Gender gaps in achievement has been a predominant policy concern in public education across the world.

disparities lead to detrimental impacts in academic performance and later life outcomes, specifically for girls (Sansone, 2019; Terrier, 2020). Studies have attempted to understand the gender gap in school by examining student-teacher gender matching (Dee, 2007; Sansone, 2017), and many find a significant positive relationship of having a female-identifying teacher for girls, especially in middle school – the age that students tend to internalize gender stereotypes (Gong et al., 2018; Lim and Meer, 2017; Xu and Li, 2018). Few of these papers, however, have explored this relationship causally.

This paper uses causal inference to examine teacher-gender matching by leveraging a unique policy change: in 2006, China’s Compulsory Education Law banned the sorting of students to teachers based on teacher performance. To comply, schools randomly assign a teacher group to each randomized student homeroom. Students in the same homeroom share a schedule, and teachers rotate to the homeroom to teach. Students and teachers typically stay in assigned homerooms as students rise to higher grades throughout all years at the same school. The China Education Panel Survey (CEPS), China’s first nationally representative, longitudinal survey of middle school students starting in the 2013-14 academic year, meticulously collected this data at the student-, teacher- and administrator-levels.

Using CEPS, Gong et al. (2018) and Xu & Li (2018) find that female students matched with female teachers receive a midterm score that is over 0.5 standard deviations higher relative to boys for both English and Chinese. However, there is one key drawback in these findings: while these studies begin to address gaps in gender equity, they conduct their analysis of male and female students without adjusting for baseline differences in performance, thus overlooking the interaction of gender and over-inflating its impact on results.

**Research Question**

Using CEPS data, this paper addresses the following question: What is the causal impact of teachers’ gender and gender matching on student learning outcomes and beliefs, taking into account different baseline scores by gender?

**Significance**

Our study contributes to a rigorous literature body that examines the causal impact of teacher gender matching on student academic outcomes and self-confidence. We attempt to obtain precise estimates of teacher effects in three ways. First, given random assignment enforced by national policy, we are able to use between-teacher variation to estimate internally valid teacher effects (see Ladd and Sorensen, 2017; Papay and Kraft, 2015). Second, we model teacher gender and gender matching separately to understand the role both gender effect and gender matching play on student outcomes. Third, we control for school fixed-effects to account for systematic differences across schools and a rich set of student-, homeroom-, and teacher-level covariates to improve estimation precision (see Chetty et al., 2014; Kraft, 2019). Here, the most important to note is the cubic polynomial functions of four scores (in three core content subjects and cognitive test) in prior years that effectively absorb noise from individual learning ability.

**Data**

***Sample.*** We draw our sample from the nationally representative China Education Panel Survey (see Appendix A Data Description). We focus on baseline 7th grade students who were successfully followed up in 2014-15 (follow-up rate 91.93%) and restrict the sample to 63 public schools that successfully enforced random assignment of teachers and assigned homerooms to students. We do not consider across-school sorting because school fixed effects absorb any time-invariant factors that drive students sorting in or out of school.

We obtain three separate samples by matching students with their Chinese, English, and math teachers. We dropped all observations that had any missing predictor or outcome variables and replaced missing values on other variables with leave-one-out mean within homeroom (for student variables) or school (for teacher variables). We are left with 4,945, 4,962, and 5,016 students in Chinese, English, and math samples, respectively. Summary statistics of key variables are presented in Table 1, with teacher-student gender matching and student gender shown in Figure 1.

***Measures***. For each subject, student academic outcomes are measured using two variables: student’s score on the school-administered mid-fall semester exam and self-reported confidence level, measured on a four-point Likert scale, ranging from very difficult to not difficult at all. Both are standardized to have a mean of zero and standard deviation (SD) of one within each school. Teacher background and demographic information were collected from the teacher survey. Control variables were included at the student, teacher, and school level.

**Methods**

Following Xu and Li (2018) and Garrett and Steinberg (2015), we conduct a student baseline covariates balance check by regressing the predictor variable (*female teacher*) against student covariates while controlling for school fixed effects and clustering standard errors at school level and present results in Table 2. We do the same for the predictor variable *gender match*. The covariates balance check on teacher pre-treatment characteristics confirm that student sorting is highly unlikely.

Provided random assignment, we argue that the variation in teacher characteristics is independent from any observed and unobserved factors that also impact student outcomes. We recover the causal impact of teacher gender matching by estimating ordinary least squares (OLS) regression models to estimate both test score and confidence level.

**Findings**

***Gender effects in Chinese and English.*** Naive results in Table 3 find a significant effect of teacher gender on student test scores and confidence for all main subjects, Chinese (*SD=*0.176), English (*SD=*0.091) and math (*SD=*-0.081). However, as girls outperform boys to begin with in Chinese and English, we find that teacher-student gender match does not differentially impact boys or girls in either of these subjects, for both test score (see Table 4) and subject confidence (see Table 5).

***Gender effects in math.*** We find that teacher gender match in math leads to 0.178 standard deviation increase in test score for girls, controlling for all other covariates. There are no significantly different effects for boys or for confidence level (see Table 4 & 5). These are important findings in understanding the relationship between gender equity and academic achievement, supporting the motivational theory of role modeling.