrant status (the results from the alternative specifications with interaction terms are reported in Table A6). The proposed results examine if migrants and local students are affected by teacher attitudes differentially within the same school.

By looking at the average effects, this approach does impose a conceptual assumption that teacher attitudes are formed based on students from their own school. Judging from the questionnaire module which mostly asks questions about teachers' attitudes about the school or their teaching styles within the classroom, the assumption is likely reasonable although violation cannot be fully ruled out. A possible violation would be that teachers form their attitude based on average migrant students beyond the school (e.g., within the county), but they teach in a school with better or worse performing migrant students due to sorting into schools. This would lead to a classical measurement error in teachers' attitude measure, and result in a downward attenuation bias. Therefore, the estimates in this study should be interpreted as lower bounds of the true effects.

1.5 Results

1.5.1 Main results

Following the specifications detailed in Section 1.4.2, Table 1.7 presents the estimated effects of teacher's attitudes towards migrant students on students' test scores. The regressions are conducted separately for migrant and local students.

The dependent variables are standardised test scores. Test scores and the teachers' attitude index are standardised z-scores to have a mean of 0 and a standard deviation of 1. The test scores are the average scores for three core subjects (Chinese, mathematics, and English). Scores here are stacked (i.e., most students appear three times for each of these subjects with the same values of averaged mid-term test scores). This student–subject level of observation allows the characteristics of students and teachers to be controlled for.

Table 1.7: The effects of teachers' attitudes on students' test scores

	Test scores	
	Migrant	Local
Teacher attitude index	0.1290***	0.0052
	(0.0436)	(0.0265)
Observations	1745	7607
P-Value (Migrant=Local)	0.0046	

Notes: Reported estimates are from OLS estimation. Regressions control for student characteristics, teachers' characteristics, school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results show that teacher's attitudes towards migrant students have significant positive effects on the test scores of migrant students. A one standard deviation increase in teachers' attitude index is associated with an increase in migrant students' test scores by 0.1290 standard deviation. By contrast, there is no impact of teachers' attitudes on local students' test scores. The estimated coefficient for local students is minimal and insignificant.[34] This study explains the estimated positive effects of teachers' favourable attitudes towards internal migrant students as lower boundaries for three reasons: First, given the existence of social desirability bias in explicit measures, the potential under-evaluation of migrant students by teachers may be larger if teachers systematically provide more positive evaluations in response to social desirability pressures. Second, the scoring method of the tests is unavailable in CEPS and it is possible that there is grading bias of measured test scores. Based on Alesina et al. (2024)' work, teachers may underevaluate migrant students, meaning that migrant students tend to receive lower scores in non-blindly-graded tests, conditioning on their performance in blindly graded exams. If test scores in CEPS are obtained from non-blindly-graded exams, the true performance of migrant students may be underestimated. Third, as stated in Section 1.4.2, this study assumes that teacher attitudes are formed based on students from their own school. This assumption will be vi-

34. To investigate the heterogeneous effects of teacher's attitudes by subject, student, family, and school characteristics, the study conducts a heterogeneity analysis. The results are reported in Appendix Table A7 and Table A8. There appears to be no heterogeneity by subject. This suggests that the effect of teacher attitudes is consistent across subjects. No heterogeneity by student gender, hukou type (rural vs urban), local dialect proficiency, student pre-middle-school ability and school quality is found in this study. This suggests that the effect of teacher attitudes is broadly shared across migrant students rather than being concentrated in particular subgroups. The absence of systematic heterogeneity also suggests that the effect is not primarily driven by the rural origin, cultural differences (proxied by limited proficiency in the local dialect), or weaker prior academic performance of migrant status. Nevertheless, the interaction estimates are relatively imprecise, so this study cannot rule out modest differences across subgroups.

olate if teachers form their attitude based on average migrant students beyond the school (e.g., within the county), but they teach in a school with better or worse performing migrant students due to sorting into schools. This would lead to a classical measurement error in teachers' attitude measure, and result in a downward attenuation.

1.5.2 Mechanisms

The main results in Table 1.7 suggest that migrant students' test scores are substantially higher when they are taught by teachers with more favourable attitudes towards them. In this section, possible mechanisms through which teachers' attitudes towards migrant students influence migrant students are investigated. This study examines three potential channels: teachers' behaviour, students' mental states, and parental responses. Regressions are conducted separately for migrant and local students to make reliable comparison and reveal the true mechanisms.

1.5.2.1 Teachers' behaviour

Given that attitudes could induce behaviours, teachers may adjust their communication strategies and teaching styles when they have different attitudes. In CEPS, students were asked to describe their interactions with teachers, such as criticizing and praising.[35] Potential changes in teachers' behaviours induced by differentiated attitudes are examined in Table 1.8. As shown in Table 1.8, a subject teacher with more positive attitudes towards migrant students is more likely to praise migrant students and criticise local students (when they have bad feelings)[36].

Table 1.8: Mechanism: teacher's behaviours

	Teacher's praise		Teacher's criticism	
	Migrant	Local	Migrant	Local
Teacher attitude index	0.0981***	0.0192	-0.0874*	0.0550**
	(0.0342)	(0.0267)	(0.0462)	(0.0237)
Observations	1736	7587	1742	7590
P-Value (Migrant=Local)	0.0312		0.0043	

Notes: Reported estimates are from OLS estimation. Regressions control for student characteristics, teachers' characteristics, school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

35. CEPS asks students to rate how much they agree with the statements "My subject teacher always praises me" and "When I experience bad emotions, my teacher criticizes me in private." They should choose from four answers: "strongly disagree", "somewhat disagree", "somewhat agree", and "strongly agree".
36. The reduction in reported criticise when migrant students have bad feelings is explained as teachers' emotional support by this study. This criticise is not directly related to instruction and does not necessarily harm the academic performance of local students.

1.5.2.2 Students' feelings and emotions

Students may directly feel teachers' attitudes in the classrooms. Additionally, teachers' attitudes may be indirectly internalised by local students accordingly, following their teachers as role models (Alan et al., 2023). These may affect students' feelings and emotions, thus influencing their academic performance.

Table 1.9: Mechanism: mental states and subjective feelings

	Feeling blue	Feeling sad	Make friends with rural non-locals	Most of classmates are friendly
Migrant	-0.1468**	-0.1013*	0.0278***	0.1117**
	(0.0691)	(0.0575)	(0.0104)	(0.0477)
Observations	1742	1742	1742	1742
Local	-0.0267	-0.0105	-0.0038	0.0296
	(0.0313)	(0.0266)	(0.0057)	(0.0218)
Observations	7604	7592	7556	7598
P-Value (Migrant=Local)	0.0640	0.0932	0.0049	0.0862

Notes: Reported estimates are from OLS estimation. Regressions control for student characteristics, teachers' characteristics, school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

CEPS has questions on students' emotional conditions, their subjective feelings about classmates and schools.[37] Table 1.9 presents the effects of teachers' attitudes on mental states. The results show that migrant students taught by teachers with positive attitudes towards them are less likely to feel blue, feel sad and are more likely to feel that their local classmates are willing to make friends with rural non-locals, and that most of their classmates are friendly.

1.5.2.3 Parental responses

Teachers' attitudes can be easily observed by parents through teacher-parent communications or conveyed by children through daily conversations, potentially leading to parental responses. In one respect, favourable or unfavourable attitudes of teachers may be regarded as a form of public input by parents and thus change their parenting behaviours (or other forms of household investments).[38] In another respect, attitudes of teachers may update parents' information (or beliefs) about their children's academic ability, given that teachers usually serve as authoritative and credible information source for parents.[39] Here, this study tries to shed light on the mechanism related to parents' responses.

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37. The initial survey questions and corresponding answers are as follows: Do you feel blue in the last seven days? Do you feel sad in the last seven days? (1. Never 2. Seldom 3. Sometimes 4. Often 5. Always). Do you think your classmates from the local county/district will make friends with classmates who come from other rural counties/districts? (1. yes, they will 2. No, they won't); How much do you agree with the statement "Most of my classmates are nice to me" (Students should choose from four items: "strongly disagree", "somewhat disagree", "somewhat agree", "strongly agree".).

38. A host of studies find that parents do adjust household investments in response to external educational inputs, either reinforcing high-quality (or increased) inputs or compensating for low-quality (or decreased) ones. Studies find that parents do respond to changes in school grants, class size, school quality, teachers' qualifications, migrant students' access to public schools, and school tuition fees (Chang et al., 2022; Das et al., 2013; Fredriksson et al., 2016; Pop-Eleches and Urquiola, 2013; Shi, 2012; Ye et al., 2024).

39. Existing literature shows that parents may have misbeliefs about the actual ability of their children (Dizon-Ross, 2019; Wang, Cheng and Smyth, 2022). There is increasingly experimental evidence showing that providing information to parents about students' actual school performance and improvement suggestions could correct their beliefs, alter parenting behaviours, and improve parental support, ultimately improves students' performance (e.g., Barrera-Osorio et al., 2020; Berlinski et al., 2025).

CEPS covers information on how parents discipline and interact with their children.[40] Categorical variables on the extent to which parents are strict with children's Internet and TV time, the frequency of mothers discussing worries and troubles with children in daily life, and the frequency of having dinner with children over the last year are generated.

Additionally, trying to investigate the effects of teachers' attitudes on parents' beliefs about the performance of students, a dummy on parental misbeliefs in the baseline year is constructed. Specifically, following Wang, Cheng and Smyth (2022), which uses the same dataset as this study, the dummy variable is created according to the distance between parents' assessed rank of their children in the class and the actual score rank they attained in exams.[41]

Table 1.10 presents how migrant parents respond to teachers' attitudes towards migrant students compared with parents of local students, by changing the beliefs about their children's ability and parenting style. The results suggest that having teachers with positive attitudes towards migrant students make parents be more likely to overestimate the

40. Parents are asked, "Do you care about and are you strict with this child regarding the following?" Two of the aspects the question covers are "Time he/she spends on the Internet" and "Time he/she spends on watching TV". Parents need to choose among "1. I don't care," "2. I do care about it, but am not strict," and "3. I'm very strict about it."; Parents are asked, "How often did the family members do the following together with this child over the last year?". One of the aspects included in this question is "Having dinner". Parents need to choose from "1. Never," "2. Once a Year," "3. Once every half year," "4. Once a month," "5. Once a Week," and "6. More Than Once a Week."; Students are questioned, "How often do your parents discuss the following with you?". One of the aspects included by this question is "Your worries and troubles". Students should choose from "1. Never," "2. Sometimes," and "3. Often" respectively for the interaction with their father and mother.

41. In CEPS, parents are asked: "How does this child's academic record rank in his/her class at present?". Parents should choose from "1. Near the bottom, 2. Below the average, 3. About the average, 4. Above the average, 5. Around the top". The assessed-performance variable is reverse-coded in this study so that higher values indicate lower positions and lower values indicate higher positions. To get students' actual rank in the class, students are ranked by their baseline test scores. Then, an actual rank variable based on students' actual rank in the baseline test is created to divide students into 5 categories, corresponding to the categorical variable of parents' assessment. The actual rank variable takes a value of 1 if a student's rank falls within the 80th to 100th quantile in the class. Other values follow the same pattern: 2=60-80th quantile, 3=40-60th quantile, 4=20-40th quantile, 5=0-20th quantile. Then, the difference between the assessed rank and the actual rank is calculated as the assessed category minus the actual category, and a negative value indicates parents' overestimation.

current performance of their children. Faced with teachers who have favourable attitudes towards migrant children, their parents are also more likely to care and be strict with children's internet and TV time. Additionally, migrant students report that their parents are more likely to discuss worries and troubles, as well as have dinner with them. This evidence is interpreted as parents adopting a strict parenting style in disciplining and paying more attention to providing emotional support.[42]

Table 1.10: Mechanism: parental responses

	Parental over-estimation	Care and be strict with Internet time	Care and be strict with TV time	Discuss worries and troubles with mother	Having dinner together
Migrant	0.0867***	0.0770***	0.1175***	0.1015***	0.0297***
	(0.0205)	(0.0286)	(0.0356)	(0.0353)	(0.0105)
Observations	1495	1716	1716	1705	1717
Local	-0.0020	0.0030	-0.0087	-0.0301	0.0010
	(0.0172)	(0.0096)	(0.0110)	(0.0298)	(0.0057)
Observations	6656	7536	7549	7522	7527
P-Value (Migrant=Local)	0.0000	0.0095	0.0003	0.0068	0.0069

Notes: Reported estimates are from OLS estimation. Regressions control for student characteristics, teachers' characteristics, school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

42. This study also investigates the effects of teachers' attitudes on other parental beliefs, behaviours, and family investments, including parents' feelings about teachers' attitudes towards migrant students, parental attendance in parent-teacher meetings, as well as behaviours regarding private and family tutoring, including participation in private tutoring, expenditure on private tutoring, time spent on private tutoring (weekdays), and time spent on private tutoring (weekends) (See Appendix Table A9). There is no significant difference of the impacts of teachers' attitudes on the parenting behaviours as mentioned above.

1.6 Robustness checks

1.6.1 Validity of the attitudes measures

As stated in Section 1.3.4.2, there may be some concern about whether the measure constructed by the survey question could capture the teachers' attitudes or simply measure teachers' observations. First, this study uses alternative attitude measures to consider the component of teacher observations on the performance of current students; Second, the attitude index is further discretised to check its robustness to an alternative form; Then, given that the attitude index is constructed by comparing the students' foundation and their actual performance in a post-enrolment exam, checks on whether the variations in the attitude index are driven by the progress of students and the class since enrolment are conducted. Additionally, to consider the influences of peers on teachers' attitudes and students' outcomes, this study further tests the robustness of the main results to the inclusion of peer quality. Finally, it is also possible that teachers' attitudes are based on observations of parental behaviours, this study conducts a relevant check using parental baseline behaviours as additional control variables.

First, to further test the concern that the variations in this study are mainly driven by teachers' observations of students' performance, this study reconstructs the core attitude index by only employing teachers' attitudes towards students' abilities in the subjects they are not teaching. It is potentially easier for teachers to give observations of students' performance when they are asked about the students' abilities in the subjects they teach, where they possess direct information and regular exposure to students. By contrast, if

teachers are inquired about their perceptions of student ability in other subjects that they do not teach, the influences of teachers' observations may be alleviated, and their responses may be more relevant to their subjective attitudes. Subsequently, if the variations in the key measure of teachers' attitudes are not mainly driven by teachers' observations, then the regressions using responses from other subjects, except for the subject they are teaching, should present similar results to those generated from the main specifications. The results from the specifications with attitudes on subjects that teachers are currently not teaching are reported in Table A1. The results remain largely constant with the main results, suggesting that teachers' observations do not drive the main results in this study.

Second, as stated in Section 1.3.4, this study uses a continuous index of teachers' attitudes. To examine the sensitivity of the estimates to alternative constructions of teacher bias, this study redefines the key bias variable as a categorical measure. The variable takes the value of 3 if the teacher's continuous bias is greater than 1 (indicating the most positive attitudes towards migrant students), 2 if it is between -1 and 1 (indicating neutral attitudes), and 1 if it is smaller than -1 (indicating negative attitudes). The results from the specification with a discretised measure of attitudes are reported in Appendix Table A2. The results remain significant with the alternative measure.

In addition, given that the preferred index on teacher attitudes in this study is based on the difference between teachers' responses about students "academic foundation" and their actual performance in mid-term scores, one may argue that the variation in this index may be driven by the observations of teachers on the changes in students' ability from the pre-middle school period to the time point when they take mid-term examinations. That is, the positive index may indicate that the migrant students make notable progress

in academic performance since enrolment, which means the constructed index is more about how students improve (or regress) rather than teachers' real attitudes about the academic ability of migrant students-or alternatively, teachers' updated perceptions of students' potential rather than their prior beliefs. Considering this concern, an additional variable, variations in students' rank from 6th grade (i.e., the last year in primary school) to 7th grade is controlled and the results are shown in Table A3 column (1). The results remain largely analogous, which indicates that students' progress does not influence the main results.

Fourth, it is likely that teachers have more positive attitudes towards migrant students when they belong to classes that perform well or show better progress relative to other classes in the baseline year within a school. If this is true, then the index may be irrelevant to attitudes and just capture the relative rank of a certain class within a school. To alleviate this concern, variations in the rank of a class within the school and current class ranks themselves are controlled as a robustness check.[43] The results are presented in Table A3 column (2), which are quite similar to the main results. This suggests that the variation in the attitude index and the main results in this study are not driven by changes in teachers' observations of class-level performance.

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43. In CEPS, subject teachers report the class rank when they first started teaching the class and its current rank relative to other classes at the same school in the baseline wave. Specifically, teachers are asked "When you started teaching this class, how does the academic performance of this class compare with other classes in the same grade at this school?" and "Currently, how does the academic performance of this class compare with other classes in the same grade at this school?". The provided answers for both questions are: "1. The lowest 2. Below average 3. Average 4. Above average 5. Highest". The variable on the current ranks of the class is a categorical variable. The variable regarding variation in class rank is defined as the difference between the class rank when the teacher first started teaching the class and its current rank.

Fifth, teachers' attitudes toward migrant students may come from their impressions of their peers in the classroom. At the same time, classmate peers may have direct effects on students' academic performance. To consider the potential influences of peers on teachers' attitudes and their confounding impacts on the main results, this study further controls for the leave-one-out average scores of peers at the class level. The results are reported in Table A3 column (3). The main results remain significant. This indicates that peer effects do not drive the variations in teacher attitudes and that potential confounding effects from peers do not affect the main results.

Finally, another potential concern is that teachers may report their attitudes based on the observations of parents' behaviours. For instance, teachers may observe that the parents of particular migrants in their class are more engaged with learning and thus think that they have better potential. If this is the case, the results of teachers' attitudes will be confounded by parents' baseline behaviours. To eliminate this concern, this study further includes variables on parents' baseline behaviours as additional controls to test the robustness of the main results and to conduct an additional balance test. The relevant results are reported in Table A5 and A4. The tables report results similar to the main results of this study. This implies that the main results in this study are not driven by teachers' observations of parents' baseline behaviours.

1.6.2 Alternative specifications

Here, the main regressions are re-estimated using an alternative specification. The alternative specification allows for an interaction between teachers' attitudes and student's local status (see Appendix Table A6). The results are consistent with the main results from subgroup regressions.

1.7 Conclusion

Previous empirical studies have highlighted the disadvantaged situations of migrant students (Chen and Feng, 2019; Lüdemann and Schwerdt, 2013; Schneeweis, 2011; Wang, Cheng and Smyth, 2022). However, little attention has been given to the role of local teachers and their attitudes in the integration process of migrant students in local educational institutions, while teachers' attitudes have increasingly been proven to be important determinants of between-student gaps in academic and non-cognitive outcomes (Gershenson et al., 2022; Sabarwal et al., 2022, etc.).

Intended to fill this gap, this study explores whether teachers' attitudes towards internal migrant students about their academic ability could influence students' academic performance, employing data covering two waves in CEPS. Making use of randomised assignment of students to classes in China, this study finds positive impacts of teachers' positive atti-

tudes towards internal migrant students. In contrast, there is no significant effects on local students. Further, some evidence on potential channels indicates that teachers' attitudes induce variations in teachers' behaviours, students' feelings and emotions at schools, as well as parental beliefs and parenting styles.

Combined with previous literature about the situations of migrant students in host regions, this study contributes to finding modest influences of teachers' attitudes in local schools on academic performance of migrant students. This is consistent with previous studies suggesting that the factors related to educational institutions in locality (such as the frequency of taking external grading and time spent in local schools) could explain a proportion of migrant-local gaps. Given that local status of students in China largely indicates the socioeconomic status of their families, this study gives caveats that the existence of biased attitudes of teachers is not limited to just a few instances. That is, the biased attitudes of teachers may exist not only in the context with cross-boundary migration and influx of refugee are taking place but also occur when teachers can easily observe the family backgrounds of children. Government should then be aware of these potential risks for those disadvantaged students that are implicit, take measures to detect and correct unfair attitudes of teachers so that the educational environment for migrant students could be ensured.

While this study controls for observable student, family, and teacher characteristics. This study acknowledges that there are many unobservable confounders that may cause bias. For instance, migrant students in host cities may have more motivation and educational aspirations than local students. These factors, however, may lead to teachers' positive attitudes and improvements in students academic performance (Carlana et al., 2022).

Ideally, the setting with randomised class assignments should allow this study to avoid the situation motivated and ambitious students sort into certain classes. Nevertheless, this is untestable in this study. This is one of the limitations of this study. If there is such a sorting problem based on these unobserved aspirations and motivation, there should be an upward bias in the effects estimated in this study.

There are some interesting questions left for future research: First, while this study suggests the modest size of effects of teachers' attitudes towards internal migrant students on their educational performance, further studies on internal migrant students are still necessary to check whether this effect size is context specific. This is especially true given that the disadvantaged social identity of migrant students is caused and enhanced by formal hukou institutions in China. It is likely that the modest effect size is partly due to the institutional barriers. Second, the size of the effect that is found in this study may also be a lower boundary since only explicit measures of teachers' attitudes are available and employed. Using implicit measures may lead to larger effects of teachers' attitudes, which helps remove social desirability bias that is normally positive. Third, the mechanism through parental responses documented in this study should encourage further studies and the government to pay attention to the role of teachers' attitudes in shaping children's outcomes, which may complicate the impacts of randomised experiments and policy implementation. Delivering accurate information about the performance of students to parents is increasingly stressed by economists. However, it seems that information provision to migrant parents may offset the benefits of positive attitudes of teachers

on migrant students by reducing parental overestimation of their ability. Investigating the heterogeneity of student groups and their potential household reactions may be meaningful for the experimental teams and government to accurately detect the suitable targeting group.

Chapter 2

Fit together: The impact of sports-oriented peers on students' outcomes

Abstract

Countries worldwide face challenges of physical inactivity and low sports participation among school students. Social networks may play a role in students' exercise habit formation. Using data from Taiwanese high schools, this study examines the effects of peers' sports preference on students' exercise participation, health, mental health, cognitive performance in the short term, as well as on educational achievement and labour market outcomes in the long term. Making use of the random assignment of students to classes, this study finds that having peers who favour sports could improve students' probability of participating in vigorous sports. Having sports-oriented peers could improve students' probability of not being obese. Importantly, these gains do not come at the expense of students' cognitive performance. The impact of sports-oriented peers on students' mental health, schooling years, and labour market outcomes is insignificant. The positive effects on exercise and health are partly driven by social comparison pressure related to body management. This study contributes to the literature on the determinants of sports participation by documenting the role of peers. Additionally, this study complements the literature on peer effects, especially on peer effects in health behaviours and outcomes, by showing how health behaviours and norms may diffuse through peer groups.

2.1 Introduction

Physical inactivity constitutes a major global public health challenge, being associated with a range of chronic diseases and premature deaths (Bauer et al., 2014; Blair, 2009; Katzmarzyk et al., 2022; Lee et al., 2012). According to a recent study by Katzmarzyk et al. (2022) using data from 2016, physical inactivity accounts for 7.2% of global all-cause mortality, with a particularly high burden in middle-income countries, where 69% of total deaths are associated with physical inactivity.[1] Thereafter, these health-related outcomes result in substantial economic costs, either by directly increasing healthcare expenditures or indirectly reducing worker productivity.[2] Promoting a physically active lifestyle is essential and especially important for children and adolescents, who are in a critical developmental period, as it influences their physical and mental health, cognition, and the formation of long-term habits and outcomes (Biddle and Asare, 2011; Hallal et al., 2006). This is particularly critical given the rising prevalence of chronic conditions among children and adolescents, such as obesity, youth-onset diabetes, and early-life accumulation of cardiovascular risk factors (Centers for Disease Control and Prevention, 2024; World Health Organization, 2017, 2023).

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1. This study finds that physical inactivity is associated with higher risks of coronary heart disease, stroke, hypertension, type 2 diabetes, several cancers, dementia, and depression.
2. See Allender et al. (2007); Ding et al. (2017, 2016); Pratt et al. (2014); Saavaste et al. (2025) for relevant evidence. For instance, according to Ding et al. (2016), physical inactivity generated health care costs of INT$53.8 billion and productivity losses of INT$13.7 billion in 2013.

Despite the well-documented public and individual benefits of physical activity, participation rates among students remain low in Taiwan, as in many other Asian economies.[3] According to the 2015 report of the Programme for International Student Assessment (PISA), fewer than 40% of 15-year-old students engage in vigorous physical activity in Asian regions, whereas the share exceeds 60% in European countries and the United States (Pál, 2018). Specifically, in Taiwan, where this study focuses on, surveys conducted by the Ministry of Education show that only 22% of junior high school students and 13.6% of senior high school students engage in at least 60 minutes[4] of physical activity per day, in 2018 and 2017, respectively (Health Promotion Administration, Ministry of Health and Welfare, 2019).

Given the substantial health and economic consequences of physical inactivity and its widespread prevalence, there are substantial policy and research interests in understanding the causes of physical inactivity. Previous studies have mainly investigated the impacts of individual demographic characteristics (e.g., education and gender), income, time constraints, and the availability of sports facilities (Black et al., 2019; Brown and Roberts, 2011; Cerin and Leslie, 2008; Cleland et al., 2012; Powell et al., 2007; Venn and Strazdins, 2017).[5] However, individual participation in physical activity may also be shaped by factors beyond these structural factors. Students spend a substantial amount of time in-

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3. Physical inactivity is also prevalent among adults globally. According to a recent study, 31% of adults worldwide did not meet the recommended levels of physical activity in 2022 (Strain et al., 2024). There is a similarly disadvantaged situation in Asian regions among adults: The highest rates of physical inactivity were observed in the high-income Asia Pacific region (48%), while the number is 28% in high-income Western countries.

4. The World Health Organization recommends that children and adolescents engage in at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity across the week (World Health Organization, 2020).

5. Other investigated factors in the literature include physical education, religion, mega sports events, neighbourhood quality and built environments (Bednar and Rouse, 2020; Cawley et al., 2007; Krekel et al., 2025; Mellor and Freeborn, 2011; Moogoor et al., 2022; Zou and Wang, 2025). Within the educational context most relevant to this study, existing evidence on whether physical education promotes sports participation remains mixed (Bednar and Rouse, 2020; Cawley et al., 2007).

teracting with their peers, particularly their classmates, throughout their school years. The impacts of peers in shaping health behaviours and outcomes, including obesity, unhealthy snacking behaviours, smoking, drinking, and health care usage behaviours such as vaccine take-up and participation in health checks, have been documented in the health economics literature (Bouckaert et al., 2020; de Vries Mecheva et al., 2021; Eisenberg et al., 2014; Fletcher and Ross, 2018; Frijters et al., 2019; Liu et al., 2023; Mora and Gil, 2013; Pruckner et al., 2020; Sato and Takasaki, 2019). Despite this potential, evidence on the role of peers in shaping physical activity behaviours remains scarce, particularly causal evidence, largely due to limited data availability and challenges in addressing selection bias.

This study uses a dataset from Taiwan called the Taiwan Education Panel Survey (TEPS), which covers information on Taiwanese students, teachers, and schools. Aimed at identifying the causal spillover effects of sports-oriented peers in classrooms, this study makes use of the conditional random assignment of students to different classes in Taiwanese high schools to eliminate concerns about sorting into peers. Additionally, school fixed effects are included to control for common environmental factors between individual students and their peers. Furthermore, this study removes the concern about simultaneous bias due to the contemporary measures of individual and peers' exercise behaviours by using a pre-high school measure of students' preference for sports. This study compares the outcomes of students in various classes with differing shares of sports-oriented peers within the same school, controlling for student's and teachers' characteristics.

This study finds that having sports-oriented peers in the classroom could increase students' probability of participating in sports. Specifically, a ten–percentage-point increase in the proportion of peers who somewhat like sports is associated with a 1.227–percentage-point increase (i.e., 0.2473 standard deviations) in the probability of moderately participating in sports per week. The rich information on students in TEPS allows this study to provide further evidence on the spillover effects on students' health, cognitive outcomes, as well as long-term outcomes. Students exposed to a higher share of peers who like sports are less likely to be obese. There is no significant effect of peers' pre-determined sports preference on students' mental health, cognitive performance, long-term schooling years and labour market outcomes. The positive health impact of sports-oriented peers is driven by social comparison pressure regarding body management.

This study contributes to several strands of the existing literature. First, this study contributes to the literature on determinants of sports participation and physical activity by documenting peers' preference as one influential factor. Several studies on the determinants of individual participation in physical activity or sports have stressed the influences of monetary incentives, socioeconomic status, time constraints and facility availability (Black et al., 2019; Brown and Roberts, 2011; Cerin and Leslie, 2008; Cleland et al., 2012; Powell et al., 2007; Venn and Strazdins, 2017). However, no study investigates the causal effects of peers on individual exercise. This question is particularly important given the spatial concentration of physical inactivity and chronic diseases, which suggests a potential role for social interactions within geographic units (Lee et al., 2017; Smurthwaite and Bagheri, 2017; Tamura et al., 2014).

Second, the effects of peers' preference for sports documented in this study are related to a body of recent studies on the influences of peers in shaping health behaviours and determining health status (Bouckaert et al., 2020; de Vries Mecheva et al., 2021; Eisenberg et al., 2014; Fletcher and Ross, 2018; Frijters et al., 2019; Liu et al., 2023; Mora and Gil, 2013; Pruckner et al., 2020; Sato and Takasaki, 2019).[6] This set of studies has considered peer effects on obesity, unhealthy snacking, and risky health behaviours such as drinking and smoking, health care usage including vaccine take-up and participation in health checks. Previous evidence on peer effects in health behaviours and outcomes rarely investigates the possible channels. This study contributes to the literature by providing evidence regarding the social comparison channel and showing how healthy behaviours and health-related norms may diffuse through peer groups. Additionally, the existing evidence largely overlooks the intensity dimension of peer effects within the same type of health behaviour: Most studies use a binary definition of peers' health behaviour, ignoring the possibility that peers with varying degrees of health behaviour engagement may have differential impacts. This approach implicitly assumes that all peers who engage in a given behaviour have homogeneous influence, regardless of the degree of their involvement. In contrast, this study uses information on students' preference for sports in TEPS to construct three peer composition measures based on different levels of sports preference. This allows this study to compare the effects of peers across the intensity of their health preference.

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6. Typically, studies in this literature make use of quasi-experimental changes in health-related policy, such as reforms in PE education, and exploit the subsequent impacts on individuals and their family peers (see Berniell et al. (2013) as an example). Random dormitory and class assignment provide researchers with another setting for causal identification of peer effects on health-relevant outcomes and behaviours (see Frijters et al. (2019) as an example).

Third, this study is relevant to the literature on the benefits of sports or physical activities for individual outcomes in multiple domains. A modest body of literature shows that there are positive associations between sports participation and health, labour market outcomes, education attainment, mental health and subjective welfare of individuals (Cappelen et al., 2026; Fricke et al., 2018; Heckman et al., 2025; Hyytinen and Lahtonen, 2013; Insler and Karam, 2019; Pfeifer and Cornelißen, 2010; Rooth, 2011; Routon and Walker, 2015; Stevenson, 2010). However, much less effort has been devoted to investigating whether the prevalence and consequences of individual physical inactivity extend beyond the individual to affect others, and whether such potential spillover effects extend to health and cognitive outcomes, as well as long-term outcomes. Estimating the potential spillover effects is crucial for understanding the true returns to sports-promoting interventions and class-level health policy. Since peer influences can amplify the impact of interventions and policies, ignoring the potential spillover effects would significantly underestimate the overall benefits. Additionally, this study provides caveats for sports interventions at the individual level in a school setting: when sports interventions are randomised across students within the same class, spillovers to classmates in the control group would bias the estimated treatment effect. While randomisation at the class level, or designs that explicitly estimate spillovers, would avoid this problem.

The rest of this study is structured as follows. Section 2.2 presents the institutional setting for this study. Section 2.3 describes the data, sample and presents some descriptive analysis. Section 2.4 conducts a series of checks for the validity of randomisation of students and presents the empirical strategy. Section 2.5 states the main findings. Section 2.6 discusses potential mechanisms. Section 2.7 presents robustness tests. Section 2.8 concludes.

2.2 Institutional background

2.2.1 Physical activity and sports in Taiwan

The prevalence of physical inactivity and sedentary behaviours among students is high in Taiwan. Guthold et al. (2020) suggest that the prevalence rate of insufficient physical activity among 11-17 adolescents in Taiwan is 84.4% in 2016. Regarding the specific time spent on physical activities, Wang et al. (2019) collect data on Taiwanese junior high school adolescents and show that Taiwanese adolescents only spend 22.8 min per day on moderate-to-vigorous physical activity. This level is obviously insufficient compared to WHO recommendations of 60 min.

Despite well-equipped sports facilities, established physical education institutions, and considerable fiscal investments in sports, sports participation among Taiwanese students is hindered by heavy academic workloads and pressure. Since time constraints are a crucial factor determining sports participation, Taiwanese students who face fierce educational competition and have to spend more time studying are less likely to participate in exercise activities. This trade-off between academic workloads and physical activity is supported by evidence from PISA 2015. According to PISA reports, Chinese Taipei students rank 3rd and 4th respectively in mathematics and science among 70 countries and economies (PISA, 2015). However, Chinese Taipei is the 10th-highest in students' schoolwork-related anxiety among 57 participating countries and economies. Additionally, Taipei ranks 9th from the bottom among the 56 participating economies in the percentage of students who report exercising or practising sports before or after school (OECD, 2017).

The score-oriented education system and the cultural emphasis on education are predominant sources leading to academic pressure among Taiwanese students. Taiwan's education system relies on high-stakes examinations. Admission to higher education in Taiwan requires scores from the General Scholastic Ability Test, which is held once per year at the end of high school. The fierce educational competition has led to a boom in private tutoring. The heavy study load, both inside and outside of school, leaves Taiwanese students with little time for physical activity. According to a recent survey on child and adolescent learning conditions in 2023, the average daily in-school hours of Taiwanese junior and senior high school students vary between 7.5 and 8.5 hours (Child Welfare League Foundation, 2025). It appears that there is limited time left for exercise and rest.

2.2.2 Taiwanese high schools and context for identification

The site of this study is high schools in Taiwan. Students in Taiwanese high schools typically attend Grades 10 to 12 (i.e., they are usually aged around 15 to 17). Taiwan has a nine-year compulsory education system, consisting of six years of primary education and three years of junior high school. After graduating from junior high school and completing compulsory education, students could choose among three-year senior high schools (the academic pathway), three-year senior vocational schools, and five-year junior colleges (collectively referred to as the vocational pathway), and comprehensive high schools[7]. Admission to these types of schools is generally determined by students' entrance examination scores. According to Taiwanese Ministry of education, there are around 87.78% of

7. Comprehensive high schools allow students to explore both academic and vocational pathways before specializing at a later stage (i.e., by the end of 10th grade). See `https://www.tntcsh.tn.edu.tw/ischool/publish_page/41/?cid=803` as an example of the timelines for pathway and track decisions, as well as class assignments in comprehensive high schools.

junior high school students entering post-compulsory education in 2004, when the cohorts in the main sample in this study enter senior secondary education (Ministry of Education, 2026*a*).[8] Between the sampled periods (2005-2007), the number of students enrolled in general high schools was roughly half that in vocational high schools: for example, in 2005, there are 523,412 students enrolled in vocational high schools while the number of students who enrolled in general and comprehensive high schools is 255,387 (Ministry of Education, 2026*b*).[9]

For both academic and vocational senior high schools, students are required to complete common compulsory subjects. These subjects include Chinese, Mathematics, English, Physical Education, Arts, Integrated Activities, and Technology (foundational level).[10] For academic senior high school students, there are normally two rounds of class assignments to generate administrative classes (i.e., homerooms) to manage students. Students experience the first round of assignments when they enter high school. Maintaining this assignment for a year, students are required to choose between Science, Technology, Engineering, and Mathematics (i.e., STEM) and non-STEM tracks before they enter 11th grade. High schools tend to reassign students based on the track they choose at the beginning of 11th grade. Since 11th grade, the assignment of classes generally remains constant throughout the remaining two years for most students.[11] For vocational senior high schools, middle school graduates could choose among several vocational tracks such

8. This percentage of junior high school students has increased steadily, reaching 99.74% in 2026.
9. There is no data reports the number of enrolment in general and comprehensive high schools respectively in 2005. The number of students enrolled in general high schools gradually grew steadily, and by 2013, it had overtaken enrolment in vocational high schools (Ministry of Education, 2026*b*)
10. In addition to compulsory courses, students also need to complete some track-specific courses. For example, students who have chosen the STEM (i.e., Science, Technology, Engineering, and Mathematics) track in academic high school need to learn physics, chemistry, and biology.
11. Class transfer is also possible if a student submits an application form. Class transfer is usually allowed under exceptional circumstances. The transfer applications are discussed and assessed by schools (see an example with detailed procedure of class transfer at `https://www.tcsh.hlc.edu.tw/ischool/public/resource_view/openfid.php?id=3605`). Thus, only few students would transfer to another class.

as agriculture, marine and fisheries, industry, arts, business, and home economics before enrolment. Then the administrative class assignment is based on the specific track they choose. That is, those who choose the same track will be assigned to the same class. If the number of students selecting a given track exceeds the standard class size, several classes are formed for that track.

Under the Taiwanese education system, the administrative class is a unit through which students interact with classmates during morning study sessions, other self-study sessions, lunch breaks, and class-based collective activities such as class meetings. That is, administrative classes are the primary settings in which students' daily routines and collective activities take place. Then how are the teaching classes organized in Taiwanese high schools? This depends on the decisions of individual schools, including both academic and vocational high schools. Some schools choose to organise teaching (at least for core courses) based on the administrative units. In these schools, subject teachers come to teach in the classrooms assigned to different administrative classes, each of which has a fixed homeroom. In contrast, other schools may have students attend classes according to their ability (i.e., using tracking, ability group teaching, or ability grouping). Specifically, in some high schools, students from the same administrative class may leave their homeroom to attend ability-adjusted subject classes in different classrooms during instructional periods. This practice is allowed by the government to improve the academic performance of students. The divided teaching groups are normally adjusted according to students' scores each semester. Regardless of how subject instruction is organised, there is a Daoshi (i.e., homeroom teacher) assigned for each administrative class in Taiwanese

high schools. Daoshi is in charge of managing, guiding, and educating students on daily life, study, behaviours, career, and physical and mental health. They are also responsible for communication with parents (e.g., via home visits or phone calls) and administrative tasks (such as taking attendance for students and approving students' leave).

The empirical strategy of this study is powered by the conditional random assignment of (both administrative and teaching) classes in a considerable fraction of Taiwanese high schools. The Taiwanese Ministry of education stresses the random principle for the formation of homerooms to ensure equality.[12] There are some schools that form classes based on students' scores or academic performance either before or after entering high school. However, a considerable fraction of high schools in Taiwan randomly assigns students to homerooms, normally using S-shaped assignment, public lottery, or computer programs to ensure balance based on class size, gender, and other characteristics. This principle applies to all grades in a substantial number of schools, covering both academic and vocational high schools. As stated above, in academic high schools, a second round of class assignment occurs in grade 11, whereas vocational high schools implement a single class assignment throughout the three years. In both cases, the assignment is based on the track selected by the students, after which they are allocated to different homerooms within that track. That is, the assignment to different administrative classes in some Taiwanese high schools is a quasi-experiment, conditioning on the track they have chosen. In addition, the dataset employed allows this study to remove schools that conduct group teaching

12. See `https://edu.law.moe.gov.tw/LawContent.aspx?id=GL002210&kw` for government-issued guidelines on class assignment in Taiwanese high schools.

and thus to leave schools using administrative classes as teaching units. The conditional random assignment provides an opportunity for this study to largely eliminate the confounding effects of class and teacher sorting problems. How the sample is restricted to classes that have been randomly assigned within the track is stated in Section 2.3.1.

2.3 Data, sample and measures

2.3.1 Data source and sample

This study uses data from the Taiwan Education Panel Survey (TEPS). This survey has been collected since 2001 by Academia Sinica, the Ministry of Education, and the National Science Council in Taiwan. The TEPS is designed to be representative of Taiwanese students in middle and high schools by applying a stratified, multistage sampling design. Specifically, in the first stage, schools were stratified by school system, including junior high schools and senior high schools, with the latter further classified into general senior high schools, comprehensive high schools, vocational high schools, and five-year junior colleges (Academia Sinica, 2001).[13] In the second stage, classes are randomly selected within each sampled school, with a target of four classes per school. In the final stage, approximately 15 students were randomly selected from each class.[14] Available data includes four waves of surveys conducted in 2001, 2003, 2005, and 2007, respectively. The 2001-2003

13. In the main sample of this study, only general senior high schools, comprehensive high schools, and vocational high schools are included.
14. This means the usage of TEPS data faces issues of incomplete sampling of students' peer groups. To address this concern, this study conducts a robustness check using Sojourner (2013)'s correction method (see Section 2.7).

waves and the 2005-2007 waves constitute two panels, respectively[15]: The first panel is a pooled panel that includes both middle school and high school students observed between 2001 and 2003. The second panel includes only high school students observed between 2005 and 2007. Overall, TEPS randomly selects approximately 59,242 students (including 39,106 students from 2001 to 2003 and 20,136 students from 2005 to 2007) and 9,993 teachers in 4,759 classes across 796 schools over 4 waves.

This study employs data from 2005 to 2007 and focuses on the traced high school students to utilise the panel features of the dataset (these students are in grade 11 in the 2005 wave and in grade 12 in the 2007 wave).

In this study, the sample is restricted to schools where the administrative class assignment is reported to be random. In Taiwan, students in academic high schools are assigned to homerooms according to the track they choose when they finish grade 10 and start to enter grade 11. The assignment is generally kept constant from grade 11 to grade 12 in most schools. Students in vocational high schools have completed the assignment within the track at the beginning of high school, and this assignment remains constant throughout

15. The two panels generally follow different cohorts and groups of students and therefore cannot be combined into a single longitudinal panel. One exception is students who are followed as a core sample in TEPS. The core sample across four waves constitutes a panel sample, including around 4000 students. Those students belonging to the core sample are first surveyed in the fall of Grade 7 (i.e., the first year of junior high school) in 2001 and are subsequently followed over time. They are thereafter surveyed in the fall of Grade 9 in 2003, the fall of Grade 11 in 2005, and the spring of Grade 12 in 2007. The non-core samples are, in essence, composed of three separate panel samples, each covering two waves. Specifically, the first panel sample covers students who were in Grade 7 in 2001. They are followed longitudinally to Grade 9 in 2003. Senior high school students (including both academic and vocational high schools) comprise the second panel from 2001 to 2003. They are in Grade 11 in 2001 and in Grade 12 in 2003. The third panel consists of high school students in grade 11 in 2005. They are subsequently followed to grade 12 in 2007. The main sample used in this study comes from the third panel.

the three years (see Section 2.2.2 for detailed background information). To make use of the random assignment of classes and eliminate the effect of class sorting, the sample is restricted to classes where the assignment of students to classes is random (this is reported in the questionnaires for administrative staff in schools in wave 4).[16]

In addition, as stated in Section 2.2.2, there are some Taiwanese schools that may implement ability tracking. If ability-based teaching exists, the estimation will be biased due to changed peer composition in the teaching unit and the potentially endogenous assignment of teachers and students to different ability groups. To address this concern and ensure the consistency between administrative and teaching classes, the sample is restricted to schools where there is no ability tracking (this is also reported in the questionnaires for administrative staff in schools in wave 4).[17] One may be concerned that there may be some classes set for professional athletes or other gifted students in high schools, which may cause biases. To eliminate this concern, the sample is further restricted to students who report no experience attending advanced classes during the high school stage.[18] There are some previous studies making use of random assignment of students to classes in educational institutions, see Gong et al. (2018) and Huang et al. (2025) as examples. Following these studies, checks on random assignment are conducted in Section 2.4.1. The analysis sample includes 2511 students and 417 Daoshi in 417 classes across 92 schools. Summary

16. Random assignment of classes is a basic principle implemented by the Taiwanese government to ensure equality. See `https://edu.law.moe.gov.tw/LawContent.aspx?id=GL002210` Article 7 for the government's regulation on random class assignments. Administrative staff are asked, "Does your school adjust class assignments considering the differences in students' abilities?" The options are "1. Yes, it applies to all grades. 2. Yes, it applies to some grades. 3. No". The sample in this study is restricted to schools whose staff only report option 3.

17. Administrative staff are asked, "Does your school group students for teaching according to abilities in core subjects?" The options are "1. Yes, it applies to all grades. 2. Yes, it applies to some grades. 3. No 4. Other situations". Sample in this study is restricted to schools whose staff only report option 3.

18. Students are asked in 2007, "Have you attended advanced classes since high school? If you have attended, what kinds of advanced classes have you attended?" The options are "1. Haven't attended 2. Yes, STEM advanced classes. 3. Yes, English advanced classes 4. Yes, advanced classes in humanities and social sciences 5. Yes, advanced classes in music, visual arts, physical education, dance, etc. 6. Yes, other types of advanced classes". The sample in this study is restricted to students who only report option 1.

statistics of students and their Daoshi related variables in the analysis sample are presented in Tables 2.1 and 2.2. Please see Table B13 for detailed steps on sample restrictions, with the number of classes and the average number of student per class listed for each step.[19]

The TEPS research team also conducted follow-up surveys through the Taiwan Education Panel Survey and Beyond (TEPS-B) to collect information on students' long-term educational and labour market outcomes. To examine the long-term effects of sports-oriented peers, this study uses the 2013 TEPS-B survey, the only follow-up wave available for the cohort in the main (TEPS) sample. Among the 2511 students included in the main (TEPS) sample, 1671 were successfully followed up in the 2013 TEPS-B survey. While the attrition rate is considerable, an attrition check conducted shows that the attrition is nearly random (see Section 2.5.2).

2.3.2 Measures and variables

2.3.2.1 Core explanatory variables

The core explanatory variables are the leave-one-out shares of classroom peers who like sports and those who love sports. In the 2007 wave of TEPS, parents are asked to report the extent to which their children liked sports when they were in grades 5 and 6. Specifically, parents are asked: "Please recall the child's life in primary school, did this child like sports?". Parents need to choose from "1. Like very much 2. Somewhat like 3. Somewhat dislike 4. Strongly dislike". According to this question, three dummy variables indicating the degree of sports' liking for children are generated. There are 49.43% students in main

19. Table B14 shows the differences of pre-high-school student characteristics between the retained and original sample.

sample whose parents choose option 2 and think their children somewhat like sports. Meanwhile, 27.14 % of students are reported as "Like very much". That is, most children like sports in their primary school stage, with only 20.68% students somewhat dislike sports and 2.74% students strongly dislike sports respectively. To be consistent with the outcome dummies on exercise frequency as stated in Section 2.3.2.3 and construct simplified measures, this study defines exercise-averse students as those who are reported as "Somewhat dislike" or "Strongly dislike" by their parents. In contrast, sports lovers (i.e., students who love sports) are students who "Like sports very much". The remaining student group who are reported as "Somewhat like sports" is then be regarded as those who like or favour sports. Then, variables on leave-one-out peer shares of exercise-averse, sports-favouring and sports-loving peers at the class level are generated accordingly. Notably, the core peer shares are constructed according to students' exercising preference prior to high school, this allows this study to avoid simultaneous bias that is caused by contemporary measures on a student and their peers. Figure 2.1 shows the distribution of the shares of sports-favouring and sports-loving peers in the main sample.

2.3.2.2 Control variables

As shown in Table 2.1 and 2.2, there are a variety of student and Daoshi characteristics available in TEPS, which are employed in the subsequent regressions in this study. The student-related controls include demographic characteristics covering student gender, age, highest parental education (1. Junior high school or below, 2. General or vocational senior

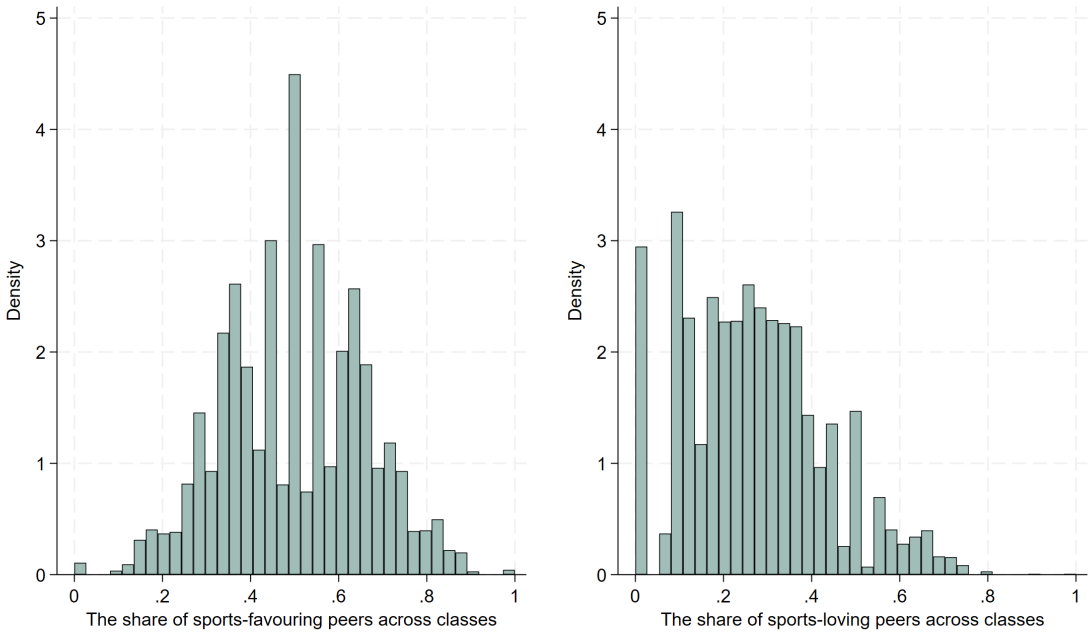


Figure 2.1: Distributions of core peer shares.

high school, 3. Junior college, 4. General university, 5. Graduate school), family income (a categorical variable on the income level of the family before age three: 1. Very difficult, 2. Somewhat difficult, 3. Moderately well-off, 4. Well-off), and dummy variables indicating serious parental illness, parental mental illness, and parental alcoholism before high school.

Additionally, TEPS provides information on student's cognitive ability before they enter primary school so that this study can control for the cognitive skills of students before their enrolment in high school. In 2005 wave of TEPS, parents are asked to recall their children's performance in the period just before entering elementary school and to choose the items that their children can do (allowing multiple options). Those items relevant to pre-primary school cognitive ability include: can do simple addition and subtraction; can recognise Zhuyin (Bopomofo) symbols or simple Chinese characters; can recognise English

letters; can recognise colours or shapes; can recite poems or the Three Character Classic (or classical Chinese texts). This study then constructs one pre-school cognitive variable by averaging items related to cognitive ability. This variable is standardised to have a mean of zero and a standard deviation of one.

TEPS also provides information on Daoshi's characteristics. The available variables include Daoshi's gender, Daoshi's age (1. 25 years old or below, 2. 26–30 years old, 3. 31–35 years old, 4. 36–40 years old, 5. 41–50 years old, 6. 51 years old or above), Daoshi's education (1. Junior College Diploma, 2. Bachelor's Degree, 3. Master's Degree, 4. Doctoral Degree), Daoshi's years of experience as a teacher (1. Less than 1 year, 2. 1–3 years (excluding 3 years), 3. 3–6 years (excluding 6 years), 4. 6–9 years (excluding 9 years), 5. 9–20 years (excluding 20 years) 6. 20 years or above).

2.3.2.3 Outcome variables

The main outcomes examined in this study include short-term outcomes covering sporting behaviours, health, mental health, cognitive ability, and learning time, as well as long-term outcomes including years of schooling, employment status, earnings, and occupation status.

Table 2.1: Summary statistics for students

	Mean	S.D.	Min	Max	Obs.
Panel A: Core explanatory variables					
Share of sports-averse peers	0.2353	0.1515	0.0000	1.0000	5022
Share of sports-favouring peers	0.5065	0.1610	0.0000	1.0000	5022
Share of sports-loving peers	0.2735	0.1644	0.0000	1.0000	5022
Panel B: Control variables					
Share of female peers	0.5107	0.3633	0.0000	1.0000	5022
Pre-high school sports preference (=1 sports-averse)	0.2306	0.4212	0.0000	1.0000	5022
Gender (=1 female)	0.4942	0.5000	0.0000	1.0000	5022
Age	17.4186	1.1469	15.0000	21.0000	5022
Highest parental education	2.2616	1.0098	1.0000	5.0000	5022
Family income	2.8947	0.4721	1.0000	4.0000	5022
Parental serious illness before high school	0.0372	0.1894	0.0000	1.0000	5022
Parental mental illness before high school	0.0096	0.0973	0.0000	1.0000	5022
Parental alcoholism before high school	0.0350	0.1839	0.0000	1.0000	5022
Pre-School cognitive performance	0.0000	1	-2.9030	1.1661	5022
Baseline cognitive score	0.3783	0.8398	-2.8459	2.6053	5022
Baseline sports participation dummy (=1 low participation)	0.3086	0.4620	0.0000	1.0000	5022
Baseline weight dummy (=1 abnormal)	0.4190	0.4934	0.0000	1.0000	5022
Panel C: Outcome variables					
Low sports participation	0.2015	0.4012	0.0000	1.0000	5022
Moderate sports participation	0.5613	0.4963	0.0000	1.0000	5022
High sports participation	0.2366	0.4250	0.0000	1.0000	5022
Obesity	0.0888	0.2845	0.0000	1.0000	5022
Overweight	0.1101	0.3131	0.0000	1.0000	5022
Underweight	0.1237	0.3292	0.0000	1.0000	5022
Abnormal weight	0.3226	0.4675	0.0000	1.0000	5022
Depression	2.3285	0.8222	1.0000	4.0000	5016
Do not want to live	1.4657	0.7560	1.0000	4.0000	5010
Feel helpless	2.0092	0.8786	1.0000	4.0000	5011
Feel cared for and loved	2.6734	0.8830	1.0000	4.0000	5015
Comprehensive analytical test	0.0000	1.0000	-3.5550	2.9020	4956
General analytical test	0.0000	1.0000	-3.5421	2.3883	4956
Math analytical test	0.0000	1.0000	-3.5309	2.3522	4956
Learning time (excl. school tutoring)	2.5196	0.9782	1.0000	5.0000	5006

Notes: This table reports the summary statistics. Sample means, standard deviations, minimum and maximum values, as well as the number of observations are presented. The unit of observation is the student year combination.
$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table 2.2: Summary statistics for Daoshi

	Mean	S.D.	Min	Max	Observations
Daoshi gender (1 = female)	0.5827	0.4934	0	1	834
Daoshi highest education	2.5671	0.5101	1	4	834
Daoshi age	3.9317	1.2440	1	6	834
Daoshi's years of teaching experience	4.4496	1.3259	1	6	834

Notes: This table reports the summary statistics. Sample means, standard deviations, minimum and maximum values, as well as the number of observations are presented. The unit of observation is the Daoshi.
$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

The first strand of outcome variables are dummy variables on the frequency of vigorous physical activity. In TEPS, students are asked in both 2005 and 2007: "In a typical week, how many times do you engage in vigorous physical activities that make you sweat (such as swimming, basketball, running, or other aerobic exercises)?"[20] Subsequently, three dummy variables on the frequency of sporting behaviours are generated: The first dummy indicates that whether a student participates in vigorous sports no more than once per week (i.e., rare participation). The second and third dummies show that whether a students participates in vigorous sports two to three times (i.e., moderate participation) and four or more times per week (i.e., high participation) respectively. To control for students' sports participation in the baseline year, a dummy variable indicating whether students participate in vigorous physical activity rarely in 2005 is also created.

The second series of outcomes of interest is about students' health states in terms of BMI (Body Mass Index). TEPS has collected information on students' weight and height in both 2005 and 2007 in student questionnaires. Then, this study creates four dummy variables—obesity, overweight, underweight, and abnormal weight—based on the calcu-

20. Students need to choose from "1. Less than once, 2. About once, 3. Two to three times, 4. Four to five times, 5. Six to seven times, 6. More than eight times". There are 55.98% of high school students who choose option 3, whereas only 4.29% and 5.32% of students select categories 5 and 6, respectively. Since the distribution of this sports variable is highly concentrated in value 3 and dispersion across the highest categories (5 and 6), the six-point Likert scale is collapsed into three categories by combining categories 4, 5, and 6 into a single category (i.e., high participation) and categories 1 and 2 into another single category (i.e., rare participation). This combination is data-driven and aimed at simplification.

lated BMI. The abnormal weight indicator equals one if an individual is underweight, overweight, or obese, and zero otherwise. These dummies are generated according to the Recommended Body Mass Index Values for the Growth of Children and Adolescents in Taiwan, published by the Taiwanese government, which provides age-specific standards for BMI categories (i.e., underweight, normal weight, overweight, obesity) (Health Promotion Administration, Ministry of Health and Welfare, Taiwan, 2021).[21]

In addition to information on physical health, there are some questions related to mental health that are asked to students in TEPS in 2005 and 2007 waves. For instance, students are asked "Since the beginning of this semester, have you ever felt depressed?". Students are required to choose among "1. Never 2. Yes, occasionally 3. Yes, sometimes 4. Yes, often". The items relevant to mental health covered in this study include: feel depressed, don't want to live anymore, feel helpless, feel cared for and loved.

TEPS provides students' scores on cognitive ability, including three aspects: comprehensive analytical ability, general analytical ability, and mathematical analytical ability, in the 2005 and 2007 waves. To control for cognitive performance in the baseline year, an index for baseline cognitive scores (i.e., the averaged cognitive score in the 2005 wave using cognitive scores of the 3 aspects) is also created. The cognitive scores in both the 2005 and 2007 waves are standardised at the overall sample level to have a mean of 0 and a standard deviation of 1, facilitating comparability of regression coefficients with other studies.

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21. There are some students who are older than 17 in TEPS. For them, the generation of four weight-related dummies is according to the governments' recommendations for adults that are consistent with WHO's standards, see Health Promotion Administration (2018).

There are some survey questions on time use asked to students in TEPS. Among these questions, there is a survey question related to learning time in TEPS. The question is "Excluding time spent attending classes and private tutoring, how much time do you spend on homework, studying, and preparing for exams on an average day?" The provided options are: 1. Less than one hour; 2. From one hour to less than two hours; 3. From two to less than four hours; 4. From four to less than six hours; 5. Six hours or more.[22]

As stated in Section 2.3, long-term outcomes observed in students' adulthood are collected in TEPS-B. Specifically, information on students' education, employment status, salaries, and occupations is available. Individual education is a categorical variable: 1. Senior high school 2. Vocational high school 3. Five-Year junior college 4. Two-Year junior college 5. Technical institute or university of science and technology 6. University 7. Master's degree 8. Doctoral degree. The income variable is an ordered categorical variable indicating pre-tax monthly salary ranges, varying from 1 to 17.[23] The employment variable is a dummy variable indicating whether an individual has a full-time job.[24] The variable on individual occupational status is a variable indicating whether an individual has a job that is perceived as having higher social prestige in Taiwanese society.[25]

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22. In the 2005 wave, the provided options are: 1. Less than one hour; 2. From one hour to less than two hours; 3. From two to less than three hours; 4. From three to less than four hours; 5. From four to less than six hours; 6. Six hours or more. To make the measure consistent across the two waves, the variable was transformed into five categories to match the 2007 wave.
23. 1. No income; 2. Less than NT$10,000; 3. NT$10,000–14,999; 4. NT$15,000–19,999; 5. NT$20,000–24,999; 6. NT$25,000–29,999; 7. NT$30,000–34,999; 8. NT$35,000–39,999; 9. NT$40,000–44,999; 10. NT$45,000–49,999; 11. NT$50,000–54,999; 12. NT$55,000–59,999; 13. NT$60,000–64,999; 14. NT$65,000–69,999; 15. NT$70,000–74,999; 16. NT$75,000–79,999; 17. NT$80,000 or above.
24. A full-time job is defined as working 30 hours or more per week.
25. 1 = Managers and senior officials (large enterprises, 30+ employees); owner-managers or general managers (small firms, <25 employees); physical, mathematical and engineering professionals; life science and health professionals; teaching professionals; other professionals; office clerks; customer service clerks. 0 = Personal service workers; sales workers; agricultural and animal husbandry workers; mining and construction workers; metal, machinery and related trades workers; precision instrument, handicraft, printing and related trades workers; other craft and related trades workers; plant and machine operators and assemblers; drivers and mobile plant operators; elementary occupations including street vendors and service workers; agricultural, fishery and related labourers; mining, construction, manufacturing and transport laborers.

2.4 Methodology

2.4.1 Random assignment checks

A threat to identification in this study is the potential sorting of students to classes, peers, and Daoshi. For instance, parents with higher levels of income and education may choose classes with higher-ability peers for their children in high school. These children are more likely than their counterparts to develop regular exercise habits due to parental education regarding health behaviours. In this case, the estimated coefficients on sports-oriented peers would be upward biased. Similarly, the coefficients of sports-oriented peers will capture the confounding effects of other characteristics of individual students, peers, and Daoshi on students' exercising behaviours in subsequent time periods and thus be biased. As discussed in Section 2.3, the sample in this study is restricted to schools where both the administrative and teaching class assignments are random, and the sorting problem should not exist in principle. Here, to further confirm the random assignment of students to classes in this sample, balance checks based on student and Daoshi characteristics are conducted.

First, Table 2.3 Panel A presents the results of checks regarding sorting based on students' pre-high school characteristics. The checks follow Alan et al. (2023)'s paper and try to see whether the shares of peers who like sports are correlated with students' predetermined characteristics. Specifically, this study regresses each student characteristic on the proportions of sports-favouring and sports-loving classmates, respectively, with urban region, school type (general, vocational, and comprehensive/hybrid senior high schools),

Table 2.3: Balance tests based on student and Daoshi characteristics

	Sports-Favouring peers	Sports-Loving peers	Observations
Panel A: Student characteristics			
Family income	0.0173	-0.0594	5022
	(0.0411)	(0.0439)	
Highest parental education	0.0821	-0.1388	5022
	(0.0846)	(0.0941)	
Parental serious illness before high school	-0.0104	-0.0187	5022
	(0.0167)	(0.0182)	
Parental mental illness before high school	0.0100	0.0011	5022
	(0.0093)	(0.0101)	
Parental alcoholism before high school	0.0029	0.0205	5022
	(0.0182)	(0.0206)	
Age	0.0687	0.0574	5022
	(0.0473)	(0.0507)	
Gender (1=female)	-0.0649**	0.0466	5022
	(0.0295)	(0.0325)	
Pre-school cognitive performance	-0.0020	0.0005	5022
	(0.0214)	(0.0255)	
Panel B: Daoshi characteristics			
Daoshi gender (1=female)	-0.1903*	0.0147	834
	(0.1036)	(0.1180)	
Daoshi highest education	-0.1324	-0.0668	834
	(0.1108)	(0.1194)	
Daoshi age	0.0616	0.1895	834
	(0.2548)	(0.2927)	
Daoshi years of teaching experience	-0.0229	0.2045	834
	(0.2648)	(0.2974)	

Notes: Reported estimates are from OLS estimation. Each cell in columns (1) and (2) presents the coefficient and standard error (in parentheses) from a separate regression where the dependent variable is the listed characteristic and the independent variable is the relevant peer share. Regressions control for urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level. Daoshi balance tests are conducted at the class level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

school ownership (public vs. private), school, and track fixed effects. If there is a classroom sorting process based on students' features, then students' pre-determined characteristics may be significantly related to the core peer shares in sizeable magnitudes. Table 2.3 Panel A shows that most of the coefficients of student characteristics have no predictive power on the shares of peers who like sports. The only exception is student gender. Nevertheless, the magnitude of student gender is relatively small, and it is controlled in all regressions: while the estimate on student gender is significant, the coefficient indicates that a ten–percentage-point increase in the proportion of peers in the class who favour sports is associated with a decrease in the probability of being a female student by 0.0649 percentage points. This suggests that classes with a higher proportion of sports-favouring peers tend to have students with a lower share of female students. To mitigate the potential bias caused by the changes in the share of female peers, this study controls for the leave-one-out share of female peers at the class level throughout all regressions.

Second, balance tests based on Daoshi's characteristics are reported in Table 2.3 panel B. This check follows Gong et al. (2018) and regresses the shares of peers who favour and love sports on Daoshi's characteristics, respectively. Specifically, this study regresses each Daoshi characteristic on the proportion of sports-favouring or sports-loving classmates, with urban region, school type, school ownership, school, and track fixed effects. The units of observation are at the Daoshi-class levels. As presented in Table 2.3, none of the coefficients for Daoshi characteristics are significant at the 5% significance level.

2.4.2 Empirical strategy

The estimation specification for student-level outcomes is as follows:

$$Y_{icst} = \beta_0 + \beta_1 Sportslovingpeers_{cst} + \beta_2 Sportsfavouringpeers_{cst} + \beta_3 Controls_{icst} + \gamma_u + \zeta_h + \delta_o + \lambda_s + \theta_k + Time_t + \mu_{icst} \tag{2.1}$$

Where Y_{icst} is the outcome of interest for student i, in class c, school s and year t. $Sportsfavouringpeers_{icst}$ and $Sportslovingpeers_{icst}$ are the regressors of interest. These two variables indicate the leave-one-out peer shares of classmates who somewhat like sports and like sports very much. Correspondingly, β_1 and β_2 are the coefficients of interest, capturing the effects of having sports-favouring and sports-loving peers respectively after their exposure to the classmates in high school for one and a half year.[26]

$Controls_{icst}$ represents a series of student, class, and Daoshi characteristics. It includes baseline measures of students' exercise behaviour, BMI, and cognitive scores collected in the 2005 wave of TEPS (corresponding to the 2005–2006 academic year). Specifically, dummy variables indicating whether a student had low sports participation and abnormal weight in 2005 wave are generated respectively. The baseline variable on cognitive skill is the standardised cognitive scores (averaged based on 3 aspects) measured in the baseline

26. Since the 2005 wave was conducted in fall 2005 and the 2007 wave was conducted in spring 2007, the period between the two waves corresponds to approximately one and a half years of peer exposure following class assignment in fall 2005.

year. The inclusion of these baseline variables corresponds to a value-added specification, allowing the analysis to control for students' prior exercise behaviour, cognitive performance, and weight status, while enabling the key coefficients to capture the impact on the changes in health and cognitive outcomes.

Additionally, $Controls_{icst}$ also covers variables on students' demographic and family characteristics, including student gender, age, the highest value of parental education, family income status before age three, dummy variables indicating serious parental illness, parental mental illness, and parental alcoholism before high school. Two variables regarding students' pre-high-school exercise preference and cognitive performance are also controlled for: These two variables include a dummy variable indicating student's own sports preference in primary school (=1 indicates a sports-averse students), and a variable on students' pre-school cognitive ability[27]. Four variables on Daoshi' characteristics are also included: Daoshi's gender, Daoshi's age, Daoshi's education (Junior college diploma, Bachelor's degree, Master's degree, Doctoral degree), Daoshi's years of experience as a teacher. Based on the balance check shown in Table 2.3, this study also generates and controls for a variable on the leave-one-out peer shares of female students at the class level. This allows the estimated coefficients in this study to distinguish the effects of sports-oriented peers from the effects of female peers.

γ_u, ζ_h, δ_o, λ_s, and θ_k denote urban region, school type, school ownership, school, and track fixed effects, respectively. Throughout this study, estimations based on the above empirical model have been conducted.

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27. As stated in Section 2.3.2.2, this variable is related to the following items: can do simple addition and subtraction; can recognise Zhuyin (Bopomofo) symbols or simple Chinese characters; can recognise English letters; can recognise colours or shapes; can recite poems or the Three Character Classic (or classical Chinese texts).

Importantly, the main specification here does not control for school-track fixed effects. This means that school-track characteristics of students, teachers and schools may bias the results. Examples of these school-track fixed effects include: school-track-specific admission thresholds, which determine the ability and family background of students in each track and differ across schools; practical and workshop training in vocational programmes, whose content and intensity vary across schools; the assignment of teachers, including whether schools place more experienced or sports-oriented teachers in particular programmes; Because these factors may be correlated both with the share of sports-oriented peers and with students' exercise, weight status and study time, additive school and programme fixed effects cannot rule out bias from them, whereas school-track fixed effects absorb them fully.

2.5 Results

2.5.1 Short-Term results

2.5.1.1 Exercising behaviours

The estimated effects of having peers with different sports preference on students' exercising frequency per week based on equation (1) are presented in Table 2.4. The dependent variables are dummies on exercising behaviours. The results show that having peers who somewhat like sports (i.e., sports-favouring peers) has significant positive effects on students' own exercising behaviours. There is a consistent pattern between peers' degree of liking for sports and induced changes in students' exercise frequency. A ten-percentage-

Table 2.4: The effects of having sports-oriented peers on students' sporting behaviours

	Low sports involvement dummy	Moderate sports involvement dummy	High sports involvement dummy
Sports-Favouring peers	-0.0355	0.1227**	-0.0882*
	(0.0394)	(0.0602)	(0.0471)
Sports-Loving peers	-0.0099	0.1062	-0.0933*
	(0.0402)	(0.0646)	(0.0534)
Observations	5022	5022	5022

Notes: Reported estimates are from OLS estimation. Dependent variables are dummies on students' sporting behaviours. The unit of observation is the student-year. Regressions control for student characteristics (student gender, age, highest parental education, family income, serious parental illness, parental mental illness, and parental alcoholism before high school, pre-high school sports preference, pre-school cognitive ability), Daoshi characteristics (Daoshi gender, Daoshi age, Daoshi education, and Daoshi's years of teaching experience), female peer share, urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

point increase in the proportion of peers who somewhat like sports is associated with a 1.227-percentage-point increase (i.e., 0.0247 standard deviations) in the probability of moderately participating in sports per week[28] and a 0.882-percentage-point decrease in the probability of frequently participating in sports per week (although only significant at the 10% level).[29] The coefficient on rare participation is negative but small and statistically insignificant. In contrast, the effects of proportion of peers who like sports very much on students' exercising behaviours are generally insignificant, while the magnitude

28. This corresponds to a one standard deviation increase in the share of sports-favouring peers being associated with a 0.0398-standard-deviation increase in the probability of participating in sports moderately.

29. The estimated effect of sports-favouring peers on exercise seems to be modest compared with the effects reported for other interventions aimed at increasing physical activity. For instance, Royer et al. (2015) find that offering a commitment-contract option and financial incentives (10 dollars for each visit) increased the probability of a weekly gym visit by 0.225 and 0.45 standard deviations, respectively, in the short term. Notably, these estimates are derived from pre-treatment descriptive statistics and assume that the dummy outcome variable follows a Bernoulli distribution, as the standard deviations and means for the full sample over the entire treatment period are not available.

are similar to those of sports-favouring peers. This may indicate that there may be a threshold of sports intensity that is difficult to surpass, and that students are more likely to imitate peer behaviours perceived as attainable. However, this study cannot draw any definitive conclusions on this issue.[30] [31]

2.5.1.2 Physical health

Table 2.5: The effects of having sports-oriented peers on students' physical health

	Obesity	Overweight	Underweight	Abnormal weight
Sports-Favouring peers	-0.0913***	0.0204	0.0067	-0.0642*
	(0.0283)	(0.0357)	(0.0351)	(0.0333)
Sports-Loving peers	-0.0925***	0.0465	-0.0234	-0.0694*
	(0.0329)	(0.0367)	(0.0384)	(0.0382)
Observations	5022	5022	5022	5022

Notes: Reported estimates are from OLS estimation. Dependent variables are dummies on students' physical health. The unit of observation is the student-year. Regressions control for student characteristics (student gender, age, highest parental education, family income, serious parental illness, parental mental illness, and parental alcoholism before high school, pre-high school sports preference, pre-school cognitive ability), Daoshi characteristics (Daoshi gender, Daoshi age, Daoshi education, and Daoshi's years of teaching experience), female peer share, urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level and reported in parentheses.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Given that sports influence individual health states, it is likely that having peers who like exercising could influence students' physical health. The effects of the share of sport-oriented peers on students' health outcomes are reported in Table 2.5. The results in Table 2.5 suggest that a higher share of sport-oriented peers is associated with a lower probability of students being obese and having abnormal weight. Specifically, A ten–percentage-point increase in the proportion of peers who somewhat like sports is associ-

30. This study also conducts a series of heterogeneous analysis. See Tables B5 to B11 for heterogeneity by student gender, parental education, family income, student age, baseline BMI, baseline cognitive ability and student own pre-high-school sports preference. Generally, there is no heterogeneity found in this study.

31. Previous studies suggest that males are more likely to participate in physical activities and sports, compared with females (see, for example, Lee and Lim (2022) and Eberth and Smith (2010)). To consider the potential differentiated effects of female and male's sports-oriented peers, this study construct measures on the leave-one-out averaged values of female and male sports-oriented peers and conduct regressions. The relevant results are reported in Table B12. There is no significant effect of male and female sports-oriented peers.

ated with a 0.913-percentage-point decrease (i.e., -0.0321 standard deviations)[32] in the probability of being obese and a 0.642-percentage-point decrease in the probability of having abnormal weight (only significant at the 10% level). Meanwhile, an increase in the proportion of peers who like sports very much by ten percentage points is correlated with a decrease in the probability of being obese by 0.925 percentage points[33], and a decrease in the probability of having abnormal weight by 0.694 percentage points (only significant at the 10% level). The coefficients on overweight and underweight are small and statistically insignificant.

The estimated effects of sports-oriented peers on obesity are moderate compared with the effects reported in previous studies on the impact of peers' weight.[34] Specifically, Asirvatham et al. (2018) report small effects: a one-percentage-point increase in the percentage of obese new peers leads to a 0.0045-standard-deviation increase in a student's BMI z-score. In contrast, the estimated effects in Gwozdz et al. (2015) are larger: a one standard deviation increase in the average BMI of peers leads to 0.395-standard-deviation increase in own BMI; A one percentage point increase in cohort obesity is associated with a 0.005 standard deviation increase in individual BMI. Similarly, Nie et al. (2015) find that one standard deviation increase in average peer BMI is associated with an increase in individual BMI by 0.1938 standard deviations.

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32. This corresponds to a one standard deviation increase in the share of sports-favouring peers being associated with a 0.0517-standard-deviation decrease in the probability of obesity.
33. This corresponds to a one standard deviation increase in the share of sports-loving peers being associated with a 0.0535-standard-deviation decrease in the probability of obesity.
34. Compared with evidence from other studies investigating the contributing factors to obesity, the estimated effects found in this study are considerable. For instance, Courtemanche and Carden (2011) find that the opening of a Wal-Mart store per 100,000 residents increases the risk of obesity by 0.0562 standard deviations. Gundersen et al. (2012) find that the National School Lunch Program reduces obesity by 0.0810 standard deviations. Li and Xia (2025) find that the entry of dockless bike-sharing services for a year could decrease indiviuals' BMI by 0.0552 standard deviations. Notably, there are a body of studies investigating the impact of monetary incentives on weight loss, see for example, Cawley and Price (2013). However, the existence of the potential effect is generally mixed. There is no information on standard deviations of the main sample in most studies, making effective size comparison across studies difficult.

Importantly, the interpretation of the effects of sports-oriented peers on obesity found in this study should be cautious for several reasons. First, the reduction in obesity may not be solely operated through physical activity. As shown in Table 2.4, a higher share of sports-oriented peers does not increase students' overall exercise frequency. The evidence on exercise therefore cannot by itself account for the estimated reduction in obesity, and other channels are likely to play a role. Second, one possible channel through which obesity can be reduced is diet. A substantial literature documents that peers influence adolescents' eating behaviour and weight. Obesity has been shown to spread through social networks (Christakis and Fowler, 2007), peer weight is associated with adolescents' own weight (Trogdon et al., 2008), and peers affect fast-food consumption and subsequent weight gain (Fortin and Yazbeck, 2015). Students exposed to more sports-oriented classmates may thus adopt healthier eating habits or pay more attention to their food intake. The data used in this study do not allow us to test this channel convincingly. The diet measure available in the employed survey is relatively coarse and does not show a significant response (Table 2.10), but it captures neither the quantity nor the composition of food intake in detail. This study therefore cannot rule out that changes in diet contribute to the reduction in obesity. Third, a further issue is that height and weight, and hence BMI and obesity status, are self-reported. Adolescents are known to under-report their weight, especially those who are heavier or more concerned about their body shape (Sherry et al., 2007). If the extent of under-reporting were unrelated to peer composition, this would shift measured obesity similarly across classes and would not bias our estimates. However, if exposure to sports-oriented peers heightens body-image concerns through social comparison, students with a larger share of such peers may be more inclined to under-report their weight. Part of the estimated reduction in obesity could then reflect

changes in reporting behaviour rather than in actual weight, and estimates in this study would overstate the true effect. The effects on weight status should therefore be interpreted with caution, and as an upper bound on the true reduction in obesity. This study regards this mixed evidence on obesity reduction as one of the limitations for future investigation.

2.5.1.3 Mental health

Table 2.6: The effects of having sports-oriented peers on students' mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for and loved
Sports-Favouring peers	-0.1924*	-0.2058**	-0.0210	0.1771*
	(0.1029)	(0.0884)	(0.1098)	(0.0996)
Sports-Loving peers	-0.0556	-0.0963	0.0755	-0.0646
	(0.1020)	(0.0951)	(0.1104)	(0.1113)
Observations	5016	5010	5011	5015

Notes: Reported estimates are from OLS estimation. Dependent variables are variables on students' mental health. The unit of observation is the student-year. Regressions control for student characteristics (student gender, age, highest parental education, family income, serious parental illness, parental mental illness, and parental alcoholism before high school, pre-high school sports preference, pre-school cognitive ability), Daoshi characteristics (Daoshi gender, Daoshi age, Daoshi education, and Daoshi's years of teaching experience), female peer share, urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.6 presents the effects of having peers who like sports on students' mental health. Overall, there is limited evidence supporting the effects of sports-oriented peers on students' mental health. Most of the coefficients of sports-oriented peers on mental health outcomes are insignificant (while the signs of the coefficients point to positive effects of sports-oriented peers on students' mental health), there is only one significant and neg-

ative association between sports-favouring peer share and the variable on do not want to live. Specifically, a ten-percentage-point increase in the proportion of peers who somewhat like sports is associated with a 0.0272-standard-deviation decrease in the index of not wanting to live.

2.5.1.4 Cognitive ability and learning time

Table 2.7: The effects of having sports-oriented peers on students' cognitive ability and learning time

	Comprehensive analytical ability test	General analytical ability test	Mathematic analytical ability test	Learning time
Sports-Favouring peers	-0.1293*	-0.0068	-0.0647	-0.1230
	(0.0743)	(0.0840)	(0.1176)	(0.1165)
Sports-Loving peers	-0.0684	0.0333	0.0347	-0.4074***
	(0.0852)	(0.0966)	(0.1353)	(0.1241)
Observations	4956	4956	4956	5006

Notes: Reported estimates are from OLS estimation. Dependent variables are variables on students' cognitive performance and learning time. The unit of observation is the student-year. Regressions control for student characteristics (student gender, age, highest parental education, family income, serious parental illness, parental mental illness, and parental alcoholism before high school, pre-high school sports preference, pre-school cognitive ability), Daoshi characteristics (Daoshi gender, Daoshi age, Daoshi education, and Daoshi's years of teaching experience), female peer share, urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Since exercise is a time-intensive activity, it is possible that having peers who like sports has a decreasing impact on students' cognitive performance and time use. By contrast, cognitive ability might be positively influenced by peers' liking for sports through enhancing students' health. Table 2.7 examines the effects of having peers who like sports on

students' cognitive scores and learning time. Generally, there is no significant impact on students' cognitive ability and learning time. Cognitive scores of no dimension are significantly correlated with peers who like sports. Having peers who like sports very much is negatively correlated with students' learning time at the 1% significance level.[35]

2.5.2 Long-Term results

Table 2.8: Attrition balance test based on student characteristics

	Coefficient	SE	Obs.
Low family income	0.0013	(0.0222)	2511
Parental education	-0.0093	(0.0421)	2511
Age	-0.0163	(0.0235)	2511
Gender (1=female)	0.0035	(0.0180)	2511
Baseline cognitive score	-0.0437	(0.0293)	2511
Pre-School cognitive performance	-0.0186*	(0.0102)	2511
Parental serious illness before high school	0.0031	(0.0117)	2511
Parental mental illness before high school	-0.0082	(0.0059)	2511
Parental alcoholism before high school	0.0056	(0.0108)	2511

Notes: Reported estimates are from OLS estimation. Each cell in columns (1) and (2) presents the coefficient and standard error (in parentheses) from a separate regression where the dependent variable is the listed characteristic and the independent variable is a dummy indicating whether the student dropped out of the sample. Regressions control for urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Sports participation and exercise are found to be rewarded in the labour market, potentially because they signal good health, cooperative personalities, and higher productivity (Humphreys et al., 2014; Lechner, 2009; Lechner and Downward, 2017; Lechner and Sari, 2015; Rooth, 2011). Given that sports-oriented peers have moderately positive effects on students' exercise behaviour and obesity reduction, these effects may persist to longer term and contribute to students' labour market outcomes. Trying to investigate the po-

35. This may partly explain why sports-loving peers could decrease the probability of students being obese but do not contribute to exercise behaviours: while students are not inspired to participate in vigorous sports, they may learn from peers who have healthy habits and reduce their sedentary time. However, learning time may not be a suitable proxy for the sedentary time of students since it also reflects students' learning habits and behaviours. Thus, this study could not draw any conclusions on this issue.

tential long-term effects, this study uses data from TEPS-B 2013. As stated in Section 2.3, among the 2511 students included in the main (TEPS) sample, 1671 were successfully followed up in the 2013 TEPS-B survey. Given this attrition, a corresponding concern is that attrition may be non-random, potentially biasing the estimated effects of sports-oriented peers due to students' underlying characteristics. For instance, there may be a possibility that students who have better educated parents are more likely to be traced. Then the effects of sports-oriented peers on students' earnings may be exaggerated by the confounding effects of parental education. This study conducts an attrition test to check whether there is any association between attrition and students' characteristics. The results of the attrition test is conducted and reported in Table B14. None of the coefficients in Table B14 are significant, this shows that the attrition is nearly random.

Table 2.9: The effects of having sports-oriented peers on students' long-term outcomes

	Education	Employment	Salary	Occupation
Sports-Favouring peers	0.1068	-0.0420	0.9907	-0.0848
	(0.1534)	(0.0926)	(0.6872)	(0.0911)
Sports-Loving peers	0.3849*	0.0437	1.0803	-0.0738
	(0.1990)	(0.1042)	(0.7064)	(0.1066)
Observations	1401	1386	980	1030

Notes: Reported estimates are from OLS estimation. Dependent variables are variables on students' education and labour market outcomes. The unit of observation is the student. Regressions control for student characteristics (student gender, age, highest parental education, family income, serious parental illness, parental mental illness, and parental alcoholism before high school, pre-high school sports preference, pre-school cognitive ability), Daoshi characteristics (Daoshi gender, Daoshi age, Daoshi education, and Daoshi's years of teaching experience), female peer share, urban region, school type, school ownership, school, and track fixed effects. Standard errors are clustered at the class level and reported in parentheses. The variation in the number of observations is due to missing values in the relevant dependent variables.

$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

The relevant results on the estimations of sports-oriented peers on students' long-term outcomes are reported in Table 2.9. Overall, this study does not find any significant effects of sports-oriented peers on students' educational attainment, probability of employment, salaries, and occupational choice.

2.6 Mechanism

Table 2.10: The effects of having sports-oriented peers on students' health behaviours

Panel A: Body management				
	No body management	Exercise for body management	Fitness course	Change diet
Sports-Favouring peers	-0.1920**	0.1428*	0.0542*	0.0448
	(0.0746)	(0.0841)	(0.0293)	(0.0786)
Sports-Loving peers	-0.1030	0.0490	0.0320	0.0326
	(0.0769)	(0.0848)	(0.0318)	(0.0869)
Observations	2507	2507	2507	2507
Panel B: Other health behaviours				
	Have breakfast	Getting drunk	Smoking	Sleep hours
Sports-Favouring peers	0.1468	-0.0097	0.0720	0.0708
	(0.1276)	(0.0423)	(0.0657)	(0.1683)
Sports-Loving peers	0.1583	-0.0434	-0.0182	0.2308
	(0.1385)	(0.0482)	(0.0803)	(0.1951)
Observations	2508	2505	2508	2242

Notes: Reported estimates are from OLS estimation. Standard errors are clustered at the class level and reported in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

How do peers' sports preference and behaviours influence individual exercise participation? There are several potential pathways beyond direct behavioural imitation and participation in group sports. First, through social interaction with sports-oriented peers, students may obtain health-related information and knowledge, such as nearby parks and basketball courts, in-school exercise opportunities, as well as ways to train and avoid injury. Second, sport-oriented peers may shape classroom norms, as well as students' attitudes and perceptions toward exercise and body management through social comparison.

When a student has observed peers' exercise behaviour and their good physique, the student may regard such a physique as a norm to follow or view these peers as role models to emulate. This social comparison channel is supported by the literature (Carpenter and Churchill, 2026; Mueller et al., 2010; Nie et al., 2015; Patel et al., 2016). For instance, Nie et al. (2015) find that peers' BMI in the community can shape female students' perceptions of their own body weight, thereby affecting students' BMI. Carpenter and Churchill (2026) shows that the coverage of Miss America and Miss USA beauty pageant winners causes teen girls and pageant-aged women to lose weight via negative social comparison.

If this social comparison mechanism is at work, sports-oriented peers are expected to influence students' body-shaping behaviours. TEPS asks students about their body management behaviours in 2007. Specifically, students are asked "Have you ever done any of the following for body shaping?" with options including "changed dietary habits," "exercise," "attended fitness or body-shaping classes," "consumed health food products or medications," "other," and "none of the above.". Accordingly, dummies for each health behaviours and for whether one has at least one of these relevant health behaviours are generated and used as dependent variables for mechanism analysis. The relevant results are reported in Table 2.10 Panel A.[36] Sports-oriented peers significantly increase the probability that students engage in at least one of the body management behaviours (even though the results on each specific behaviour such as taking medicine for body management, are generally insignificant). This provides supportive evidence for the social comparison channel.

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36. The data on the relevant outcomes used in this table are only available in the 2007 wave. However, this should not affect the mechanism analysis, since the core specification in this study adopts a value-added form and the main variations come from the 2007 wave data.

Some may argue that these results reflect the contagion of information (or awareness) about the benefits of fitness and ways to manage health among peers, rather than the social comparison mechanism. However, given that the TEPS main sample consists of high school students, such general health knowledge and awareness barriers are likely to be relatively low. Furthermore, if the impacts of sports-oriented peers on students' general health awareness, information, and knowledge are driving the peer effects in exercise documented in this study, similar effects should also be expected for other health behaviours. As presented in Table 2.10 Panel B, the effects of sports-oriented peers on students' behaviours, including having breakfast, drinking, smoking, and sleeping are statistically insignificant. This shows that the main results of this study are not driven by the contagion of general health knowledge and information.[37]

2.7 Robustness checks

2.7.1 Validity of random assignment

Despite the careful sample restriction and balance tests to ensure the random assignments of students to classes. Concerns may still remain regarding non-random student sorting into classes due to potential misreporting of school class formation by school staff. To address this concern, this study further conducts two tests to verify the validity of random assignment.

37. This study cannot rule out the possibility of peer sharing of information and knowledge regarding exercise spaces, opportunities, and practical exercise knowledge, due to data limitations.

First, this study uses a Monte Carlo simulation and conducts a further check, following Bietenbeck (2020). The aim of using simulation is to check whether the data are consistent with a random allocation process. Specifically, the simulation process ensures that students are randomly assigned to classes, condition on schools and tracks. Meanwhile, the number and size of classes, tracks, and the share of peers who dislike sports in simulated data are based on the actual data. Then, the number of peers who dislike sports in a class is regressed on school and track fixed effects, and the residuals are collected. Intuitively, these residuals indicate where the variation in empirical identification arises in this study. This process for obtaining residuals is implemented in both simulated and actual data. Figure B1 describes the distribution of the residuals from 1,000 replications and actual data. Density calculations for this figure are based on an Epanechnikov kernel. The two distributions look similar to each other, supporting that the peers who like sports are randomly assigned to classes within track-school combinations.

Second, this study checks the stability of results by following Gong et al. (2018) and randomly dropping schools from the sample. If the baseline sample covers schools that mostly assign classes randomly, randomly dropping schools from baseline sample should not largely change the estimated results. For each dropping process, only two schools are eliminated to ensure sufficient sample size. In total, there are 4,005 regressions for each outcome. Figure B2 plots the distributions of these estimated coefficients for exercise behaviours, health and learning time. It is clear that all distributions are centered around the baseline coefficients respectively. The upper and lower bounds of all distributions are in the same direction as the baseline estimates. These suggest that the main findings are not largely affected by the possible inclusion of schools implementing non-random class assignments.

2.7.2 Corrections for missing peer information

As stated in Section 2.3.1, the data on classroom peers in this study are incomplete. This is a limitation commonly encountered in empirical studies of peer effects. Specifically, in this study, there are two reasons for the incomplete peer information. First, the incomplete sampling of students in TEPS, despite a random sampling design. Second, missing values in key variables. The incomplete peer information may lead to biased estimates: the former may induce classical attenuation bias, while the latter may result in selection bias due to non-random missingness. To check whether the incomplete peer information affects the main results, this study follows the approach of Sojourner (2013) by weighting estimates using weights based on the leave-one-out share of observed classroom peers in the original class size (which is available in TEPS 2005) and controlling for the impacts of the observed fractions at the school level. Sojourner (2013) suggests two forms of the weighted estimators: the unrestricted and restricted estimators. The unrestricted estimators controls for the school-level impacts of the observed fraction of peers by interacting the fraction with school fixed effects. The restricted estimators allow for interactions between school group dummies (based on school-level mean of the observed fraction) with observed fractions. Compared with the unrestricted estimators, the restricted estimations have more power, are more precise but more biased. The relevant results are presented in Tables B1, B2, B3, and B4. Tables B1 and B2 report the results using restricted estimators. Tables B3 and B4 show the results using unrestricted estimators. Consistent with Sojourner (2013)'s study, the coefficients on the core share variables from unrestricted estimations are substantially larger than those from the restricted estimations. In contrast, the effect sizes from the

restricted estimations are quite similar to the baseline results of this study. Nevertheless, the main results remain statistically significant under both estimation approaches. This shows that the main results are not affected by the potential bias due to missing peer information.

2.8 Conclusion

Previous empirical studies have highlighted the importance of sports or physical activities in improving health and labour market outcomes (Guo et al., 2019; Heckman et al., 2025; Humphreys et al., 2014; Hyytinen and Lahtonen, 2013; Lechner, 2009; Lechner and Downward, 2017; Lechner and Sari, 2015; Pawlowski et al., 2018; Ransom and Ransom, 2018; Rooth, 2011; Stevenson, 2010). However, little attention has been given to the role of peers in shaping sporting behaviours of students while a growing body of literature in health and education economics suggests that health behaviours may exhibit spillover effects within school settings (de Vries Mecheva et al., 2021; Eisenberg et al., 2014; Frijters et al., 2019; Liu et al., 2023; Luo and Pan, 2020; Mora and Gil, 2013).

Intended to fill this gap, this study explores whether classroom peers' pre-enrol sporting preference could influence students' exercising behaviours, physical health, mental health, cognitive performance, schooling years, and labour market outcomes, employing data covering two waves in TEPS. Making use of conditional randomised assignment of students to classes in high schools in Taiwan, this study finds positive impacts of having peers who

like sports on students' probability of exercising and not being obese. While there is no significant effects on students' mental health, cognitive performance, schooling years and labour market outcomes. The positive influences of sports-oriented peers on exercise are driven by social comparison pressure on body management.

This study sheds light on the spillover effects of sporting behaviours. The documented externalities found in this study provide caveats on the impacts of implementing randomised experiments as real policy designs. Revealing the positive externalities of sporting preference may indicate the possibility of an underestimation of some exercise-related interventions and class-level policies in real life. This may also suggest that sports-interventions at the class level are better in avoding the potential bias caused by spillover in a school setting.

There are some interesting questions left for future research: First, which type of sports (such as individual versus group sports) drives the spillover effects found in this study is unclear. Studies with richer information on sports (types or energy consumptions) can be helpful in revealing the heterogeneity and exploring the behavioural roots behind the peer effects. Second, despite the study finds no significant effect of peers' sports tendency on students' cognitive performance, whether there are impacts on students' test scores (or other measures on subject-related academic performance) is unclear. Given that cognitive tests are designed to capture analysing and logical ability rather than subject knowledge, this study cannot explore the possible influences of peers' exercising tendency on performance in subject-specific courses. Third, given that family members play an important role in shaping individual behaviours, classroom peer effects may also spill over to parents. More studies with information on parent-child or siblings' exercising

should be encouraged to check whether the spillover effects of sporting preference exist in various peer groups. Importantly, the interpretation of the effects of sports-oriented peers on obesity found in this study should be cautious due to unavailable information on diet and the measurement error of slef-reported BMI. This study regards this mixed evidence on obesity reduction as one of the limitations for future investigation.

Chapter 3

The long-term effects of higher education on non-cognitive skills

Abstract

Personality traits, preferences, and attitudes could significantly impact life outcomes, while the effects of general education on these non-cognitive skills are unclear. This study analyses the long-term effects of higher education on individuals' Big Five personality traits, risk aversion, confidence about future, life satisfaction, and trust, examining outcomes 10 years after graduation on average. Making use of the differences in exposure to higher education expansion policy in China across provinces and cohorts via an instrumental variable, this study finds that finishing higher education improves individuals' conscientiousness while decreasing risk aversion, confidence about future, and trust levels in general. No significant effect on the other four dimensions of Big Five personality traits, mental health, and life satisfaction is found. This study contributes to the limited literature on understanding the comprehensive impacts of higher education in addition to earnings and cognitive returns in the long term.

3.1 Introduction

Personalities, preferences, and attitudes are crucial for individual labour market and life outcomes (Bütikofer and Peri, 2021; Dasgupta et al., 2022; Dupuy and Galichon, 2014; Fasani, 2020). These personal traits are often referred to as non-cognitive skills. The literature shows that non-cognitive skills play an important role in determining educational attainment, labour market outcomes, well-being, and major life decisions such as migration (Edin et al., 2022; Fasani, 2020; Nandi and Nicoletti, 2014, etc.). Thus, understanding how different factors and interventions contribute to the development of non-cognitive skills is important, but the relevant evidence is limited. Several studies, such as Alan and Ertac (2018) and Alan et al. (2019), find that curriculum-based interventions can foster children's grit and patience. Additionally, peer and teacher characteristics are found to influence students' non-cognitive traits, serving as important environmental factors (Gong et al., 2018; Shan and Zölitz, 2025, etc.).[1] This implies a potential impact of higher education (i.e., HE) on non-cognitive skills, given that HE provides curriculum, autonomous learning environments, and opportunities to interact with peers (Brandt et al., 2019; Eakman et al., 2019; Wen et al., 2021).[2] On the other hand, relatively low achievers and students who emphasise employment needs may struggle with passing exams, face a lower rank in a competitive environment in HE, and lose several years of work experience compared with high school graduates. Which effect dominates is unclear. There are numerous

1. In addition to factors incorporated in school environments, previous studies establish the impacts of household contributors on children's non-cognitive skills. The examples of investigated family factors include family income, parental education, and parental engagement in children's education (Anger and Schnitzlein, 2017; Elkins and Schurer, 2020; Fletcher and Wolfe, 2016, etc.). Previous studies show that experiencing disaster influences non-cognitive skills (Biener and Landmann, 2023; Callen, 2015, etc.).
2. Notably, previous literature implicates that non-cognitive skills are highly malleable for young children (Almond et al., 2018; Heckman et al., 2013, etc.), while recent studies show that the non-cognitive skills are also changeable during late adolescence and adulthood (Anger et al., 2017; Schlosser and Shanan, 2025; Stieger et al., 2021, etc.).

studies that document positive effects of higher education on employment, earnings and health, see, for example, Smith et al. (2025), Cowan and Tefft (2025) and Anelli (2020). However, much less is known about the impact of higher education on non-cognitive skills. A clear understanding of higher education's effects on non-cognitive skills provides essential policy implications regarding the comprehensive impacts of higher education and, more broadly, the effects of the general education system beyond cognitive development and academic progress. This question is particularly important in China, where parents have high educational expectations and the education system places a strong emphasis on academic attainment, often at the expense of students' non-cognitive development.

This paper explores the effects of finishing HE on non-cognitive skills and several behavioural traits including the Big Five personalities[3], risk aversion, depression, confidence about future, life satisfaction and trust level. The data employed in this study is from the China Family Panel Study (CFPS) 2018 wave[4], along with data from the National Bureau of Statistics. This study makes use of the higher education expansion (HEE) policy in 1999 in China and constructs an instrumental variable to deal with the endogeneity issue caused by selection to HE. The HEE policy sharply increased HE enrolment in China, with heterogeneous impacts across provinces and cohorts. The instrumental variable is constructed based on this heterogeneity. By employing an instrumental variable method, this study captures the local average treatment effect (LATE) for students who comply to HEE policy.

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3. Big five personalities are a broadly accepted taxonomy of personality traits in the empirical economics and psychology literature. There are five factors in Big five: conscientiousness, extraversion, agreeableness, openness, and neuroticism. See Section 3.3.2 for detailed survey questions on Big Five personalities. See Feher and Vernon (2021) and Najm (2019) for detailed reviews on Big Five personality traits (the meaning, history and development) and the alternative measures to the Big Five model.
4. The Big Five personality traits are available in this wave.

This study finds that HE completion improves individuals' conscientiousness and reduces their risk aversion, confidence about the future, and general trust in the long term. In contrast, no significant effect of HE on other dimensions of the Big Five personality traits, mental health, and life satisfaction is found. There are heterogeneous effects by gender: males experience decreases in agreeableness and depression after graduation from HE relative to females. There is evidence of one potential channel: HE-induced changes in work conditions are a channel through which conscientiousness is shaped in the long term. By contrast, major-specific programme design does not drive the main results in this study.

This study contributes to several strands of the existing literature. First, this study is relevant to the literature on the relationships between HE and non-cognitive skills. Current evidence on this correlation is limited and focuses on short-term effects. For example, Dasgupta et al. (2022) employ regression discontinuity design based on the high school exit examination scores of second- and third-year students enrolled in economics and commerce disciplines at fifteen colleges and explore the causal effect of enrolling in a selective college on students' personality, cognition, and preferences. They find that enrolling in a selective college improves women's cognition and decreases their overconfidence and risk aversion, while there is a decline in males' extraversion and conscientiousness. This study contributes to this part of the literature by using data from, on average, 10 years after graduation (up to 25 years) and focusing on the long-term effects of higher education on non-cognitive skills, as well as providing evidence from a developing country. This study is particularly relevant to China, where the education system places strong emphasis on academic achievement and test scores, while students' lives from the higher-education stage onward increasingly extend beyond academic pursuits to include social

activities and personal development. This may make higher education a critical period for personality development in China. Findings of this study also speak to the literature on education expansions (see, for instance, (Mountjoy, 2022)). Higher education expansion itself could influence educational attainment and earnings among students who would otherwise not have attended, it may also lower educational outcomes in the next stage, such as bachelor's degree completion among students diverted from four-year institutions. Existing studies of education expansions, including the expansion of higher education in China, have focused mainly on outcomes such as degree completion, earnings and employment. Much less is known about how expansions affect non-cognitive skills, which are themselves important for labour market and life outcomes.

Second, this study contributes to the literature on the returns to higher education and the consequences of education expansions. A large body of work shows that university graduates earn higher wages (Anelli, 2020; Fu et al., 2022; Smith et al., 2025; Zimmerman, 2014), but the sources of these returns remain debated. Human capital explanations hold that education raises productivity by developing individuals' skills, a view formalised for both cognitive and non-cognitive skills in models of skill formation (Cunha and Heckman, 2007). Signalling explanations instead argue that graduates earn more because completing higher education reveals pre-existing ability or potential to employers (Spence, 1973; Thurow, 1975). This study contributes to this debate by showing that higher education raises conscientiousness, a trait that is itself valued in the labour market (Almlund et al., 2011; Heckman et al., 2006). This finding is consistent with higher education generating returns partly by developing non-cognitive skills, rather than only by signalling ability.

The third contribution relates to the information on respondents' current employment conditions available in our data, which allows us to provide suggestive evidence on one potential channel behind the long-term effects of HE on non-cognitive skills. By improving access to jobs with different characteristics, working environments, and prospects for promotion, HE may shape the experiences that individuals accumulate in the workplace over many years. A growing psychological literature documents that personality traits continue to change in adulthood and that work experiences are among the life circumstances associated with such change (Bleidorn et al., 2018). For example, unemployment is associated with changes in personality traits (Boyce et al., 2015), and chronic job insecurity is associated with increases in neuroticism and decreases in agreeableness and conscientiousness (Wu et al., 2020). At the same time, this literature emphasises that the relationship is reciprocal: personality traits influence which jobs individuals select into and how they perform, while job characteristics in turn shape the development of personality over time (Holman and Hughes, 2021; Wille and De Fruyt, 2014). This study therefore do not interpret the relationship between job characteristics and personality as causal. Instead, this study show that HE affects the employment conditions that this literature associates with personality development, which is consistent with, but does not establish, a work-related channel. This channel has received little attention in the economics literature on the non-cognitive returns to education.

The rest of this chapter is structured as follows. Section 3.2 presents the institutional setting for HE and HEE policy in China. Section 3.3 describes the construction of the main variables used in the empirical analysis, the data sources, and sample restrictions. Section 3.4 presents the empirical strategy. Section 3.5 states the main findings and outlines the heterogeneity. Section 3.6 discusses and investigates potential channels. Section 3.7 presents robustness tests. Section 3.8 concludes.

3.2 Institutional background

3.2.1 Higher education in China

There are generally two types of higher educational institutions (HEIs) in China: four-year university and three-year vocational college.[5] China's government-led higher education system was established in 1949, following the Soviet model, with HEIs nationalised under state control (Zhang, 2017). Under that HE system, the quotas of each HE institution were planned and assigned by the central government on the basis of the predicted demand of industries and then were delivered to HEIs through local government (Xiong et al., 2022; Zhang, 2017). Beginning in the 1990s, the central government started to release its control and granted the HEIs' autonomy in admission quotas: the HEIs is responsible for formulating the annual admission quota plan and then submit the plan to obtain the examination and approval of the government (Fu et al., 2022; Xiong et al., 2022). This model for the allocation of HE quotas has been used up to now. HEIs usually

5. The definition of HE in China here is according to the official classifications used by the Chinese government. See `https://www.moe.gov.cn/jyb_sjzl/s5990/` for examples of government reports that employ this definition. The recent evolution of the HE sectors in China has been documented by several authors, such as Peng (2008), Zhang (2017), and Xiong et al. (2022).

determine the annual quotas according to the historical patterns of allocation, which may also be adjusted based on provincial population growth, the capacity of teachers and HEI facilities, government financial support, and other reasonable criteria (Fu et al., 2022; Peng, 2008).

Importantly, there are disparities in the number of HEIs across provinces due to historical reasons[6], provincial economic development, and the financial budgets of the local governments (Qin, 2022; Song, 2012). Therefore, the quotas are not equally distributed among provinces; instead, the assignment of the admission quotas depends on the number of HEIs in each province and varies largely across provinces.[7] Within each HEI in each province, there are normally more quotas for local students who live where the HEIs are located than for students from other provinces.[8] That is, students from certain provinces are more likely to be admitted to the local HEIs than their counterparts from other provinces. The admission to the HEIs in China is dependent on students' test scores in the National College Entrance Examinations (gaokao or NCEE), regardless of their family background, gender, and ethnicity. Students normally take gaokao at the age of 18, after finishing 12 years of schooling (9-year compulsory education and 3-year senior or vocational high school education).

6. Examples of historical factors determining the distribution of HEIs across provinces include the movement of some universities to western areas of China to survive during the War of Resistance Against Japan and differences in economic development levels in previous ages.
7. Regional disparities in HE resources have long existed and been documented by many authors such as Si (2022).
8. Local students refer to students whose hukou is registered in the local province; Individual hukou is created by and registered in the Chinese government so that the government can keep track of and manage demographic information.

3.2.2 Higher education expansion in China

The higher education expansion policy in China was imposed in response to the economic downturn and surging unemployment in the late 1990s. The 1997 Asian financial crisis led to a turbulent economy. Under this condition, the Chinese government adopted the suggestions from two economists to double college admissions to ease job market pressures, stimulate domestic spending, and increase the HE population (Wang, Liu, Yan and Zhao, 2022).

The process of policy adoption and implementation was quick and abrupt. And there is a consensus that HEE policy is exogenous due to unexpected enforcement and its sizeable scale.[9] This allows this study to make use of and construct an instrumental variable. The proposals on HEE policy were put forward in November 1998. Shortly after that, in January 1999, the Ministry of Education announced a plan to enrol 1.31 million new students in HEIs. This enrolment was 0.23 million higher than that in the previous year, representing a 20% increase. Later, on 16th June 1999, 3 weeks before gaokao, the State Council revised the plan, increasing enrolment quotas by a further 0.33 million. This brings the total increase to 0.55 million, equivalent to a 40% rise over the 1998 level.[10] This revision was determined by the State Council and the economists, without notifying and discussing with HEIs and Ministry of Education in advance of the announcement.

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9. See Fu et al. (2022), Huang, Tani, Wei and Zhu (2022), Si (2022), Wang, Liu, Yan and Zhao (2022) for examples of arguments about the exogeneity of HEE.
10. Notably, HEE policy did not change the enrolment criteria for HE system in China. Students' scores are still the only factor that determines the HE admission.

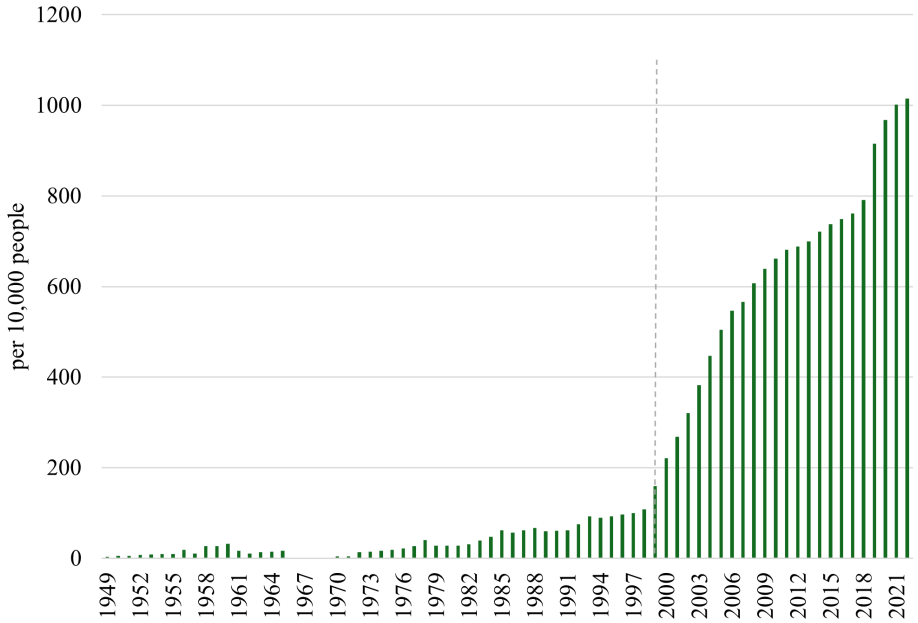


Figure 3.1: 1949-2021 student enrolment in HE institutions in China.
Data source: National Bureau of Statistics.

The expanded enrolment quotas were still assigned based on province and were then implemented by each HE institution. Although HEIs made enrolment plans by themselves in 1999 before the announcement of the revision in June, they still had little bargaining power with the government and had to accept the abrupt increases in enrolment in response to the solid policy requirements notified in June.

HE enrolment has been constantly growing since the implementation of the HEE policy in 1999. In 1999, HE enrolment broke through 1.5 million for the first time. After 24-years of growth, the enrolment in HEIs rose dramatically from 1.08 million in 1998 to 10.14 million in 2022, achieving a 9-fold increase. Figure 3.1 indicates the sharp increase in HE enrolment for cohorts taking the NCEE after 1998, in contrast to those who took the NCEE in and before 1998.

3.3 Data, sample and variables

3.3.1 Data and sample

This study uses data from two sources: the Chinese Family Panel Study (CFPS) and the National Bureau of Statistics. The CFPS is a nationally representative biannual survey collected by the Institute of Social Science Survey (ISSS). The survey uses implicit stratification and multi-stage probability sampling and covers data from 31 of 34 provinces, autonomous regions, and municipalities in China (Institute of Social Science Survey, Peking University, 2010). This study mainly uses the 2018 wave of CFPS, since the survey questions about personality——the main outcomes of interest for this study are only covered in that wave. Data from the National Bureau of Statistics includes the number of annual enrolment students in post-secondary education at province and national levels between 1987 and 2022, which is used to construct the instrumental variable in this study (National Bureau of Statistics of China, 2023*a*).

The main sample is restricted to the individuals aged between 25 and 48 full years of life in 2018, relative to September 1970.[11] Since most HE graduates have entered the labour market in CFPS at the age of 23 and the retirement age for women in white-collar jobs is 55 in China (for women in blue-collar jobs, it is 50) (Feng et al., 2020; Wang, Liu, Yan and Zhao, 2022), the sample restriction from roughly 25 to 54 corresponds to a potential working lifespan and could exclude life events such as fresh entry to labour market and retirement. This restriction could avoid the potential confounding impacts

11. Or individuals born between September 1970 and September 1993.

of these events on personalities (Bleidorn et al., 2018; Schwaba and Bleidorn, 2019). Additionally, individuals aged 48 to 54 years of life in 2018 (relative to September in 1970) are dropped to exclude the confounding effects of the Compulsory Education Reform in China imposed in 1986. This reform requires that individuals finish 9-years of compulsory education and thus could increase people's years of schooling at the compulsory education level. This increased schooling spent in compulsory education may also influence non-cognitive skills. By excluding the 48-54 sample, the main sample only includes cohorts that must complete 9-years of compulsory education. Finally, the main sample covers 4098 observations with 4098 individuals. Table 3.1 presents the summary statistics for the main sample. Table 3.1 reports summary statistics for the estimation sample. About 24% of respondents hold a higher education degree. Respondents are on average 36.6 years old, ranging from 25 to 48, and 51% are male.

3.3.2 Outcome variables

Personality traits, mental health, trust, risk aversion, confidence about future, and life satisfaction are the outcomes of interest in this study.

The measures of personality traits are the 15-item Big Five scale (3 items per trait). Respondents were asked to what extent they agreed with the 15 statements.[12] These 15 items are measured on a 5-point Likert scale, ranging from 1 "Strongly disagree" to 5 "Strongly agree". 5 variables are generated for 5 personalities, the value of each variable is equal to the average value of the 3 items specifically for that personality.

Mental health in this study is measured by the Center for Epidemiologic Studies Depression scale (CES-D scale). CES-D scale includes 20 statements.[13] The answer for each statement should be chosen from 1 = Rarely or none of the time (less than 1 day), 2 = Some or a little of the time (1-2 days), 3 = Occasionally or a moderate amount of time (3-4 days), 4 = Most or all of the time (5-7 days). The sum of the responses is used to measure the mental health condition. The higher the sum score is, the higher levels of depression the respondents have.

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12. See Table C1 in Appendix for the details of the 15 statements.
13. See Appendix Table C2 for the full list of 20 statements.

Table 3.1: Summary statistics

Variable	Mean	S.D.	Min	Max	Obs.
Panel A. Personality traits					
Conscientiousness	3.4374	0.4826	1.3333	5.0000	4,079
Extraversion	3.5424	0.6552	1.0000	5.0000	4,079
Openness	3.2132	0.8061	1.0000	5.0000	4,079
Agreeableness	3.4753	0.4846	1.0000	5.0000	4,079
Neuroticism	2.9717	0.7491	1.0000	5.0000	4,079
Panel B. Trust					
General trust	2.5692	1.9533	1.0000	5.0000	4,076
Trust in parents	9.5317	1.1454	0.0000	10.0000	4,079
Trust in neighbours	6.6283	2.0241	0.0000	10.0000	4,076
Trust in strangers	2.4971	2.1569	0.0000	10.0000	4,078
Trust in officials	4.6900	2.5490	0.0000	10.0000	4,068
Trust in doctors	6.6275	2.3194	0.0000	10.0000	4,078
Panel C. Mental health, risk aversion, confidence, life satisfaction					
Depression	6.2607	2.9098	3.0000	21.0000	4,073
Risk aversion	4.1740	1.2080	1.0000	5.0000	3,206
Confidence about future	4.1792	0.8699	1.0000	5.0000	4,079
Life satisfaction	3.9316	0.9192	1.0000	5.0000	4,079
Panel D. Background characteristics					
Higher education degree	0.2405	0.4274	0.0000	1.0000	4,079
Age	36.6450	6.8542	25.0000	48.0000	4,079
Gender (1 = male)	0.5109	0.4999	0.0000	1.0000	4,079
Father's education	3.4276	1.3538	1.0000	8.0000	4,079
Mother's education	2.8308	1.4367	1.0000	9.0000	4,079
Father political status	3.5558	1.0555	1.0000	4.0000	4,079
Mother political status	3.9164	0.4772	1.0000	4.0000	4,079
Birthweight	6.0965	1.1223	2.0000	10.5000	4,079
Lagged avg. HE teacher-student ratio	0.4061	0.2271	0.1095	1.1519	4,079
Panel E. Additional controls (robustness checks)					
Father left home (0–3 yrs, days)	2.6166	14.2144	0.0000	144.0000	3,135
Mother left home (0–3 yrs, days)	1.3386	11.4010	0.0000	144.0000	3,169
Father admin/managerial position	0.0680	0.2519	0.0000	1.0000	1,940
Mother admin/managerial position	0.0149	0.1210	0.0000	1.0000	1,749
Father left home (4–12 yrs, days)	7.5432	41.1166	0.0000	384.0000	3,183
Mother left home (4–12 yrs, days)	4.8304	36.3550	0.0000	384.0000	3,184

Notes: This table reports the summary statistics. Sample means, standard deviations, minimum and maximum values, as well as the number of observations are presented. The unit of observation is the individual.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

CFPS provides seven questions regarding respondents' trust covering individual generalised trust and trust towards different social groups, including parents, neighbours, Americans[14], strangers, local government officials, and doctors. The question on generalised trust is: "Generally speaking, would you say that most people can be trusted or that you can't be too careful when dealing with others?" Respondents need to select one of the two answers: 1=Most people can be trusted and 5=Need to be very careful.[15] For the remaining questions on group trust levels, the answers about group trust are measured on a 10-point Likert scale. Higher scores mean higher levels of trust.[16]

"Risk averse" people are those who prefer a certain payment than an uncertain payment with the same expected value as the certain payment (Cobb-Clark et al., 2022). There are 5 risk experiments in CFPS, testing the financial risk aversion of respondents.[17] Generally, in each experiment, the respondents are required to make a choice between option 1 with an uncertain value (i.e., a constant expected returns of 100 RMB throughout the 5 experiments) and option 2 with a certain value (the certain value of option varies across the 5 risk experiments). In this case, the respondents are actually comparing uncertainty 100 RMB with certain varying values. If a respondent prefers to choose a certain value lower than 100 RMB rather than the uncertain 100 RMB, the respondent is regarded as risk averse.[18] A variable is created to measure individual risk preferences according to self-reported choices they made in the risk experiments. A higher value of the variable represents that the individual is more risk averse.[19]

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14. Question 4 is similar to measures on trust in foreigners (or international trust and out-group trust) used by other studies (Guiso et al., 2009, etc.) and especially measures people's attitudes towards Americans, given that the United State is one of the most important trading partners outside of Asia (Morrison, 2019).
15. This question is reverse coded in this study to keep all the trust measures consistent.
16. See Appendix Table C3 for a complete list of the questions on trust in CFPS.
17. Those experiments are reported in Appendix Table C4.
18. The relationship between the options and the level of risk aversion is shown in Appendix Figure C1.
19. See how the variable is created according to the respondents' answers in Appendix Table C5.

The question on confidence about future is, "How do you rate your confidence about the future?".[20] Response items are measured on a 5-point Likert scale, ranging from 1 "Very discouraged" to 5 "Feel pretty confident". The question on life satisfaction is "How are you satisfied with your life?". Response items are measured on a 5-point Likert scale, ranging from 1 "Very unsatisfied" to 5 "Feel pretty satisfied".

3.3.3 Key explanatory variable and control variables

The key explanatory variable in this study is a dummy for whether an individual has a HE degree (includes both three-year vocational college and four-year university) or not.

This study controls for basic demographic and family backgrounds characteristics, including gender, age, father's education, mother's education[21], father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals[22], individual birth weight.[23] And lagged provincial teacher-student ratio in HEIs is also included in the main specification.[24]

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20. This measure is future-oriented and is not about individual self-confidence and esteem.
21. Education levels of parents are represented by categorical variables: 0. Never go to school 1. Illiterate or semiliterate person 2. Kindergarten or preschool class or nursery 3. Primary school 4. Junior high school 5. Senior high school or special secondary school or technical school or vocational high school 6. Three-year college 7. Four-year university 8. Postgraduate education 9. Doctoral education.
22. Categorical variables for parents' political status are used: 1. Communist party 2. Democratic parties 3. Communist youth league 4. General crowd.
23. Notably, since there is a correlation between individual relative obesity (measured by body mass index (i.e.,BMI)) and non-cognitive skills during adolescence in the literature, the inclusion of individual birth weight aims at capturing the effects of individual early years' health and family caring factors on later non-cognitive development (Huang, Liu and Zuppann, 2022).
24. Inclusion of the teacher-student ratio as a control variable is aimed at capturing the potential effects of HE quality at province level on non-cognitive skills and thus to improve the estimation precision. The lagged teacher student ratio variable is constructed excluding students who enroled in the year when the individual i took NCEE so that to avoid being directly correlated with individual HE enrolment.

3.4 Methodology

3.4.1 Empirical Strategy

The baseline specification for individual-level outcomes based on OLS is as follows:

$$Y_{itd} = \beta_0 + \beta_1 HE_{itd} + \beta_2 X_{itd} + \varepsilon_{itd} \tag{3.1}$$

Where Y_{itd} is the outcome of interest for individual i, who took gaokao in year t (i.e., from cohort $t-18$) in province d. HE_{itd} is the regressor of interest, an indicator variable taking the value of 1 if an individual has finished HE and 0 otherwise. β_1 is the coefficient of interest, capturing the effects of completing higher education on individual non-cognitive skills. X_{itd} represents covariates measuring demographic characteristics, pre-treatment individual characteristics[25] and household characteristics, including age, gender, mother's and father's education, mother's and father's political status when an individual was 14 years old, individual birth weight, and time-varying lagged teacher-student ratio in HEIs at the province level.[26] ε_{itd} is the error term. Standard errors are clustered at the province level.

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25. Pre-treatment characteristics refer to characteristics measured before individuals turn 18.
26. Here, the teacher-student ratio is calculated as the number of students enroling in HE divided by the number of staff in HEIs in the province d. This variable is lagged, and individual i faces this ratio before their enrolment in year t. This variable is used to proxy for HE capacity and quality. Here, students who live in provinces with highly capable HEIs are more likely to enter HE. These students are also more likely to have higher non-cognitive skills as a consequence of better HE resources. Including pre-enrolment teacher-student ratio could be helpful for controlling the confounder on HE quality and resources. Teacher-student ratio is often used to proxy for school quality in economic studies, see examples such as Card and Krueger (1992) and Frisvold and Golberstein (2011).

OLS could only provide unbiased estimates about β_1 when the exogeneity assumption holds, i.e., when there is no omitted observable and unobservable factor correlated with both HE_i and Y_i. Importantly, here the direction of bias in OLS estimation is unknown and may vary across different dimensions of personalities and other outcomes of interest. For instance, omitting controls for parental illness and unemployment may bias the OLS estimates downward for conscientiousness and upward for neuroticism: Students facing paternal unemployment or illness are less likely to enter university and may choose to take burden of the family by making money early. At the same time, paternal unemployment is correlated with an increase in conscientiousness (Angelini et al., 2018). In addition, Angelini et al. (2018) documents a negative correlation between neuroticism and paternal unemployment.

To address the concern about endogeneity bias, this study applies a two-stage least squares (2SLS) approach using the ratio of unexpected part of expanded higher education enrolment from 1999 to 2023 across provinces induced by HEE policy (i.e., the intensity of HEE policy) as an instrumental variable. The instrumental variable is constructed as Equation (3.2):

$$Z_{itd} = \frac{UE_{itd}}{HS_{itd}} = \frac{AE_{itd} - PE_{itd}}{HS_{itd}} \tag{3.2}$$

$$PE_{itd} = \beta_0 + \beta_1 t_i \tag{3.3}$$

Where subscripts i, t, d denote individual, the year when individual i took the college entrance examination and the province d where the individual lives in respectively. UE_{td} is the unexpected HE enrolment in province d in year t, which is define by the difference between actual HE enrolment (AE_{td}) and predicted HE enrolment (PE_{td}). Year t is the year when individual i took NCEE that is inferred by individual birth year (i.e., t-18). HS_{td} is the number of high school graduates in year t in province d.

PE_{td} is obtained as Equation (3.3). This prediction on HE enrolment follows Fu et al. (2022)'s method and uses pre-HEE HE enrolments to estimate a province-specific linear time trend for enrolment.[27] Intuitively, this predicted value is expected to be equal to the real enrolment if there was no HEE policy. PE_{td} equals to 0 for those individuals who took college entrance examination before 1999. Then UE_{td} represents the linearly detrended university enrolment for province d since 1999. PE_{td} is expected to play a similar role as a province-cohort fixed effect term in terms of capturing the effects of province-specific cohort trend of provincial characteristics on HE enrolment.[28] The instrumental variable equals 0 for those individuals who took the college entrance examination before 1999 (UE_{td}=0).

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27. Data on enrolment from 1987 to 1998 from National Bureau of Statistics is used for prediction in this study.
28. Examples of these province-specific cohort trends of provincial characteristics include provincial economic development trends and province-specific cohort trend in non-cognitive skills itself.

Intuitively, this study makes use of the policy effect and assumes that high school students who live in provinces strongly influenced by the HEE policy (i.e., a relatively large exogenous increase in enrolment) in a certain year (when they take NCEE) are more likely to enter HEIs in that year.[29]

The specifications using the cross-sectional instrumental variable approach are as follows:

$$HE_{itd} = \alpha_0 + \alpha_1 Z_{itd} + \alpha_2 X_{itd} + \varepsilon_{itd} \tag{3.4}$$

$$Y_{itd} = \gamma_0 + \gamma_1 \widehat{HE}_{itd} + \gamma_2 X_{itd} + \theta_{itd} \tag{3.5}$$

Y_{itd}, HE_{itd}, X_{itd} have the same meanings as they are in (3.1). Z_{itd} is the instrumental variable constructed in (3.2). HE_{itd} is the key indicator variable on HE completion. ε_{itd} and θ_{itd} are error terms. Standard errors are clustered at the province level.

The parameter γ_1 captures the local average treatment effect (LATE) of HE. That is, the effects of HE on compliers who would enter HE if there was HEE policy and would not enter if there was no such a policy. This study could not speak about how HE influences students who would never choose HE ("never-takers") and students would always choose HE ("always-takers"). In fact, this group of students who are sensitive to HE policy changes is particularly relevant to education policy.[30]

29. Since the data on the place of residence when individuals took their college entrance exam is unavailable, the province they are currently living in is used to proxy for the 18-year-old location and thereby to construct the instrumental variable here. To remove the concern about the potential bias caused by the usage of this proxy variable, a robustness check is conducted in Section 3.7.

30. The identified effect in this study may be student group with either dispensable academic motivation or marginal academic ability. To further investigate this issue, this study conducts heterogenous analysis based on the type of degree that individuals have obtained (vocational college versus university). The relevant results are reported in Table C13. Contrary to the conjecture that the effects estimated in this study may mainly come from the vocational students, the heterogeneity analysis shows that the effects

3.4.2 Identification assumptions

Exogeneity assumption states that the instrumental variable should not be correlated with determinants of the individual non-cognitive outcome. As stated in Section 3.2.2, the release of the HEE expansion policy is abrupt, the number of the increase in enrolment is dramatic and unexpected, the intensity across cohorts and across provinces is relatively unpredicted. It is safe to say that the unexpected enrolment expansion is uncorrelated with observable and unobservable factors contributing to individual non-cognitive skills.

Exclusion restriction assumption requires that the unexpected enrolment increase induced by HEE policy only affects individual non-cognitive skills and behavioural traits through HE. The unexpected expansion should neither have direct effects on individual outcomes, nor have effects on individuals via other channels. In the case of this study, it seems plausible to assume that HEE policy itself (or the release of a new policy) has no direct effects on individual non-cognitive skills and behavioural traits: it is intuitive that if a new policy is not relevant to HE enrolment, students and their parents will not be affected by that. They would not even be interested in and pay attention to that policy, given heavy study tasks in high school. That is, releasing a new policy would not affect individual non-

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on students' non-cognitive skills are larger for those who obtain a university degree. This may mean that the LATE estimated in this study primarily reflects the returns to university education for students at the margin of admission. That is, the IV estimates mainly capture the effect of university education for marginal students. However, this is still possible in Chinese context. Since HEE policy in 1999, there have been large expansion of undergraduate programmers in China, particularly in lower-tier institutions. This expansion makes the distinction between university and vocational HE in China becomes decreasingly obvious over time. This study cannot provide further evidence to inform this discussion.

cognitive skills. Someone may argue that HEE policy may make students and parents less conscientious especially about going to HE in the long run since the enrolment increase may make them feel that HE is a cheap good and less effort is required. However, entering HE is still considered as one of the most important factors for success in China today.

As discussed in Section 3.2.1, HE expansion may be endogenous since the allocation of quotas depends on historical number and industry (or economic)' demands and HEIs could also claim and adjust HE quotas based on some reasonable criteria such as provincial population growth, the capacity of teachers and facilities in HEIs etc. Even unexpected expansion and prediction are in use to eliminate the endogenous part on quotas allocation, there is a possibility that the endogenous part remains, and the unexpected HEE (the instrument) have effects on individual via several other factors, including time-invariant provincial differences and province-invariant cohort trend.

Economic development in locality could both improve students' probability of obtaining a HE degree and non-cognitive development (via improving household income). To address these concerns, the real provincial GDP in 1998, real provincial GDP in 1995, and real provincial GDP in 1994, as well as their interactions with cohort dummies are included in the regressions as a robustness check, the relevant results are reported in Table C6. The expectation is that once the economic development is controlled for, HEE policy should not have effects on individual development via local economy and household income. The results in Table C6 show that inclusion of these economic-related variables as control variables does not influence the main results, implying that the main results are not affected by the potential bias caused from the economic development of province.

Even with evidence as stated above, the study cannot draw strong causal conclusions, as there is insufficient statistical power to control for both cohort and province fixed effects. Causal identification relies on the assumption that cross-provincial differences and cohort trends in expansion intensity affect non-cognitive development only through HE completion, rather than any other factors including cohort-constant and province-constant factors. This is a strong assumption. Time-constant factors such as secondary educational resources and cultural emphasis on education may contribute to non-cognitive development of individuals. These factors could also influence individual access to HE. This study therefore interprets the findings from the instrumental variable estimations as suggestive evidence.

The IV estimates rely on the standard monotonicity assumption. This study assumes that a more intensive expansion of higher education does not lead anyone to forgo a degree they would otherwise have obtained. Under this assumption, the population can be divided into three groups according to how their educational attainment responds to the expansion. Always-takers obtain a higher education degree regardless of expansion intensity. These are typically students with strong academic performance or motivation who would have been admitted even under the pre-expansion quotas. Never-takers do not obtain a higher education degree regardless of expansion intensity, for example because of low academic achievement, financial constraints, or a preference for entering the labour market early. Compliers obtain a degree only when the expansion is sufficiently intensive. These are the marginal students in terms of motivation and academic ability: they would have narrowly missed admission in the absence of the expansion, but gained access to higher education once quotas increased. Monotonicity rules out a fourth group, defiers, who would obtain a degree under a less intensive expansion but not under a more intensive one. Because

always-takers and never-takers do not change their treatment status in response to the instrument, the 2SLS estimate identifies the local average treatment effect for compliers only. The estimates in this study should therefore be interpreted as the effect of higher education on marginal students, rather than as the average effect for all degree holders. Monotonicity could be violated if the expansion discouraged some individuals from pursuing higher education. For instance, a perceived devaluation of degrees or tougher competition among graduates in the labour market could lead some students who would otherwise have enrolled to enter the labour market directly instead.

3.5 Results

3.5.1 Main results

Table 3.2 presents baseline results from OLS estimates. Among all big five personality traits, conscientiousness and openness are positively correlated with higher education completion while extraversion and neuroticism are negatively associated with higher education experience. No statistically significant relationship between agreeableness and HE is found. Regarding other behavioural traits, risk aversion and self-reported confidence about future are negatively associated with higher education. While most of the trust measures (except trust in parents and neighbours) are positively correlated with higher education. Depression and life satisfaction are not affected by HE.

Table 3.2: Returns to higher education in 2018: baseline results from OLS estimates

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.0953***	−0.1183***	0.0340	0.1310***	−0.0923***
	(0.0326)	(0.0331)	(0.0363)	(0.0261)	(0.0329)
Observations	4,083	4,083	4,083	4,083	4,083
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence about future	Life satisfaction	General trust
HE	−0.0712	−0.1714***	−0.1425***	−0.0435	0.2060***
	(0.0491)	(0.0480)	(0.0349)	(0.0512)	(0.0512)
Observations	4,077	3,210	4,083	4,083	4,080
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbours	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.0082	0.0196	0.4412***	0.2464***	0.0745**
	(0.0349)	(0.0352)	(0.0686)	(0.0561)	(0.0357)
Observations	4,083	4,080	4,082	4,072	4,082

Notes: This table reports ordinary least squares estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.
$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

These baseline results are contradictory to other studies about university education and non-cognitive skills, which find a positive correlation between extraversion and university education and a negative association between conscientiousness and higher education (Kassenboehmer et al., 2018; Lüdtke et al., 2011). However, the baseline results in this study are consistent with those studies regarding which dimensions of personalities are susceptible to education during adulthood, given that conscientiousness and extraversion are the two traits showing variations.

Table 3.3: First-Stage effects of unexpected HE enrolment ratio at province level on individual HE enrolment

Dependent variable: Individual higher education enrolment						
	(1)	(2)	(3)	(4)	(5)	(6)
	Big five personalities	Risk aversion	Depression (CES-D scale)	Confidence about future	Life satisfaction	General trust
Unexpected HE enrolment ratio	0.2904***	0.3111***	0.2864***	0.2904***	0.2904***	0.2943***
	(0.0550)	(0.0547)	(0.0542)	(0.0550)	(0.0550)	(0.0547)
First stage F statistics	27.86	32.37	27.91	27.86	27.86	28.92
Observations	4083	3210	4077	4083	4083	4080
	Trust in parents	Trust in neighbours	Trust in strangers	Trust in officials	Trust in doctors	
Unexpected HE enrolment ratio	0.2904***	0.2882***	0.2904***	0.2859***	0.2881***	
	(0.0550)	(0.0543)	(0.0550)	(0.0530)	(0.0544)	
First stage F statistics	27.86	28.17	27.84	29.12	28.05	
Observations	4083	4080	4082	4072	4082	

Notes: This table reports first-stage results from instrumental variable estimates. All the panels control for father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs and individual birthweight. Standard errors are clustered at the province level. Robust t-statistics are reported in parentheses.
$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Table 3.3 reports the first-stage results from the instrumental variable estimations. The relevance assumption of the instrumental variable requires that the unexpected increase in enrolment induced by the HEE policy should be correlated with individual higher education enrolment. According to Table 3.3, The correlation between the instrumental variable and HE enrolment status is 0.2896 (column 1). The Kleibergen-Paap Wald rk F statistics are larger than 10, indicating the strength of the instrumental variable.

Table 3.4 presents the main results from IV estimates. Significantly positive effects of HE on conscientiousness are found: completing higher education significantly increases conscientiousness by 0.3890 score in the long term (11.3 percent evaluated at the conscientiousness average value of 3.4374). Compared with OLS results, the effect size and magnitude of HE on conscientiousness are larger. Effects on all other dimensions of per-

Table 3.4: Returns to higher education in 2018: results from IV estimates

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.7523***	−0.1927	0.4435	0.1366	0.6561
	(0.2767)	(0.3358)	(0.4196)	(0.3695)	(0.4464)
First stage F statistics	27.86	27.86	27.86	27.86	27.86
Observations	4,083	4,083	4,083	4,083	4,083
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence about future	Life satisfaction	General trust
HE	0.9749	−0.6861***	−1.1061***	−0.5672**	−1.0336***
	(0.7838)	(0.2607)	(0.2925)	(0.2743)	(0.3434)
First stage F statistics	27.91	32.37	27.86	27.86	28.92
Observations	4,077	3,210	4,083	4,083	4,080
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbours	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.5126	−1.1284***	0.4368	−0.3283	−0.5205
	(0.5111)	(0.4019)	(0.3318)	(0.6200)	(0.4521)
First stage F statistics	27.86	28.17	27.84	29.12	28.05
Observations	4,083	4,080	4,082	4,072	4,082

Notes: This table reports instrumental variable estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.
$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

sonalities turn to be insignificant. This may indicate that there is a downward bias in OLS estimates about the effects of HE on conscientiousness. Alternatively, the larger estimated effect may reflect the LATE for marginal students. Effects on risk aversion remain negative, indicating that entering HE makes people less risk averse. IV estimates reveal that the effects of HE on general trust and trust in neighbours are negative, while the effects on trust in Americans are positive. Education does not influence other dimensions of trust including trust in parents, strangers, officials, and doctors.

The negative impact on general trust is in line with Wu and Shi (2020), which uses the same dataset as this study and argues that education may teach individuals to be more aware of social and institutional risks and not to trust in the context of a country with high risks, such as corruption and favouritism. Depression and life satisfaction are not affected by HE, while confidence about the future is negatively affected. The negative effect on confidence about future seems to be consistent with previous research on the negative effects of education on life satisfaction(Nikolaev, 2016; Powdthavee et al., 2015; Shields et al., 2009, etc.), but it contrasts with studies finding positive effects of education on life satisfaction (Blanchflower and Oswald, 2004; Easterlin, 2001, etc.). The potential reasons behind this negative effect are investigated by Clark et al. (2015) and Kristoffersen (2018). Their studies suggest that higher aspirations or expectations about the life circumstances of better-educated individuals hinder them from feeling happy.

3.5.2 Heterogeneity by gender

To further investigate whether the effects of HE on non-cognitive skills vary across gender groups, this study conducts a heterogeneity analysis based on gender.[31] Specifically, this study interacts higher education completion with a male indicator (male=1) for estimations using instrumental variable method. The coefficients of the interaction terms capture the differential effect of higher education for males relative to females, conditional on controls and their interactions with the gender indicator. The estimated coefficients of the HE-gender interaction term are reported in Figure 3.2.[32] According to Figure 3.2, heterogeneous effects across gender are limited: HE decreases agreeableness and depression more for males, while there is no statistically significant gender difference in the effect of HE on other non-cognitive outcomes.

3.6 Discussion on potential channels

To satisfy the job market requirements, HE provides discipline-specific curricula. For example, many science, technology, engineering, and mathematics (STEM) majors require experiments, mathematical and quantitative analysis, while most majors in the social sciences and humanities stress reading, discussions, and qualitative methods. Given these differences in programme designs, it is likely that HE shapes individuals' non-cognitive

31. Heterogeneous regressions on parental education and communist party status are also conducted, while no heterogeneity across parental education and political status is found in this study.
32. See Appendix Table C7 for the complete results for this heterogeneous analysis.

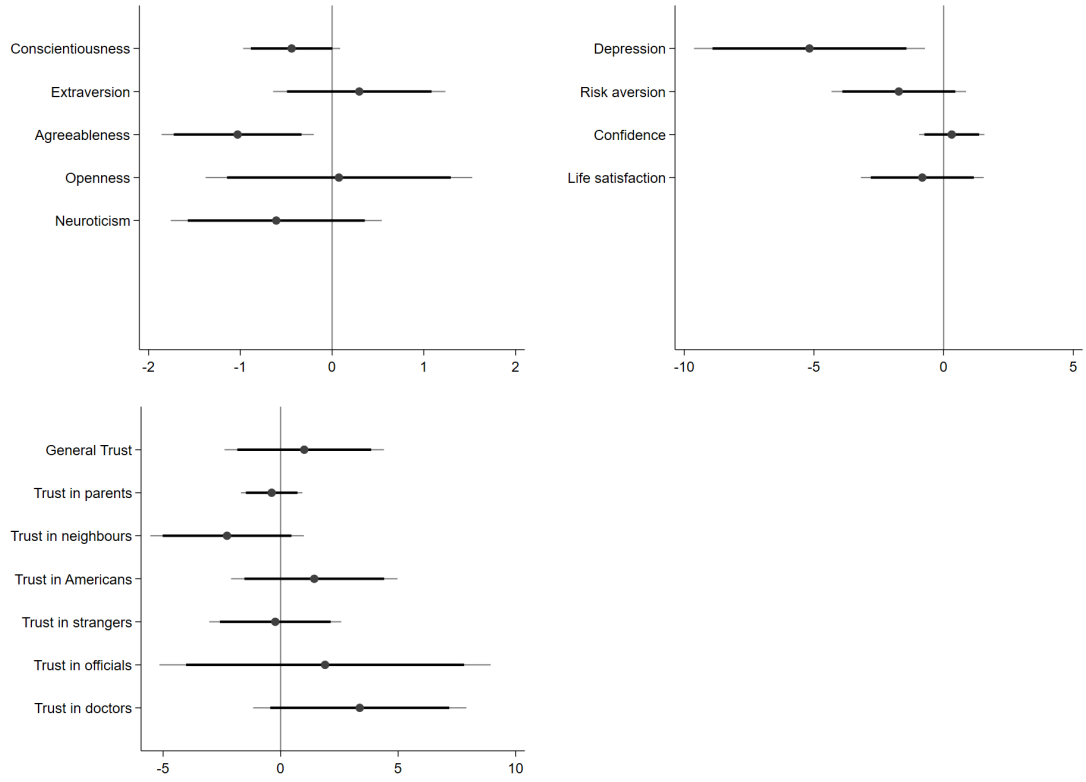


Figure 3.2: Heterogeneity by gender

Note: This figure plots the coefficients on the interaction between higher education (HE) and a male indicator from 2SLS regressions, in which HE and its interaction with the male indicator are instrumented by the unexpected HE enrolment ratio at the province level and its interaction with the female indicator. Each coefficient captures the difference in the effect of HE between women and men; a negative value indicates that HE lowers the outcome more, or raises it less, for men than for women. Dots denote point estimates; thick and thin lines denote 90% and 95% confidence intervals, respectively. All regressions control for gender, age, father's and mother's highest education, father's and mother's political status when the respondent was aged 14, the provincial teacher–student ratio in higher education institutions and birth weight, as well as their interactions with the female indicator. Standard errors are clustered at the province level.

skills differently across majors.[33] To test this channel, this study conducts heterogeneous analysis across major groups. Since the direct variable on individual majors during HE has many missing values, this study infers individuals' majors based on their job titles.[34] Figure 3.3 reports the effects of higher education on non-cognitive skills by discipline (STEM vs. non-STEM).[35] The results suggest that there is no difference in the effects of HE on individual non-cognitive skills across majors. It seems that the main long-term effects found in this study are not driven by the impacts of programme designs.

Additionally, HE may persistently influence individuals' non-cognitive development by enabling them to work in occupations and environments where non-cognitive skills can be particularly inspired. Psychological studies have investigated the potential impacts of certain job characteristics, work environments, and job transitions on personalities. For instance, Woods et al. (2020) find that investigative and artistic occupational environments are associated with openness, and more social environments are associated with extraversion and agreeableness in adulthood. Wu et al. (2020) find that chronic job insecurity is associated with an increase in neuroticism and decreases in agreeableness and conscientiousness.[36] As labour markets partly select workers on the basis of educational

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33. The potential differences in personalities across majors are documented by psychological studies with simple descriptive analysis (Vedel, 2016; Wen et al., 2021, etc.). For instance, Wen et al. (2021) suggest that students who study agriculture-related majors (with more experimental classes) are more socially shy than their counterparts who study non-agriculture-related majors (with more management and economic courses). This difference was found after 3-year university study and was not shown in freshman year. Vedel (2016) reviews studies on Big Five personalities and majors and finds consistently across studies that arts or humanities score high on Neuroticism and Openness and score low on Conscientiousness.

34. A simple example for the classification progress is like individuals whose job title is construction engineering technicians are classified into STEM group; and customer servicers are classified as social science and humanities group.

35. See Appendix Table C8 for complete results of this heterogeneous analysis by major.

36. Another example is Nieß and Zacher (2015), this study indicates that the transition to a higher position or management position is associated with an increase in openness to experience. Although they do not find any supportive evidence on the change in conscientiousness, they argue that the effect of job promotion on conscientiousness can be either positive or negative. See Bleidorn et al. (2018); Boyce et al. (2015); Costa Jr et al. (2000); Holman and Hughes (2021); Nieß and Zacher (2015); Wille and De Fruyt (2014); Woods et al. (2020); Wu et al. (2020) for relevant studies on the relationship between HE and work-related outcomes.

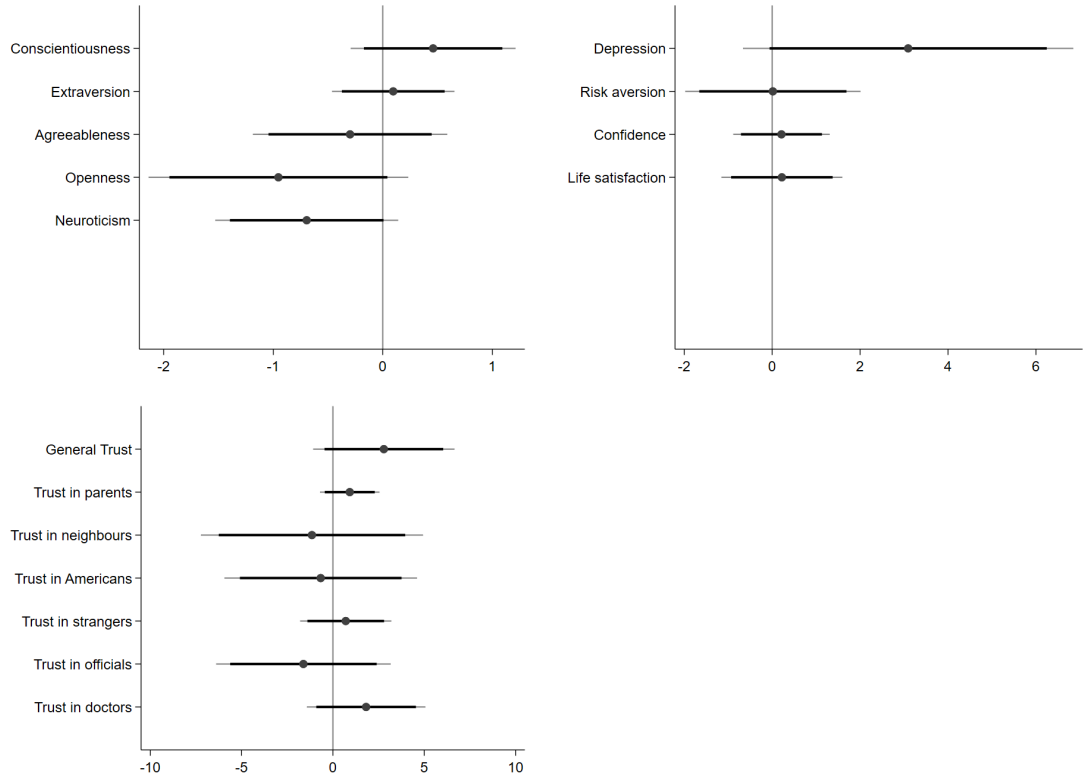


Figure 3.3: Heterogeneity by major

Note: This figure plots the coefficients on the interaction between higher education (HE) and a STEM indicator from 2SLS regressions, in which HE and its interaction with the major indicator (1=STEM major) are instrumented by the unexpected HE enrolment ratio at the province level and its interaction with the female indicator. Each coefficient captures the difference in the effect of HE between STEM and NON-STEM majors; a negative value indicates that HE lowers the outcome more, or raises it less, for STEM group than for non-STEM group. Dots denote point estimates; thick and thin lines denote 90% and 95% confidence intervals, respectively. All regressions control for gender, age, father's and mother's highest education, father's and mother's political status when the respondent was aged 14, the provincial teacher–student ratio in higher education institutions and birth weight, as well as their interactions with the STEM indicator. Standard errors are clustered at the province level.

attainment, individuals with only a high school diploma may face restricted access to stable and creative occupations as well as supportive working environments. They may also be less likely to be promoted in their careers when competing with HE graduates.[37] For instance, it is easy to imagine there are dramatic differences in work tasks and environments between manual workers and architects, even when they work in the same firm. Manual workers undertake heavy and repeated manual tasks in the construction site. By contrast, architects usually focus on creative tasks in the office.

Table 3.5 reports the results from IV estimations on the associations between HE and individual work characteristics. The investigated work characteristics include individual satisfaction with the current job (3 dimensions: satisfaction with job safety, environment, time), labour contract signing, social insurance provision, and the probability of job promotion. Job satisfaction is measured by a 5-point Likert scale, ranging from 1 "Strongly unsatisfied" to 5 "Strongly satisfied". Job insurance provision is measured by a dummy variable: whether an individual's work provides at least one of the following forms of job insurances (endowment insurance, medical insurance, unemployment insurance, employment injury insurance, and maternity insurance).[38] Job labour contracts is also measured by a dummy variable: whether an individual has signed a (formal) labour contract for his or her job. Occupations with formal labour contract signed means relatively stable jobs, in contrast to temporary jobs (Gao et al., 2012). In China, Job searchers tend to be willing to work in enterprises with insurance provision and labour contracts, which are normally

37. See Cairó and Cajner (2018); Ilyés and Sebők (2023); Solomon et al. (2022); Spilerman and Lunde (1991); Wise (1975); Zhang (2023) for relevant studies

38. In China, the provision of these five types of social insurance is legally required for enterprises. However, workers in micro and small enterprises, as well as self-employed individuals, are often not fully covered by the social insurance system. Jobs that include social insurance coverage tend to be more stable, better paid, require higher levels of education, and offer more favourable working environments.

more stable and have better salaries and welfare. This study here uses the constructed dummy variables for insurance and contracts to proxy for individual work conditions and job insecurity. Job promotion is measured by an indicator variable implying whether an individual has experienced promotion since 2010.

Table 3.5: Potential channels related to work characteristics and environments: results from IV estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Satisfaction about time	Satisfaction about environment	Satisfaction about safety	Labour contract	Social insurance	Job promotion
HE	0.3701*	0.7224*	0.8101**	0.9682***	1.2228***	0.3473**
	(0.2055)	(0.4027)	(0.3854)	(0.1865)	(0.3283)	(0.1377)
First stage F statistics	20	20	20	22	18	16
Observations	3,708	3,708	3,708	2,311	2,828	2,679

Notes: This table reports instrumental variable estimates. All the regressions control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.
$^{*}\, p < 0.1, ^{**}\, p < 0.05, ^{***}\, p < 0.01$

The results show that individuals who have completed HE are more satisfied with their job time, environment, and safety of their occupations (although the coefficients of satisfaction with their job time and environment are significant only at the 10 percent significance level), and they are also more likely to have occupations with at least one type of insurance, labour contracts, and promotion experience since 2010. These results show an improvement in employment outcomes and work environments. The results on labour

contracts and insurance provision are in line with previous psychological studies showing that job insecurity decreases conscientiousness (Wu et al., 2020). These results provide suggestive hint that the work-related channel may drive the positive effects of HE on conscientiousness in the long term.[39]

Notably, this study cannot give plausible evidence on any channel mentioned above. There are several issues on the measures and the channel investigation: First, the measure on major are inferred by current job titles, which may capture occupation rather than field of study; The analysis on curriculum channel is very preliminary and this study cannot rule out the possibility of curriculum effects. Second, the analysis on job-related channel is problematic: individual conscientiousness could influence higher education and job conditions, biasing the estimation. Third, job outcomes are only observed for employed individuals, which introduces selection on a post-treatment outcome.

3.7 Robustness checks

In this section, several robustness checks of the main results are considered. First, previous research proposes that the Cultural Revolution (1966-1976) in China caused severe disruption in the educational system, which may also affect non-cognitive development and hinder individual cognition to enrol in HEIs. During this period, the college entrance examination was suspended, primary and secondary education was severely disrupted, with many schools suspending regular teaching activities (Huang, Tani, Wei and Zhu,

39. Regarding the channels through which HE could negatively affect individuals (the negative effects on their risk aversion, confidence about future, and general trust), the main dataset in this study is limited in accessing information about HE life and work experience (such as low rank, competitive environments and losing 3 or 4-year working experience). Given this data limitation, it is very difficult to test the two channels on rank and work experience to investigate where the negative effects come from.

2022; Meng and Gregory, 2002). Including samples that experienced the Revolution may thus cause potential bias as a consequence of including confounding effects of the Cultural Revolution on non-cognitive skills. To remedy this concern, the 1976 and older cohorts are dropped as a robustness check (See Appendix Table C9). The estimates are similar to the main results in this study, suggesting the main results are not confounded by the Revolution.

Second, one may worry that the main results of the study are unique to a particular specification, given that a variety of control variables are included in the main specification. To consider this concern, extra control variables covering the number of days an individual's father left home when the respondent was 0-3 years old, number of days an individual's mother left home when the respondent was 0-3 years old, the number of days an individual's father left home when the respondent was 4-12 years old, the number of days an individual's mother left home when the respondent was 4-12 years old, whether the respondent's father has administrative or managerial positions, whether the respondent's mother has administrative or managerial positions are included. After adding those additional covariates, the results still support positive effects of HE on conscientiousness and negative effects of HE on confidence about future and trust (see Appendix Table C10).

Third, the sensitivity to alternative levels of clustering standard errors is checked. For the main results, the standard errors are clustered at the province level to account for the correlation in standard errors within the same province. The results are robust to the two-way clustering at both the cohort and province level (see Appendix Table C11).

Fourth, in the main analysis, the instrumental variable is constructed according to the province in which they currently live. The current provincial location is a proxy variable for the province where the individuals lived when they were 18 years old and took the college entrance examination, as stated in Section 3.2. This may raise concerns about the omission of the possibility that individuals' movement to other provinces and the precision of the instrumental variable. To address this problem, the main specification is conducted with an additional sample restriction: the sample is restricted to individuals whose place of residence is the same as the location they lived in when they were 12 years old (see the corresponding results in Appendix Table C12). The results hardly change and are unaffected by the use of the proxy variable.

3.8 Conclusion

Previous empirical studies have highlighted the importance of non-cognitive skills (Edin et al., 2022; Fasani, 2020; Nandi and Nicoletti, 2014). However, little attention has been given to the role of HE on non-cognitive development, while several studies have suggested that HE-related factors, such as curriculum-based interventions, teachers, and peers, could influence non-cognitive skills (Alan et al., 2019; Alan and Ertac, 2018; Gong et al., 2018; Shan and Zölitz, 2025, etc.).

Intended to fill this gap, this study explores the LATE effects of HE on non-cognitive skills in the long term, employing data from the 2018 wave in CFPS. Making use of higher education expansion policy in China in 1999 to construct an instrumental variable, this study finds that higher education has positive effects on conscientiousness and negative effects on risk aversion, confidence about future, and general trust, on average ten years after

graduation. In contrast, no significant effect of HE on other dimensions of non-cognitive skills is found. Further, some evidence on potential channels indicates that HE induces improvements in individual work conditions, including safety, stability, and promotion space. While major-specific courses do not drive the main results in this study.

Combined with previous literature about returns to HE, this study contributes to finding persistent influences of HE on non-cognitive skills. The positive effects of HE on conscientiousness is consistent with Cunha and Heckman (2007) theoretical study and show that HE could promote human capital accumulation.

There are some questions left for future research: First, while this study suggests the persistent effects of HE on non-cognitive skills in the long term, the data do not allow for further investigation of the mid-term effects. Sorting out how the effects on non-cognitive skills vary over time is important. It is likely that the effects of HE on some dimensions of non-cognitive skills gradually fade in the medium and long term. Second, because only one wave of data is available, this study remains salient in investigating the value-added effects that requires observation of students before and after HE. Third, the instrumental variable constructed in this study does not have enough power to remove the confounding province fixed effects, which may cause an overestimation bias. This may lead to the results estimated in this study being an upper bound of the long-term effects of education on non-cognitive skills. Fourth, this study does not provide evidence on channels relevant to HE life other than course design and content. However, it should encourage follow-up work to obtain data on individuals' HE life, such as their majors, teachers, specific course practices, peers, networks, ranks, after-class activities, time use, HE attendance rates, scores, and later non-cognitive skills. This would allow for the investigation of the effects

of those HE-related factors on their later non-cognitive skills. In addition, heterogeneity among HE students by their academic ability, university quality, and career or academic motivation should be investigated to assess how the net effects of HE on non-cognitive skills vary across different student groups. Further studies with rich data on university experience and a long panel structure are required to address the above problems.

Chapter 4

Conclusion

This thesis contributes to a comprehensive understanding of how three key determinants—teachers, peers, and higher education—influence human capital outcomes. The first chapter reveals the positive effects of subject teachers' favourable attitudes on migrant students in China, who normally have disadvantaged family backgrounds in host regions. Teachers' attitudes induce differentiated behaviours and lead to changes in students' subjective feelings. Notably, the influence of teachers' attitudes goes beyond schools: parents do adjust their evaluations of their children's abilities and parenting styles according to teachers' attitudes. This interplay between teachers, students, and parents, documented in this chapter, is consistent with a small but growing body of evidence in the economics of education that illustrates the wide-ranging impacts of educational interventions in schools, especially from the household perspective.

The second chapter investigates the externalities of the sports' tendency of classroom peers in Taiwanese high schools. There are positive spillover effects of sports-oriented peers: these peers could improve students' probability of moderate sports participation and reduce the probability of being obese. This benefits do not come at the cost of students' cognitive performance during high school stage and schooling years in about 6 years

after high school. Additionally, this short-term benefits do not transit to long-term labour market rewards. Interestingly, one channel behind such peer effects in students' health behaviours is the social comparison pressure on body shape. By such a comprehensive analysis of sports-oriented peers, this chapter provides a perspective on how peers' composition in educational environments shape individual health behaviours and outcomes.

The third chapter explores the long-term effects of HE on individual personalities and other behavioural traits. This study finds that HE completion improves individuals' conscientiousness and reduces their risk aversion, confidence, and general trust in the long term. In contrast, no significant effect of HE on other dimensions of the Big Five personality traits, mental health, and life satisfaction is found. HE-induced changes in work conditions act as a channel through which conscientiousness is improved in the long term, while major-specific programme design does not play a role. This chapter provides insights into the impact of HE on shaping skills and improving the level of human capital.

There are several limitations of this thesis. The first chapter has two main limitations. First, teacher attitudes are measured through survey responses, which may be subject to measurement error and social desirability bias. Second, although this study makes use of random assignment of students to classes to address selection, teachers' attitudes are still correlated with observed teacher characteristics and may still be correlated with unobserved teacher characteristics, such as teachers' non-cognitive skills. The estimates in this study should therefore be interpreted with caution. The second chapter also has two main limitations. First, the channels behind the effects on weight status remain unclear. Peers do not increase overall exercise, and the diet measure is too coarse to capture changes in food intake, so this study cannot determine whether the reduction in obesity

reflects changes in exercise, diet or other weight-management behaviours. Second, height and weight are self-reported. If social comparison with peers increases the tendency to under-report weight, the estimates would overstate the true reduction in obesity. The third chapter are limited in terms of two aspects. First, the IV estimates capture a local average treatment effect for compliers, that is, individuals who obtained a higher education degree because of the expansion. Because this study relies on a single measure of expansion intensity, we cannot separately identify the effects along different margins, such as moving from no higher education to vocational college, or from vocational college to university, and the estimates may not generalise to other groups of students. Second, the analysis of mechanisms is suggestive rather than causal.

Across these three chapters, several areas remain open for further research. First, it would be worthwhile to investigate whether the effects revealed in this thesis are context-specific and whether their effect sizes vary across contexts. The main settings of this thesis are mainland China and Taiwan, where students face fierce academic competition and long school hours. This may make the effects of teachers, school peers, and, more broadly, the school experience more profound. Second, future research could further investigate the relationships between in-school factors and household responses, especially for peer composition and students' personality development. The first chapter of this thesis suggests that students' human capital development is promoted by the multidimensional interactions among teachers, students, and parents. How in-school factors trigger households' behaviours is a question worth considering. Third, the chapters of this thesis could be en-

hanced with more accurate and consistent measures. For instance, the first chapter could be strengthened by using Implicit Association Test measures. The second chapter could be improved by having data on sports types. With these measures, future studies may extend the analysis to reduce potential measurement bias.

Appendices

A Appendix for chapter 1

Table A1: Using responses on subjects that teachers are not teaching

	Test scores	
	Migrant	Local
Teacher attitude index	0.1367***	0.0055
	(0.0462)	(0.0281)
Observations	1,745	7,607
p-value (Migrant = Local)	0.0046	

Notes: Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Using a discretised measure of teachers' attitudes

	Test scores	
	Migrant	Local
Teacher attitude index	0.1547**	0.0048
	(0.0660)	(0.0288)
Observations	1,745	7,607
p-value (Migrant = Local)	0.0133	

Notes: Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Inclusion of factors on teacher's observations

	(1)		(2)		(3)	
	Migrant	Local	Migrant	Local	Migrant	Local
Teacher attitude index	0.1240***	0.0051	0.1415***	0.0045	0.1143**	−0.0186
	(0.0375)	(0.0265)	(0.0451)	(0.0251)	(0.0441)	(0.0270)
Observations	1,727	7,607	1,745	7,607	1,745	7,607
p-value (Migrant = Local)	0.0073		0.0031		0.0021	

Notes: Standard errors are clustered at the class level and reported in parentheses.

$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Table A4: Adding controls for baseline parents' behaviours

	Test scores	
	Migrant	Local
Teacher attitude index	0.1329***	0.0030
	(0.0434)	(0.0261)
Observations	1,696	7,401
p-value (Migrant = Local)	0.0032	

Notes: Standard errors are clustered at the class level and reported in parentheses.

$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$.

Table A5: A check on sorting based on teacher attitudes with variables on parental baseline behaviours

	Teacher attitude index	S.E.	Observations
Male student	−0.0017	(0.0132)	9,097
Brought up by parents in primary school	0.0122	(0.0215)	9,097
Insisted on going to school	0.0086	(0.0112)	9,097
Tried to finish homework even disliked	0.0127	(0.0135)	9,097
Tried to finish homework even if it would take quite a long time	−0.0121	(0.0151)	9,097
Expressed opinions clearly	0.0251*	(0.0143)	9,097
Respond quickly	0.0210	(0.0135)	9,097
Learn quickly	−0.0296**	(0.0121)	9,097
Curious	0.0006	(0.0118)	9,097
Mother education	−0.0019	(0.0027)	9,097
Father education	0.0062	(0.0038)	9,097
Rank in primary school	0.0003	(0.0015)	9,097
Student age	0.0019	(0.0143)	9,097
Neighbours' migrant status (majority migrants = 1)	0.0246	(0.0251)	9,097
Self-reported neighbors' social class	0.0092	(0.0214)	9,097

Continued on next page

Table A5: A check on sorting based on teacher attitudes (continued)

	Teacher attitude index	S.E.	Observations
Self-reported diseases in primary school	0.0430**	(0.0186)	9,097
Low-income family status	−0.0395	(0.0344)	9,097
Han	0.0252	(0.0370)	9,097
Transfer school	0.0059	(0.0224)	9,097
Skip grade	−0.1365	(0.0876)	9,097
Repeat grade	−0.0250	(0.0259)	9,097
Baseline score	0.0495	(0.0439)	9,097
Class size in primary school	0.0018*	(0.0009)	9,097
Baseline parental behaviours			
Care and be strict with children's internet time	−0.0047	(0.0132)	9,097
Care and be strict with children's TV time	0.0239	(0.0157)	9,097
Discuss worries and troubles with mother	−0.0245**	(0.0098)	9,097
Having dinner together	−0.0056	(0.0085)	9,097

Notes: Reported estimates are from OLS estimation. The dependent variable is the ratio of migrant students at the class level. All regressions are estimated at the class-teacher level and control for school and subject fixed effects. Standard errors are clustered at the class level and reported in parentheses.

$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table A6: Alternative specifications

	Test scores	
	Baseline	With interactions
Migrant student	−0.0112	0.4085
	(0.0309)	(0.6290)
Teacher attitude	0.0272	0.0058
	(0.0265)	(0.0266)
Migrant × Teacher attitude		0.1208***
		(0.0435)
Observations	9,352	9,352
Student controls	Yes	Yes
Teacher controls	Yes	Yes
Migrant × Student controls	No	Yes
Migrant × Teacher controls	No	Yes

Notes: Standard errors are clustered at the class level and reported in parentheses. The baseline model includes migrant status, teacher attitudes, baseline scores, and student and teacher controls. The interaction model additionally includes interactions between migrant status and all other variables.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Heterogeneous estimations by subject

	Test scores
Migrant student	1.7343
	(1.9625)
Teacher attitude	−0.0325
	(0.0317)
Migrant × Teacher attitude	0.1563***
	(0.0396)
Migrant × Teacher attitude × Mathematics	-0.0070
	(0.0451)
Migrant × Teacher attitude × English	-0.0026
	(0.0422)
Observations	9,352
Student controls	Yes
Teacher controls	Yes
Migrant × Student controls	Yes
Migrant × Teacher controls	Yes
Migrant × Student controls × Mathematics	Yes
Migrant × Teacher controls × Mathematics	Yes
Migrant × Student controls × English	Yes
Migrant × Teacher controls × English	Yes

Notes: Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: Heterogeneous estimations by student, family, and school characteristics

	Academic performance				
	(1)	(2)	(3)	(4)	(5)
Migrant × Teacher attitude × Male	0.0468				
	(0.0748)				
Migrant × Teacher attitude × Rural Hukou		0.1343			
		(0.0941)			
Migrant × Teacher attitude × Local dialect proficiency			−0.0545		
			(0.0858)		
Migrant × Teacher attitude × Low ability				0.0684	
				(0.0804)	
Migrant × Teacher attitude × Schools with fewer resources					0.2170
					(0.1419)
Migrant student	1.2608	1.9582*	−1.2064	0.8604	−2.0618
	(0.9486)	(1.0818)	(0.9978)	(0.8195)	(2.6827)
Teacher attitude	0.0453*	0.0340	0.0238	0.0002	0.0018
	(0.0270)	(0.0276)	(0.0317)	(0.0284)	(0.0522)
Student controls	Yes	Yes	Yes	Yes	Yes
Teacher controls	Yes	Yes	Yes	Yes	Yes
Migrant × Student controls	Yes	Yes	Yes	Yes	Yes
Migrant × Teacher controls	Yes	Yes	Yes	Yes	Yes
Migrant × Student controls × Male	Yes				
Migrant × Teacher controls × Male	Yes				
Migrant × Student controls × Rural Hukou		Yes			
Migrant × Teacher controls × Rural Hukou		Yes			
Migrant × Student controls × Local dialect proficiency			Yes		
Migrant × Teacher controls × Local dialect proficiency			Yes		
Migrant × Student controls × Low ability				Yes	
Migrant × Teacher controls × Low ability				Yes	
Migrant × Student controls × Schools with fewer resources					Yes
Migrant × Teacher controls × Schools with fewer resources					Yes
Observations	8939	8629	8884	8939	8939

Notes: Each column reports estimates from separate regressions. Standard errors are clustered at the class level and reported in parentheses.

Table A9: The effects of teachers' attitudes on parental beliefs and behaviours

	Teachers like migrant students as much as local students	Attend parent-teacher meetings	Parental underes-timation about students' perform-ance	Participation in private tutoring	Expenditure on private tutoring	Time spent on private tutoring (week-days)	Time spent on private tutoring (week-ends)
Migrant	0.0390**	0.0042	-0.0354	0.0035	-225.9671	-0.1098*	-0.0622
	(0.0168)	(0.0342)	(0.0245)	(0.0352)	(170.0970)	(0.0562)	(0.0529)
Obs.	1745	1733	1495	1730	1594	1739	1737
Local	0.0461***	0.0289	-0.0302*	-0.0280**	88.5046	-0.0179	0.0331
	(0.0088)	(0.0300)	(0.0172)	(0.0140)	(114.0375)	(0.0423)	(0.0314)
Obs.	7607	7581	6656	7583	7237	7586	7576
P-Value (Mi-grant=Local)	0.7122	0.4851	0.8234	0.3595	0.1839	0.1519	0.1345

Notes: $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Figures

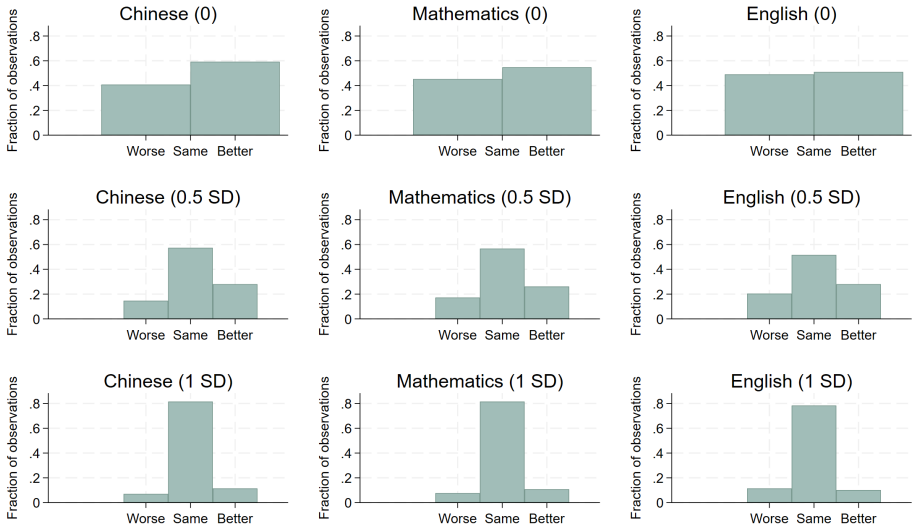


Figure A1: Actual performance at class level: migrant students versus local students.
Note: This figure displays the distribution of migrant students' actual performance at the class level relative to local students. Actual performance is coded as 1 = worse, 2 = the same, and 3 = better. Different rows show alternative definitions of relative performance. For example, the third row defines the variable as follows: 1 = average score difference between migrant and local students within the same class < -1 SD (i.e., 10 standardised score points); 2 = average score difference between -1 SD and 1 SD; 3 = average score difference > 1 SD.

B Appendix for chapter 2

Table B1: Correction for missing peer information with restricted estimators: short-term outcomes

Panel A: Exercising behaviors

	Low sports involvement	Moderate sports involvement	High sports involvement
Sports-Favoring peers	-0.3805	0.8688**	-0.4911
	(0.2677)	(0.4139)	(0.3181)
Sports-Loving peers	-0.2012	0.4426	-0.2164
	(0.2564)	(0.4006)	(0.3279)
Observations	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight	Underweight	Abnormal weight
Sports-Favoring peers	-0.6916***	0.2803	-0.0713	-0.4827**
	(0.1859)	(0.2264)	(0.2448)	(0.2323)
Sports-Loving peers	-0.4934**	0.3009	-0.2177	-0.4102
	(0.2099)	(0.2249)	(0.2515)	(0.2546)
Observations	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
Sports-Favoring peers	-1.7391**	-1.5750***	-0.5059	0.9610
	(0.6912)	(0.5933)	(0.7654)	(0.6707)
Sports-Loving peers	-0.8601	-1.1315*	0.0998	-0.3810
	(0.6365)	(0.5845)	(0.7117)	(0.6730)

Continued on next page

Table B1: Correction for missing peer information with restricted estimators: long-term outcomes (continued)

Observations	5016	5010	5011	5015
Panel D: Cognitive ability and learning time				
	Comprehensive analytical test	General analytical test	Math analytical test	Learning Time
Sports-Favoring peers	-0.9110*	0.6693	-0.6748	-0.6853
	(0.5412)	(0.5894)	(0.8484)	(0.7815)
Sports-Loving peers	-0.5223	0.4333	0.0630	-2.1528***
	(0.5867)	(0.6726)	(0.9102)	(0.7875)
Observations	4956	4956	4956	5006

Notes: Standard errors are clustered at the class level and reported in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table B2: Correction for missing peer information with restricted estimators: long-term outcomes

	Education	Employment	Salary	Occupation
SF peers	0.2467	-0.5644	5.6493	-0.3175
	(0.9913)	(0.5972)	(4.1225)	(0.6144)
SL peers	1.7100	0.3546	6.8202	0.3748
	(1.1952)	(0.7226)	(4.6802)	(0.7270)
Observations	1379	1374	979	1028

Notes: Standard errors are clustered at the class level and reported in parentheses.
SF peers: sports-favouring peers; SL peers: sports-loving peers.

$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table B3: Correction for missing peer information with unrestricted estimators: short-term outcomes

Panel A: Exercising behaviours

	Low sports involvement	Moderate sports involvement	High sports involvement
SF peers	-0.4990*	0.9633**	-0.4521
	(0.2879)	(0.4835)	(0.3875)
SL peers	-0.2875	0.7787	-0.4497
	(0.2925)	(0.4902)	(0.3981)
Observations	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight	Underweight	Abnormal weight
SF peers	-0.6699***	0.1894	-0.1544	-0.6348**
	(0.2259)	(0.2776)	(0.2872)	(0.2988)
SL peers	-0.3151	0.1381	-0.2209	-0.3979
	(0.2443)	(0.2724)	(0.3089)	(0.3242)
Observations	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
SF peers	-1.6267**	-0.5298	0.2476	0.1304
	(0.8165)	(0.8223)	(0.8833)	(0.9012)
SL peers	-1.1126	-0.1318	0.6604	0.8982
	(0.7517)	(0.8063)	(0.9002)	(0.8398)
Observations	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

Continued on next page

Table B3: Correction for missing peer information with unrestricted estimators: long-term outcomes (continued)

	Comprehensive analytical test	General analytical test	Math analytical test	Learning time
SF peers	-0.9327	0.9972	-1.2908	-0.6265
	(0.6418)	(0.7503)	(1.0310)	(0.9463)
SL peers	-0.5395	0.5931	-0.3328	-2.1411**
	(0.6648)	(0.7680)	(1.0819)	(0.9464)
Observations	4956	4956	4956	5006

Notes: Standard errors are clustered at the class level and reported in parentheses. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B4: Correction for missing peer information with unrestricted estimators: long-term outcomes

	Education	Employment	Salary	Occupation
SF peers	0.7323	-0.4400	10.4175*	0.3532
	(1.0996)	(0.7264)	(5.4892)	(0.7927)
SL peers	2.2756	-0.2644	6.4689	0.2356
	(1.3841)	(0.7751)	(5.2114)	(0.8110)
Observations	1379	1374	979	1028

Notes: Standard errors are clustered at the class level and reported in parentheses. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B5: Heterogeneity by gender

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement
Female × SF peers	0.0470	-0.0213	-0.0335
	(0.0787)	(0.1262)	(0.1009)
Female × SL peers	0.0485	0.1491	-0.1913
	(0.0816)	(0.1388)	(0.1175)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight	Underweight	Abnormal weight
Female × SF peers	-0.0124	0.0209	0.0438	0.0523
	(0.0594)	(0.0728)	(0.0683)	(0.0719)
Female × SL peers	-0.0849	0.0381	0.0566	0.0099
	(0.0662)	(0.0744)	(0.0787)	(0.0765)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
Female × SF peers	0.2489	0.1999	0.0352	0.2457
	(0.2172)	(0.2108)	(0.2043)	(0.2188)
Female × SL peers	0.1914	0.1159	0.1282	0.3298
	(0.2141)	(0.2098)	(0.2113)	(0.2366)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
Female × SF peers	-0.1544	0.0189	-0.1826	-0.0149
	(0.1458)	(0.1713)	(0.2390)	(0.2437)
Female × SL peers	-0.0355	0.1834	-0.1565	-0.2164
	(0.1512)	(0.1905)	(0.2460)	(0.2407)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table B6: Heterogeneity by parental education

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement
High parental edu. × SF peers	-0.0194	-0.0143	0.0473
	(0.0785)	(0.1197)	(0.1020)
High parental edu. × SL peers	0.0351	-0.0336	-0.0033
	(0.0816)	(0.1316)	(0.1175)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight & Obese	Underweight	Abnormal weight
High parental edu. × SF peers	-0.0407	-0.0289	0.0705	0.0416
	(0.0725)	(0.0867)	(0.0824)	(0.0755)
High parental edu. × SL peers	-0.0163	0.0481	0.0433	0.0913
	(0.0767)	(0.0880)	(0.0851)	(0.0773)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
High parental edu. × SF peers	0.3163	0.0290	0.0453	0.0558
	(0.2420)	(0.2143)	(0.2638)	(0.2185)
High parental edu. × SL peers	0.1467	0.2992	0.1897	0.4358*
	(0.2416)	(0.2158)	(0.2514)	(0.2363)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
High Parental Edu. × SF peers	0.0302	0.0989	-0.1260	-0.0927
	(0.1545)	(0.1972)	(0.2399)	(0.2264)
High Parental Edu. × SL peers	-0.0212	-0.0847	0.0724	0.0249
	(0.1615)	(0.1941)	(0.2469)	(0.2482)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B7: Heterogeneity by family income

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement
High income × SF peers	0.0032	0.0223	-0.0257
	(0.1038)	(0.1550)	(0.1288)
High income × SL peers	-0.1766*	0.1652	0.0161
	(0.0972)	(0.1663)	(0.1461)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight & Obese	Underweight	Abnormal weight
High income × SF peers	-0.0496	-0.1795*	0.0449	-0.1346
	(0.0926)	(0.1066)	(0.1045)	(0.0894)
High income × SL Peers	0.0662	-0.0183	-0.0251	-0.0434
	(0.0835)	(0.1085)	(0.1024)	(0.0958)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
High Income × SF Peers	-0.3892	-0.7196**	-0.8934***	0.2252
	(0.2778)	(0.2904)	(0.3333)	(0.2924)
High Income × SL Peers	-0.5128*	-0.4905*	-0.2170	0.1766
	(0.3002)	(0.2669)	(0.3301)	(0.3102)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
High income × SF peers	0.3322*	0.2543	0.4089	0.8269***
	(0.1748)	(0.2193)	(0.2876)	(0.3202)
High income × SL peers	0.2916*	0.1313	0.6030**	0.6129*
	(0.1755)	(0.2346)	(0.2818)	(0.3631)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B8: Heterogeneity by student age

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement
Younger × SF peers	0.0267	0.0022	-0.0389
	(0.0659)	(0.1119)	(0.0947)
Younger × SL peers	-0.0678	0.1416	-0.0759
	(0.0674)	(0.1165)	(0.1045)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight & Obese	Underweight	Abnormal weight
Younger × SF peers	0.0054	-0.0388	-0.0294	-0.0682
	(0.0569)	(0.0780)	(0.0678)	(0.0629)
Younger × SL peers	0.0420	0.0570	-0.0709	-0.0140
	(0.0645)	(0.0819)	(0.0720)	(0.0676)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
Younger × SF peers	-0.0736	0.0598	-0.3532	-0.1066
	(0.2003)	(0.1745)	(0.2156)	(0.1977)
Younger × SL peers	-0.1173	-0.0172	-0.2632	0.2529
	(0.1997)	(0.1810)	(0.2147)	(0.2193)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
Younger × SF peers	0.1908	0.0861	0.2784	-0.0166
	(0.1251)	(0.1408)	(0.2062)	(0.2149)
Younger × SL peers	-0.1729	-0.1908	-0.2625	0.1771
	(0.1338)	(0.1622)	(0.2199)	(0.2305)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table B9: Heterogeneity by baseline BMI

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement
Abnormal BMI × SF peers	0.1003	-0.0197	-0.0774
	(0.0723)	(0.1099)	(0.1020)
Abnormal BMI × SL peers	0.0290	-0.1376	0.1109
	(0.0789)	(0.1231)	(0.1055)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight & Obese	Underweight	Abnormal Weight
Abnormal BMI × SF peers	-0.1686**	-0.1225	-0.0241	-0.1466*
	(0.0726)	(0.0933)	(0.0842)	(0.0822)
Abnormal BMI × SL peers	-0.1075	0.0131	-0.1703*	-0.1573*
	(0.0840)	(0.0978)	(0.0926)	(0.0893)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do Not Want to Live	Feel Helpless	Feel Cared For & Loved
Abnormal BMI × SF peers	0.1526	-0.2270	0.1991	0.0346
	(0.1817)	(0.2129)	(0.1909)	(0.2637)
Abnormal BMI × SL peers	0.1598	-0.0069	0.0039	-0.0246
	(0.1989)	(0.2114)	(0.1949)	(0.2769)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
Abnormal BMI × SF peers	0.0027	-0.0982	-0.0004	-0.0740
	(0.1330)	(0.1789)	(0.2141)	(0.2103)
Abnormal BMI × SL peers	-0.1455	0.0449	-0.1455	0.0178
	(0.1430)	(0.1943)	(0.2281)	(0.2291)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B10: Heterogeneity by baseline cognitive ability

Panel A: Exercising Behaviours

	Low involvement	Moderate involvement	High involvement
High baseline cog. × SF peers	0.0423	-0.0896	0.0557
	(0.0767)	(0.1139)	(0.0989)
High baseline cog. × SL peers	0.0066	-0.0254	0.0122
	(0.0797)	(0.1215)	(0.1065)
Obs.	5022	5022	5022

Panel B: Physical health

	Obesity	Overweight & Obese	Underweight	Abnormal weight
High baseline cog. × SF peers	-0.0585	-0.0233	0.0419	0.0186
	(0.0614)	(0.0765)	(0.0669)	(0.0678)
High baseline cog. × SL peers	-0.1375**	-0.0803	0.0012	-0.0791
	(0.0681)	(0.0812)	(0.0734)	(0.0757)
Obs.	5022	5022	5022	5022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
High baseline cog. × SF peers	-0.2283	-0.1377	-0.2006	-0.0575
	(0.2054)	(0.1837)	(0.2212)	(0.2170)
High baseline cog. × SL peers	-0.0441	0.2260	0.1293	0.2348
	(0.2099)	(0.2024)	(0.2355)	(0.2313)
Obs.	5016	5010	5011	5015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
high baseline cog. × SF peers	0.1749	0.2358	0.1340	0.3107
	(0.1344)	(0.1608)	(0.2098)	(0.2264)
High baseline cog. × SL peers	0.1071	0.1111	0.1986	0.7113***
	(0.1463)	(0.1794)	(0.2254)	(0.2255)
Obs.	4956	4956	4956	5006

Notes: Only interaction term coefficients are reported. Standard errors in parentheses, clustered at the class level. SF peers: sports-favouring peers; SL peers: sports-loving peers.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B11: Heterogeneity by own sports preference

Panel A: Exercising behaviours

	Low involvement	Moderate involvement	High involvement	
Sports liking × SF peers	0.0922	−0.0805	−0.0106	
	(0.1108)	(0.1401)	(0.1021)	
Sports liking × SL peers	−0.0334	0.0292	−0.0034	
	(0.1044)	(0.1514)	(0.1231)	
Observations	5,022	5,022	5,022	

Panel B: Physical health

	Obesity	Overweight or obese	Underweight	Abnormal weight
Sports liking × SF peers	0.0391	0.0196	−0.0692	−0.0496
	(0.0807)	(0.0953)	(0.0888)	(0.0712)
Sports liking × SL peers	−0.1163	−0.1462	−0.0546	−0.2008**
	(0.0978)	(0.1146)	(0.1046)	(0.0889)
Observations	5,022	5,022	5,022	5,022

Panel C: Mental health

	Depressed	Do not want to live	Feel helpless	Feel cared for & loved
Sports liking × SF peers	0.1502	0.0990	−0.2512	0.3901
	(0.2537)	(0.2300)	(0.2869)	(0.2571)
Sports liking × SL peers	0.0765	0.2345	−0.1226	0.2298
	(0.2648)	(0.2447)	(0.3038)	(0.2780)
Observations	5,016	5,010	5,011	5,015

Panel D: Cognitive ability and learning time

	Comp. analytical test	General analytical test	Math analytical test	Learning time
Sports liking × SF peers	−0.0804	0.1398	−0.2059	0.2159
	(0.1519)	(0.2287)	(0.2486)	(0.2546)
Sports liking × SL peers	−0.2915*	0.2038	−0.6594***	0.2345
	(0.1544)	(0.2247)	(0.2490)	(0.2774)
Observations	4,956	4,956	4,956	5,006

Notes: Only the coefficients on the interaction terms are reported. Sports liking is an indicator for the student's own liking for sports in Grades 5–6. SF peers: share of sports-favouring peers; SL peers: share of sports-loving peers. Standard errors clustered at the class level in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B12: Effects of male and female peers' liking of sports, by student gender

	Male peers' liking of sports	Male peers' liking of sports × Male	Female peers' liking of sports	Female peers' liking of sports × Male	Obs.
	(1)	(2)	(3)	(4)	(5)
Panel A: Physical activity					
Low exercise frequency	−0.0076	0.0253	−0.0191	0.0383	5,022
	(0.0315)	(0.0300)	(0.0289)	(0.0334)	
Moderate exercise frequency	−0.0015	0.0128	0.0510	−0.0094	5,022
	(0.0432)	(0.0498)	(0.0401)	(0.0556)	
High exercise frequency	0.0089	−0.0337	−0.0321	−0.0243	5,022
	(0.0351)	(0.0420)	(0.0303)	(0.0460)	
Panel B: Weight status					
Obese	−0.0329	−0.0220	−0.0104	−0.0086	5,022
	(0.0231)	(0.0261)	(0.0209)	(0.0296)	
Overweight	0.0196	0.0328	−0.0104	0.0094	5,022
	(0.0230)	(0.0259)	(0.0207)	(0.0295)	
Abnormal weight	−0.0116	−0.0123	−0.0127	−0.0178	5,022
	(0.0248)	(0.0265)	(0.0236)	(0.0298)	
Underweight	0.0017	−0.0230	0.0081	−0.0186	5,022
	(0.0258)	(0.0274)	(0.0251)	(0.0305)	
Panel C: Mental health					
Depressed	0.0988	−0.0076	−0.0585	−0.0039	5,016
	(0.0772)	(0.0794)	(0.0740)	(0.0918)	
Do not want to live	0.0039	0.0377	−0.0366	0.1325	5,010
	(0.0795)	(0.0864)	(0.0629)	(0.0965)	
Feel helplessness	0.0940	−0.0272	−0.0134	0.0866	5,011
	(0.0816)	(0.0868)	(0.0701)	(0.0986)	
Feeling cared for and loved	−0.0405	0.0886	0.0021	−0.0187	5,015
	(0.0740)	(0.0796)	(0.0675)	(0.0877)	
Panel D: Cognitive ability					
Comprehensive analytical ability	0.0084	−0.0134	−0.0224	−0.0062	4,956
	(0.0502)	(0.0486)	(0.0465)	(0.0554)	
General analytical ability	−0.1072	0.0495	0.0612	0.0951	4,956
	(0.0685)	(0.0705)	(0.0619)	(0.0805)	
Mathematical analytical ability	0.1014	−0.0167	−0.0094	−0.0530	4,956
	(0.0839)	(0.0799)	(0.0739)	(0.0896)	
Panel E: Study time					
Study time (excl. class and tutoring)	−0.2202**	0.0275	−0.1516**	0.0809	5,006
	(0.1061)	(0.0944)	(0.0714)	(0.1036)	

Notes: Each row reports estimates from a separate regression. Male (female) peers' liking of sports is the leave-one-out average of grade 5–6 liking of sports (a four-point Likert-scale categorical variable) among classmates. All regressions include the same controls and fixed effects as the main specification. Standard errors are clustered at the class level and reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B13: Sample Construction

Step	Sample restriction	No. of students	No. of classes	Students per class
(1)	Original survey sample	19,080	1,052	18
(2)	Students with measure on pre-high-school sports tendency	14,467	1,481	10
(3)	Students without reporting experiences of attending advanced classes	12,433	1,388	9
(4)	Schools without adjusting class assignments and grouping teaching based on students' ability	4,266	486	9
(6)	Final estimation sample (Non-missing outcome and control variables)	2,511	417	6

Notes: Each row applies the restriction cumulatively to the sample in the previous row. Classes are identified by the combination of school ID and class ID. "Students per class" is the average number of students per class in the sample at each step.

Table B14: Attrition check: demographic characteristics

	Final sample		Excluded			
	Mean	S.D.	Mean	S.D.	Std. diff.	p-value
Family income	2.8880	0.4832	2.9043	0.6229	−0.0345	0.0915
Highest parental education	2.2686	1.0184	2.1053	0.9827	0.1990	0.0000
No parental serious illness before high school	0.9705	0.1692	0.9676	0.1770	0.0201	0.3591
No parental mental illness before high school	0.9928	0.0844	0.9915	0.0919	0.0182	0.3785
No parental alcoholism before high school	0.9928	0.0844	0.9924	0.0869	0.0061	0.7805
Age	17.4181	0.5614	17.4207	0.5731	−0.0055	0.8038
Gender (1 = male)	0.5062	0.5001	0.4857	0.4998	0.0496	0.2416
Pre-school cognitive performance	0.7134	0.2458	0.6805	0.2617	0.1562	0.0000

Notes: Std. diff. is the raw standardised difference between retained and excluded observations. The p-value is from regressions of each characteristic on an indicator for being retained in the final sample, with standard errors clustered at the class level.

Table B15: Effects of the share of sports-favouring and sports-loving peers on physical activity, weight status and cognitive outcomes

	Share of sports-favouring peers (1)	Share of sports-loving peers (2)	Obs. (3)
Panel A: Weekly frequency of sweat-inducing exercise			
Less than once	−0.0958**	−0.0525	5,022
	(0.0465)	(0.0436)	
About once	0.0422	−0.0034	5,022
	(0.0562)	(0.0583)	
2–3 times	0.1004	0.2518**	5,022
	(0.0904)	(0.1034)	
4–5 times	−0.0596	−0.1513*	5,022
	(0.0702)	(0.0805)	
6–7 times	−0.0344	−0.1085**	5,022
	(0.0429)	(0.0452)	
8 times or more	0.0472	0.0641	5,022
	(0.0397)	(0.0445)	
Panel B: Physical activity			
Low exercise frequency	−0.0553	−0.0552	5,022
	(0.0550)	(0.0588)	
Moderate exercise frequency	0.1046	0.2518**	5,022
	(0.0900)	(0.1034)	
High exercise frequency	−0.0435	−0.1933**	5,022
	(0.0754)	(0.0872)	
Panel C: Weight status			
Obese	−0.1092**	−0.0682	5,022
	(0.0477)	(0.0571)	
Overweight	−0.0072	0.0445	5,022
	(0.0527)	(0.0612)	
Abnormal weight	−0.0967*	−0.0638	5,022
	(0.0550)	(0.0628)	
Underweight	0.0197	−0.0401	5,022
	(0.0532)	(0.0620)	
Panel D: Cognitive ability			
Comprehensive analytical ability	−0.1060	0.0580	4,956
	(0.1191)	(0.1326)	
General analytical ability	0.0866	0.2176	4,956
	(0.1425)	(0.1656)	
Mathematical analytical ability	−0.2007	−0.0189	4,956
	(0.1817)	(0.2044)	
Panel E: Study time			
Study time (excl. class and tutoring)	−0.1532	−0.4449**	5,006
	(0.1922)	(0.1980)	

Notes: Each row reports the coefficients from one OLS regression of the outcome on the shares of classmates who reported a medium (sports-favouring) or high (sports-loving) liking for sports in Grades 5–6; the share of sports-averse peers is the omitted category. All regressions control for school type-school-track fixed effects. Standard errors clustered at the class level in parentheses. $^{*}\,p < 0.1$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$.

Table B16: Effects of the share of sports-favouring and sports-loving peers on mental health

	Share of sports-favouring peers (1)	Share of sports-loving peers (2)	Obs. (3)
Depressed	−0.2123	−0.2856	5,016
	(0.1738)	(0.1764)	
Do not want to live	−0.1519	−0.1501	5,010
	(0.1458)	(0.1711)	
Feel helplessness	0.1507	0.0911	5,011
Feeling cared for and loved	0.2089	0.1349	5,015

Notes: Each row reports the coefficients from one OLS regression of the outcome on the shares of classmates who reported a medium (sports-favouring) or high (sports-loving) liking for sports in Grades 5–6; the share of sports-averse peers is the omitted category. All regressions include the full set of individual, family, teacher and school controls. Standard errors clustered at the class level in parentheses.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figures

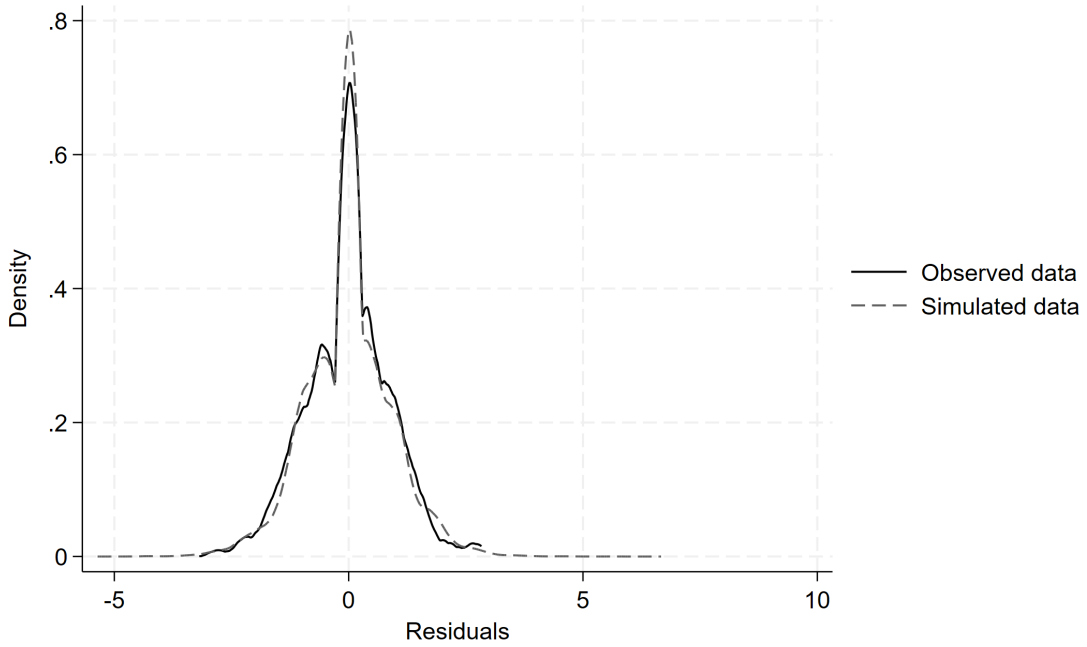


Figure B1: Actual and simulated variations in the number of peers who dislike sports

Notes: This figure compares the distribution of the number of classmates who disliked sports in Grades 5–6 in the observed data with that obtained under simulated random assignment. The solid line plots the kernel density of the residuals from a regression of the number of peers who dislike sports on school and track fixed effects in the observed data. The dashed line plots the corresponding density from simulated data, in which students are randomly reassigned to classes while holding class sizes fixed, repeated 1,000 times.

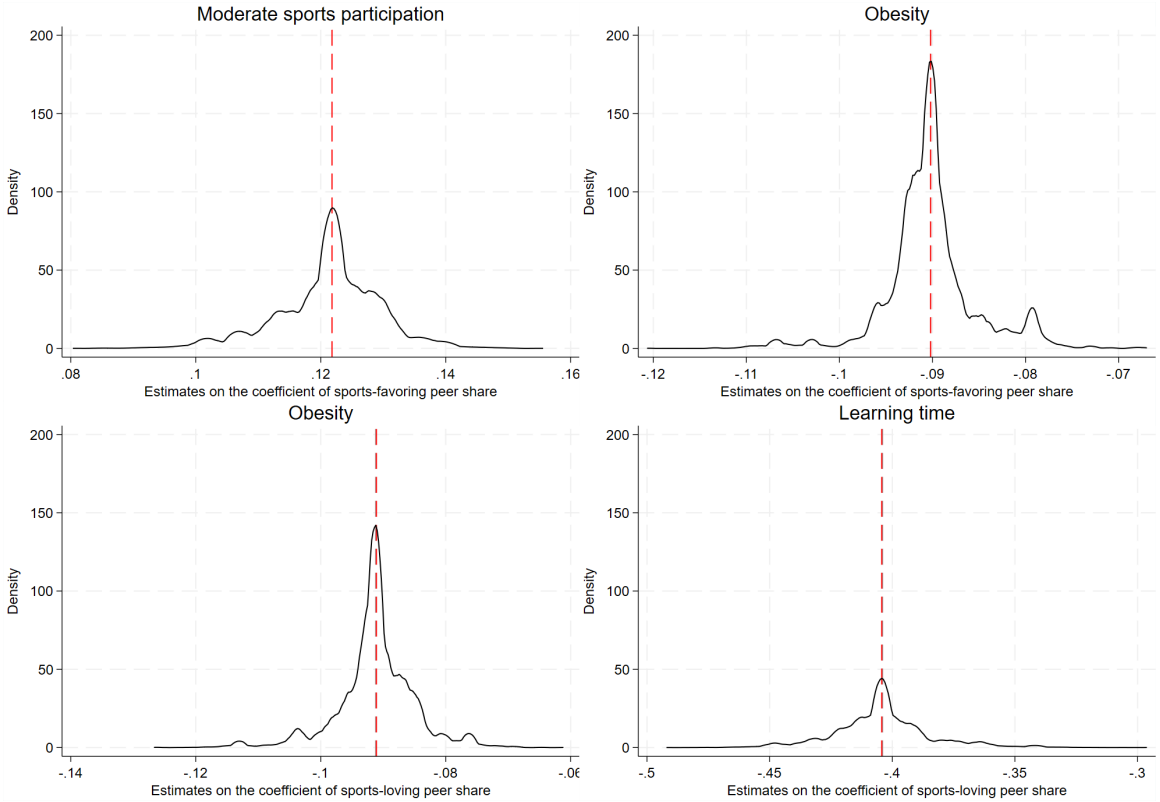


Figure B2: Distribution of estimates after randomly dropping schools

Notes: This figure examines whether the main estimates are driven by a small number of schools. In all panels, the estimates are tightly concentrated around the baseline estimates, suggesting that our results are not driven by any particular subset of schools.

C Appendix for chapter 3

Table C1: 15-item Big Five scale

Personality traits	Statements in CFPS
Conscientiousness	1. I do a thorough job.
Conscientiousness	7. I tend to be lazy (reverse coded).
Conscientiousness	11. I do things efficiently.
Extraversion	2. I am talkative.
Extraversion	8. I am outgoing and sociable.
Extraversion	12. I am reserved (reverse coded).
Openness	4. I am original and come up with new ideas.
Openness	9. I value artistic experiences.
Openness	14. I have an active imagination.
Agreeableness	3. I am sometimes rude to others (reverse coded).
Agreeableness	6. I have a forgiving nature.
Agreeableness	13. I am considerate and kind to almost everyone.
Neuroticism	5. I worry a lot.
Neuroticism	10. I get nervous easily.
Neuroticism	15. I am relaxed and handle stress well (reverse coded).

Table C2: 20-item Center for Epidemiologic Studies Depression (CES-D) scale

No.	Statements in CFPS
1	I was bothered by things that usually don't bother me.
2	I did not feel like eating; my appetite was poor.
3	I felt that I could not shake off the blues, even with help from my family or friends.
4	I felt I was just as good as other people (reverse coded).
5	I had trouble keeping my mind on what I was doing.
6	I felt depressed.
7	I felt that everything I did was an effort.
8	I felt hopeful about the future (reverse coded).
9	I thought my life had been a failure.
10	I felt fearful.
11	My sleep was restless.
12	I was happy (reverse coded).
13	I talked less than usual.
14	I felt lonely.
15	People were unfriendly.
16	I enjoyed life (reverse coded).
17	I had crying spells.
18	I felt sad.
19	I felt that people disliked me.
20	I could not get "going".

Table C3: Questions on respondents' trust

No.	Question
1.	Generally speaking, would you say that most people can be trusted or that you can't be too careful when dealing with others?
2.	How much do you trust your parents?
3.	How much do you trust your neighbours?
4.	How much do you trust Americans?
5.	How much do you trust strangers or people you meet for the first time?
6.	How much do you trust local government officials?
7.	How much do you trust doctors?

Table C4: Risk aversion survey inventories

Number of experiment	Option 1	Option 2
1	Toss a coin, if it is the front of the coin, get 200 yuan; if it is the back, get nothing	Directly get 100 yuan
2	Toss a coin, if it is the front of the coin, get 200 yuan; if it is the back, get nothing	Directly get 80 yuan
3	Toss a coin, if it is the front of the coin, get 200 yuan; if it is the back, get nothing	Directly get 50 yuan
4	Toss a coin, if it is the front of the coin, get 200 yuan; if it is the back, get nothing	Directly get 120 yuan
5	Toss a coin, if it is the front of the coin, get 200 yuan; if it is the back, get nothing	Directly get 150 yuan

Table C5: Risk aversion variable construction

Risk Aversion Level	Response Pattern
1 (Least risk averse)	Q1: Option 1 & Q4: Option 1 & Q5: Option 2
2	Q1: Option 2 & Q4: Option 2
3	Q1: Option 2 & Q2: Option 1
4	Q1: Option 2 & Q2: Option 2 & Q3: Option 1
5 (Most risk averse)	Q1: Option 2 & Q2: Option 2 & Q3: Option 2

Table C6: IV estimates and inclusion of provincial income controls

	(1)	(2)	(3)	(4)	(5)
Panel A. Inclusion of real provincial GDP in 1998 and its interactions					
	Conscien-tiousness	Extra-version	Agreeable-ness	Openness	Neuroticism
HE	1.0041***	−0.5189	0.6428	−0.2363	0.7944
	(0.3392)	(0.3318)	(0.4439)	(0.3517)	(0.5862)
Observations	4079	4079	4079	4079	4079
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.6830	−0.6054*	−1.1499***	−0.5108	−1.0467**
	(0.8186)	(0.3449)	(0.3374)	(0.3724)	(0.4855)
Observations	3343	2611	3348	3348	3353
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.4061	−1.1514***	0.3261	−0.2783	−0.4053
	(0.5179)	(0.4397)	(0.3800)	(0.6905)	(0.4570)
Observations	3356	3353	3355	3345	3355
Panel B. Inclusion of real provincial GDP in 1995 and its interactions					
	Conscien-tiousness	Extra-version	Agreeable-ness	Openness	Neuroticism
HE	0.9892***	−0.5298	0.6005	−0.2155	0.8096
	(0.3338)	(0.3309)	(0.4373)	(0.3444)	(0.5835)
Observations	3356	3356	3356	3356	3356
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.7298	−0.6020*	−1.1688***	−0.5150	−1.0467**

Continued on next page

Table C6: IV estimates and inclusion of provincial income confounders (continued)

	(1)	(2)	(3)	(4)	(5)
	(0.8295)	(0.3450)	(0.3410)	(0.3784)	(0.4855)
Observations	3351	2618	3356	3356	3353
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.4061	−1.1514***	.	.	.
	(0.5179)	(0.4397)	(0.3800)	(0.6905)	(0.4570)
Observations	3356	3353	3355	3345	3355

Panel C. Inclusion of real provincial GDP in 1994 and its interactions

	Conscien-tiousness	Extra-version	Agreeable-ness	Openness	Neuroticism
HE	0.9872***	−0.5198	0.5980	−0.2164	0.8030
	(0.3332)	(0.3323)	(0.4362)	(0.3457)	(0.5834)
Observations	3358	3358	3358	3358	3358
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.7200	−0.5978*	−1.1590***	−0.5084	−1.0487**
	(0.8270)	(0.3450)	(0.3427)	(0.3773)	(0.4865)
Observations	3353	2619	3358	3358	3355
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.4006	−1.1450***	0.3282	−0.2831	−0.4158
	(0.5195)	(0.4390)	(0.3827)	(0.6916)	(0.4605)
Observations	3358	3355	3357	3347	3357

This table reports the results of the instrumental variable estimates

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C7: Heterogeneity by gender

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	1.1069***	−0.7793*	1.0636	−0.3318	0.7991
	(0.4030)	(0.4342)	(0.7012)	(0.6039)	(0.6741)
HE×Gender	−0.8960	0.5404	−1.8716**	0.1950	−0.8526
	(0.5750)	(0.6219)	(0.7435)	(0.8735)	(0.7453)
Observations	4083	4083	4083	4083	4083
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.2069	−0.2050	−1.0006*	−0.0735	−0.7410
	(0.4718)	(0.4163)	(0.5121)	(0.7492)	(0.5674)
HE×Gender	−1.6175**	−1.2055	0.2691	−0.8532	0.4643
	(0.7044)	(0.9855)	(0.7425)	(1.1810)	(0.8022)
Observations	4077	3210	4083	4083	4080
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.2106	−0.3849	0.1625	0.0230	−0.6737*
	(0.4010)	(0.4896)	(0.3424)	(0.4080)	(0.4087)
HE×Gender	−0.2074	−0.8946	−0.0313	0.8203	1.2000
	(0.4992)	(0.7481)	(0.5147)	(1.1996)	(0.9157)
Observations	4083	4080	4082	4072	4082

Notes: This table reports the results of the instrumental variable estimates for heterogeneity by gender.

$^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table C8: Heterogeneity by major

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.2296	−0.6796	0.3867	0.1809	0.9166
	(0.5906)	(0.5288)	(0.9115)	(0.4725)	(0.6793)
HE×STEM	0.9525	0.1459	−0.6162	−1.1821	−0.9270
	(0.7961)	(0.4354)	(0.9346)	(0.7505)	(0.5691)
Observations	4015	4015	4015	4015	4015
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	−1.1137**	−0.8413**	−0.9775**	−0.5528	−1.1591
	(0.4773)	(0.3300)	(0.4594)	(0.4942)	(0.7893)
HE×STEM	1.0630	0.0132	0.2432	0.2404	1.4273
	(0.6588)	(0.8425)	(0.6435)	(0.7637)	(1.0110)
Observations	4009	3153	4015	4015	4012
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.7005	−0.5222	−0.0620	0.7046	−0.4244
	(0.6867)	(0.8163)	(0.3963)	(0.4740)	(0.3951)
HE×STEM	0.8038	−0.5672	0.3255	−0.6336	0.8131
	(0.7259)	(1.5331)	(0.5912)	(0.9566)	(0.7146)
Observations	4015	4012	4014	4004	4014

Notes: This table reports the results of the instrumental variable estimates for heterogeneity by major.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C9: Excluding samples who experienced the Cultural Revolution

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	1.0319***	−0.4644	0.5631	−0.1442	0.8092
	(0.3970)	(0.4179)	(0.5107)	(0.3703)	(0.6328)
Observations	2827	2827	2827	2827	2827
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.4928	−0.6592*	−1.1940***	−0.6014*	−1.0885**
	(0.7911)	(0.3408)	(0.3314)	(0.3344)	(0.4308)
Observations	2823	2195	2827	2827	2824
Panel C. Effects on trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.4632	−1.1909**	0.0396	−0.3531	−0.5785
	(0.5293)	(0.4727)	(0.4511)	(0.7350)	(0.5298)
Observations	2827	2824	2826	2818	2826

Notes: This table reports instrumental variable estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table C10: Adding more controls

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.9536**	−0.3272	0.5619	−0.2918	−0.1017
	(0.4702)	(0.6293)	(0.6682)	(0.4957)	(0.6672)
Observations	1458	1458	1458	1458	1458
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.4727	−0.5655	−1.3830**	0.1600	−0.5996
	(0.7198)	(0.6621)	(0.5729)	(0.6276)	(0.7199)
Observations	1456	1121	1458	1458	1456
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.6902	−0.5165	0.8515	−0.9111	−1.1377**
	(0.6958)	(1.0171)	(0.7496)	(0.8565)	(0.5557)
Observations	1458	1456	1458	1454	1458

Notes: This table reports instrumental variable estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table C11: Clustering at the province-cohort level

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.7520***	−0.1928	0.4437*	0.1367	0.6555
	(0.1158)	(0.3553)	(0.2357)	(0.3440)	(0.4106)
Observations	4083	4083	4083	4083	4083
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	0.9774	−0.6861***	−1.1058***	−0.5672*	−1.0340***
	(0.8000)	(0.2102)	(0.2731)	(0.3327)	(0.2647)
Observations	4077	3210	4083	4083	4080
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.5120	−1.1294***	0.4366	−0.3282	−0.5194
	(0.5418)	(0.2314)	(0.3489)	(0.5522)	(0.3265)
Observations	4083	4080	4082	4072	4082

Notes: This table reports instrumental variable estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table C12: Excluding samples who have moved across provinces

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.9169***	−0.1534	0.5277**	0.0191	0.6950
	(0.1198)	(0.4212)	(0.2324)	(0.4385)	(0.4771)
Observations	3897	3897	3897	3897	3897
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	1.0506	−0.6933***	−0.9756***	−0.5866*	−1.3451***
	(1.0615)	(0.2267)	(0.3291)	(0.3508)	(0.3889)
Observations	3891	3062	3898	3898	3897
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	−0.3507	−1.2900***	0.1847	−0.4363	−0.6282*
	(0.5704)	(0.4650)	(0.4353)	(0.5559)	(0.3804)
Observations	3899	3896	3898	3889	3899

Notes: This table reports instrumental variable estimates. All the panels control for individual gender, age, father's highest education, mother's highest education, father's political status at the age of 14 for individuals, mother's political status at the age of 14 for individuals, provincial teacher-student ratio in HEIs, and individual birthweight. Standard errors are clustered at the province level and reported in parentheses.

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Table C13: Heterogeneous IV Estimates: University vs. Vocational College Graduates

	(1)	(2)	(3)	(4)	(5)
Panel A. Effects on personalities					
	Conscientiousness	Extraversion	Agreeableness	Openness	Neuroticism
HE	0.3679**	-0.1212	0.2266	0.1119	0.5118
	(0.1530)	(0.2250)	(0.2232)	(0.3006)	(0.3818)
HE × Vocational	-0.2202*	0.0415	-0.1751	-0.0681	-0.3705
	(0.1167)	(0.1544)	(0.1569)	(0.1901)	(0.2847)
Observations	4,083	4,083	4,083	4,083	4,083
Panel B. Effects on mental health, risk aversion, confidence, life satisfaction and general trust					
	Depression (CES-D)	Risk aversion	Confidence	Life satisfaction	General trust
HE	2.9065	-0.8784**	-1.1030***	-0.5706**	-1.0657**
	(2.7208)	(0.3978)	(0.3168)	(0.2890)	(0.4144)
HE × Vocational	-1.8822	0.4482	0.5774**	0.3218*	0.7214**
	(1.8978)	(0.2871)	(0.2474)	(0.1812)	(0.3360)
Observations	4,077	3,210	4,083	4,083	4,080
Panel C. Effects on group trust					
	Trust in parents	Trust in neighbors	Trust in strangers	Trust in officials	Trust in doctors
HE	-0.5387	-1.1558**	0.4118	-0.3676	-0.5401
	(0.4997)	(0.4744)	(0.3352)	(0.6770)	(0.5189)
HE × Vocational	0.4095	0.7648**	-0.1054	0.3622	0.3744
	(0.3228)	(0.3569)	(0.2192)	(0.4718)	(0.3954)
Observations	4,083	4,080	4,082	4,072	4,082

Notes: Each column reports 2SLS estimates with two endogenous variables: a dummy for holding a higher education degree (HE) and its interaction with a vocational college indicator, instrumented by provincial HE expansion and its interaction with the vocational indicator. The coefficient on HE is the effect for university graduates; the coefficient on the interaction is the difference between vocational college and university graduates, so the effect for vocational college graduates is the sum of the two. Confidence about future, life satisfaction, general trust and all group trust measures are standardized. Sample restricted to respondents aged 24–48 in 2018. All regressions include individual and family controls. Standard errors clustered at the province level in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figures

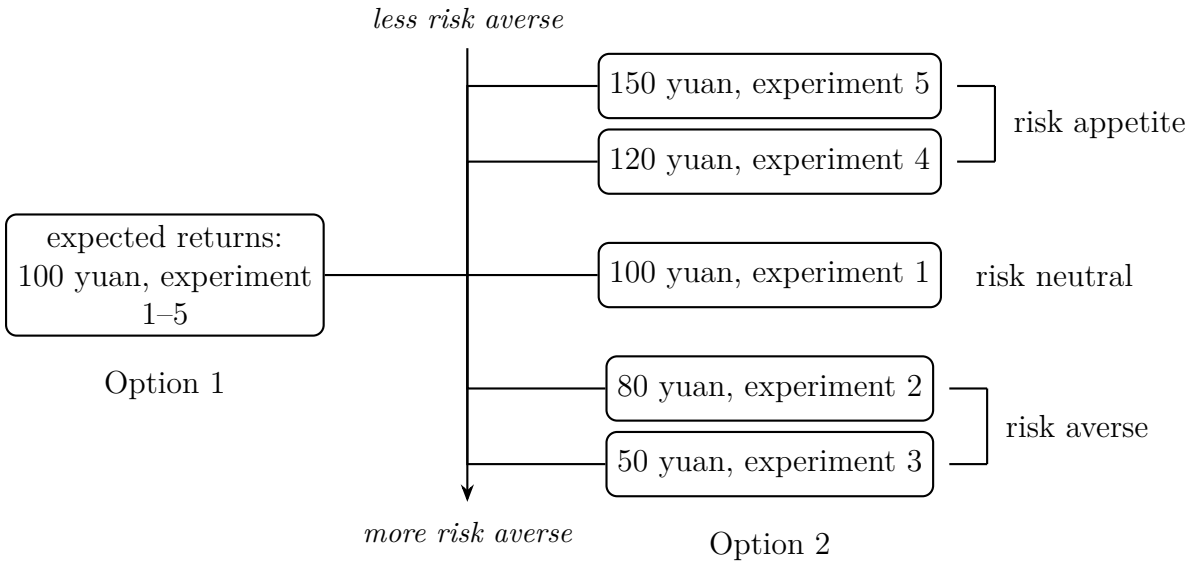


Figure C1: Measurement of risk preference

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