Head teachers, peer effects, and student achievement

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ABSTRACT

Teachers can influence student achievement, not only directly, but also indirectly via peer effects. Based on a unique data set from a Chinese middle school (grades 7–9), this paper uses a student fixed-effects model to estimate peer effects for four core subjects (Chinese, Math, English, and Science) at the level of the class cohorts studying each subject. We find negative peer effects that are significant from both an economic and a statistical perspective. However, in the subjects taught by head teachers, who have more tools to manage students than do regular teachers, such negative peer effects disappear. Further investigation suggests that head teachers generate positive peer effects that override the negative ones.

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1. Introduction

It is well known that teachers can affect their students' achievements. Many researchers have suggested that teacher quality is an important factor in improving student achievement (e.g., Rockoff, 2004; Chu et al., 2015). Others have found that stronger teacher incentives are associated with better student performance (e.g., Figlio and Kenny, 2007; Duflo et al., 2011). At least in the cases where incentives are sufficient, teachers will make efforts to improve student achievements.

Furthermore, it is acknowledged that students' predetermined peer characteristics, such as socioeconomic status, or peer behavior, including outcomes, are another important factor in student achievement (for surveys of peer effects, see Epple & Romano, 2011; Sacerdote, 2011). Such phenomena are referred to as peer effects.

Peer effects are not static and there is increasing evidence that peer effects vary by student ability, race, socioeconomic status, and gender. In addition, research shows that peer effects for the same students with the same class arrangements can differ in different subjects (Sacerdote, 2011). This leads us to wonder whether teachers can also have an influence on student peer effects.

Some studies show that teachers play key roles in some mechanisms of peer effects (Duflo et al., 2011; Lavy, Paserman & Schlosser, 2012a). Other researchers have found evidence that teachers may have the power to intentionally influence peer effects (Li et al., 2014). If teachers cared about their students' achievements, and were aware of the impact of peer effects, then it would be weird if they did nothing to utilize the benefits of peer effects to improve student achievement. If this was the case, even the same students in the same class who are taught by different teachers may experience different peer effects.

Abbreviations: MSEEMiddle School Entrance Exam; HSEEHigh School Entrance Exam.
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Burke and Sass (2013) found that if they controlled for unobserved inputs at the teacher and school levels, then estimated peer effects were generally weaker, indicating that peer achievement may vary systematically with some teacher characteristics. However, if peer effects themselves can be influenced by teachers, then, even if peer achievement is unrelated to teacher characteristics, or if all teacher characteristics have been controlled for in a regression, the estimates of peer effects can be inconsistent and biased. To see this, consider the following typical form of a student achievement function:

$$a_i = f(F_i, P_i, C_i, T_i, S_i, a_i) = \beta_0 + \beta_1 F_i + \beta_2 P_i + \beta_3 C_i + \beta_4 T_i + \beta_5 S_i + \beta_6 a_i + u_i \tag{1}$$

where a_i is the achievement of student i and $F_i, P_i, C_i, T_i, S_i,$ and α_i represent vectors of family, peer, community, teacher, school, and personal ability inputs, respectively.

We argue that the size of peer effects (β_2) can be influenced by teachers and, thus, that they are a function of certain teacher characteristics. In such a situation, the student achievement function becomes:

$$a_i = f(F_i, P_i, C_i, T_i, S_i, \alpha_i) = \beta_0 + \beta_1 F_i + \beta_2 P_i + \beta_3 C_i + \beta_4 T_i + \beta_5 S_i + \beta_6 \alpha_i + \beta_7 P_i T_i + u_i \tag{2}$$

Obviously, if Eq. (2) is the correct form of the student achievement function, and if $P_i T_i$ is omitted from the regression, all estimates will be inconsistent and biased.

However, it is difficult to measure the impact of teachers' incentives and abilities on peer effects management, making it hard to distinguish the teachers' influence within the entire range of peer effects. In other words, because T_i is unobservable, it is almost impossible to include $P_i T_i$ in the regression. This may explain why there is virtually no research focusing on the interaction between teacher and peer effects.

Fortunately for the investigation of our research agenda, the head teachers in China's middle schools have significantly different incentives and abilities to deal with peer effects compared with regular teachers. Therefore, based on our unique micro education data from a Chinese middle school (grades 7–9), we are able to estimate the influence of head teachers on peer effects. If the head teachers have a significantly different influence on peer effects, then we can say, at the least, that some teachers, especially when they are appropriately empowered, can influence student achievement via peer effects.

As explained in Carman and Zhang (2012), students in our data set were assigned to a class at the time of entry into middle school, according to a "balanced assignment" rule (explained in more detail later in the paper), and no reassignment occurred subsequently. Every teacher taught one subject for one or two classes, and none of the teachers of the four core subjects (Chinese, Math, English, and Science) were replaced over the three-year period of our study. Hence, all students in our sample stayed with the same classmates and the same teachers, learning the same subjects, in the same classroom, for all grades over the three years of the study.

As is the case with most middle school classes in China, each class in our sample had a single head teacher, who taught one of the four core subjects and stayed with the same class for all three years. The pay of all teachers, including head teachers, is linked to the achievement in their subject of the students in the classes they teach; thus, they have strong incentives to improve student achievement with all the tools at their disposal. However, head teachers have more tools than regular teachers: they can appoint a class cadre (such as monitor, secretary of the class, leader of a learning group), arrange and rearrange student seating, organize class meetings, and contact parents directly. Therefore, it is reasonable to expect that the head teachers would have a stronger influence on peer effects than regular teachers.

Based on our comprehensive data set, we can observe who is the teacher of each subject for each class, and whether the teacher is the head teacher of the class. If teachers improve student achievement via their influence on peer effects, then we will see significantly different peer effects in the subject taught by the head teacher of the class.

We use normalized High School Entrance Exam scores (HSEE) as a student achievement measure, and normalized Middle School Entrance Exam scores (MSEE) to create our peer effects variables. These exams, which are of great importance for both schools and students, are organized citywide, which makes our variables more comparable, and there is less concern regarding measurement error or testing noise, which was emphasized by Angrist (2014) and Zhang (2016).

We have scores for all four core subjects based on these two exams for all students. Based on this, we formed a data panel[1] that allows us to estimate peer effects for all four core subjects together and to use student fixed effects to capture all subject-invariant student, family, classroom, and environment variables or common shocks. It also enables us to deal with the concern that measures of peer achievement may be proxies for omitted students, family, classrooms, or other characteristics (Fruehwirth, 2014).

Estimating peer effects for all four core subjects together allows us not only to compare the peer effects for different classes for the same subject, but also to compare the peer effects for different subjects for the same class, which will provide more information.

Part of the peer effects, such as the impact of subject-invariant peer characteristics or behaviors, will be captured by our student fixed effects, meaning that our peer effects estimators will be underestimated. However, the main goal of this paper is to determine whether some teachers have a stronger influence on peer effects than other teachers. Every student has four different

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[1] It should be emphasized that, although we are using econometric specifications, including "panel data" and "student fixed effects", the data and models we use have no time component. Instead of the usual (i,t) type panel data, our observations are of the type (i,s), where i refers to an individual and s refers to a subject. We simply treat s as t, and use the fixed-effects model to capture all subject-invariant unobservable variables.