Peer Effects, Motivation, and Academic Self-Concept of Elementary School Students

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1 Introduction

The study of peer effects is common in the current economic, sociology and psychology literature. Peer effects is the term used to label the phenomena where the behavior of an individual is influenced by the behavior of the group to which the individual belongs. Hoxby (2000) notes that economists are especially interested in these effects because in many contexts they are externalities, and if these relationships can be altered there may exist improvements of social welfare.

In the education setting, the main question asked is: what influence does a student's peer group have on the academic achievement of that student? Exploring this question can have significant impact on the allocation of resources in terms of optimal student groupings and school district organization. This increase in the efficiency of learning can have an impact on school finance.

The examination of this question goes beyond current grades or test scores. Studies in the economics literature focus on the production aspect of peer effects. Organization of students and students has important implications on social welfare and economic growth, making peer composition of interest to parents, educators and policy makers alike. Economic theory and empirical evidence have linked early academic achievement with increased educational attainment and ultimately higher average lifetime earnings. In addition, households with school-age children often make residential choices based on school systems. Benson and McMillan (1991) observe that, when questioned about residential location choice, greater than 50% of parents indicate their decision is affected by the options of public schools.

The contribution of this paper is to examine peer effects from a social aspect. Peer interactions are fundamentally social interactions that describe more than the common examples of students tutoring other students and teachers instructing more efficiently. In the classroom peers are important influences on the

motivation and academic self-concept of a student. A thorough examination of this topic includes exploring the psychology literature to provide the basis for a simple theoretical model as well as testing the effect of different peer groups on academic achievement.

This paper is organized in the following manner. Section 2 contains a brief review of the relevant economic literature on peer effects in education. Section 3 examines the psychology literature and uses it to inform a basic utility framework involving identity. Finally, section 4 describes the data to be used and the proposed analysis.

2 Literature Review

The peer effects literature in economics has covered a variety topics ranging from vouchers and school finance (Nechyba (1999), Epple and Romano (1998)) to gender or racial proportions in classrooms (Hoxby (2000)). Regardless of the specific focus, most studies address the question that centers around the influence of academic outcomes of peers on the outcome of an individual student. There are two fundamental challenges in estimating these effects. The first challenge involves the difficulty in actually identifying and estimating the desired effect. The second involves identifying exogenously formed groups.

Manski (1993) discusses the challenges with estimating peer effects. He notes that extracting the true effect of peer behavior is difficult because this behavior is clouded by other effects. He identifies three types of effects: endogenous, exogenous, and correlated effects. Endogenous effects capture the propensity of the behavior of a group to affect the behavior of an individual. Exogenous effects capture the propensity of exogenous group characteristics to affect behavior of an individual. Correlated effects capture the capture the tendency of the individual to behave similarly to the group because they share similar characteristics or environment.

Endogenous social effects are of interest because they have a social multiplier characteristic. If policy can positively change the behavior of one student, her behavior could positively affect another student's behavior and so on. The challenge of estimating these effects is based upon the simultaneous nature of the question being examined. Manski refers to this issue as "the reflection problem" because of the mirror-like problem of what the researcher observes: Does the behavior of the student determine the group behavior, or does the group behavior determine the student's behavior? If this issue is not addressed in estimation, the correct effect may not be identified.

The second main challenge involves the identification of exogenous peer groups. An individual's peer

group is oftentimes a result of non-random sorting. In the education example, there is self-selection of parents choosing schools or school districts, vying for preferred teachers, and friendship formation among classmates. This self-selection results in nonrandom peer groups, and ultimately unidentified parameters.

Hanushek et al. (2003) address both of these issues using data on Texas public elementary students. In order to avoid the reflection problem, they use lagged mean outcome of the peer group instead of the current mean outcome. Lagged peer outcomes solve the issue of simultaneity. They argue that previous academic outcomes are strong predictors of current academic outcomes. The parameters are not biased if the lagged outcome captures the variation of current outcomes. When examining the data they also note that there exists enough variation across cohorts to allow them to use fixed effects at the school and school-by-grade level. This approach is intended to eliminate any nonrandom sorting of students. Their results indicate a small positive effect of peer outcomes on academic achievement.

Hoxby (2000) uses the same Texas public elementary school data. In her approach she identifies the variation in the data through comparing differences in race and gender across cohorts. She also corrects for any grade specific time trend. The results from this strategy support a positive influence of peer groups on academic outcomes, which become stronger among groups of the same race.

One drawback of both Hoxby (2000) and Hanushek et al. (2003) is in the data used. The Texas public elementary data contains information about students at the grade level, but does not identify a student's teacher or classmates. The resulting peer group is thus defined at the grade level. At such a large level, the interpretation of their estimates becomes unclear.

Vigdor and Nechyba (2004) use a similar approach as Hanushek et al. (2003) using public school data from North Carolina. These data have identifiers for a student's teacher making it possible to determine common classmates. [1] This more specific definition of peer groups is an advantage over previous studies. They hold to the argument that most of the nonrandom sorting in elementary schools is done at the school level and not the classroom level. The authors also use the variation in student body of specific feeder schools, in which a higher change in peers occurred because of changes in school assignment policy. The results from this strategy provide no support that peer groups affect academic achievement.

[1] Classmates are students with the same teacher, not to be confused with other students in the same grade level.

3 Theoretical Model

3.1 Background

The common theme among the existing literature is to approach peer effects from a production aspect. In this sense, peer effects change the efficiency of the inputs in the production function for education. It is standard to think of peer effects including students teaching others or teachers being more efficient because of knowledge spill-overs among students. The nature of peer effects, or *social* endogenous effects, includes more than just a production aspect. It is also social in nature. This social aspect has not been given much attention in the education economics literature. In order to better understand the social working of elementary students I examine the psychology and sociology literature.

Several studies in the psychology literature support the idea that children are able to make social comparisons similar to adults in order to inform their own self-evaluation. In the classroom, this self-evaluation forms an academic self-image, or identity. Children are not only able to evaluate themselves academically, but also to compare themselves with the academic competence of their friends and classmates. Gest et al. (2005) observe that children are able to develop a judgment of classmates academic skills, and consequently mentally rank classmates. These rankings form an academic reputation for a student.

According to the self-enhancement model in psychology, self-concept of a student is an important determinant of academic achievement (Guay et al. (2003)). In a meta-analysis of self-concept and peer learning, Ginsburg-Block et al. (2006) find strong positive correlations between social self-concept and student achievement. Gest et al. (2008) examine self-concept in the educational setting of upper elementary students. They conclude that academic reputations are strong predictors of a child's academic self-concept, effort and performance. In their research they note that "having a positive academic reputation may be associated with having academic successes recognized and remembered by peers, being approached more often for academic help, and affiliating with other classmates perceived as high achieving. Conversely, having a negative academic reputation may be associated with having academic failures noticed, being pointedly excluded from tasks requiring academic expertise, and affiliating with other classmates perceived as low achieving."

Motivation and effort are also important in both the formation and effects of peer groups. Kindermann (1993) examines the relationship between social groups and motivation levels in upper elementary classrooms. He notes that student motivational orientation is a function of both the similarity between his peer group and his non-peer-group classmates. He finds that peer groups have important implications on a student's motivation and that students tend to gravitate towards classmates with similar levels of motivation and

effort.

These studies provide information that can inform the approach of economists when analyzing peer effects. There are several important conclusions from these studies. First, students gain utility from higher academic success and also being associated with students of higher academic success. Secondly, students even at a young age are able to make social comparisons and rank the academic ability of classmates. These associations and rankings help to form a student's academic self-image and reputation. Thirdly, effort levels have an influence on the groups in which students choose to associate.

3.2 A Model with Identity

The above discussion of the psychology literature notes that self-image, or identity, is an important aspect of the workings of peer groups. The relevance of this aspect may help to explain why traditional peer effects specifications may not fully describe academic outcomes.

Akerlof and Kranton (2000) model economic behavior as a function of self-image. In their 2002 article, they apply this model to describe social networks of high school students based upon Coleman's (1961) description of jocks, nerds, and burn-outs. In their model they introduce identity in the utility function. Identity is defined as the utility gained from being associated, or being identified, with a certain group. I use this framework to describe the behavior of elementary students. This section contains the beginnings of a model attempting to describe the social aspect of peer groups.

In this model students gain utility from their academic identity. Gains and losses in utility are primarily from changes in academic identity. A student's utility is also dependent upon how well they match within peer groups and the effort they put forth. Identity is derived from two sources: a student's academic reputation relative to the entire class, and his/her academic position within a smaller group of students with which they identify.

3.2.1 Identity from position relative to the entire class

This portion of the utility function follows closely from Akerlof and Kranton (2002). For simplicity, assume students recognize three broad academic achievement categories, c, for high, moderate, and low achievement, $c = \{H, M, L\}$. These categories represent the social aspect rather than the production aspect of achievement. The utility gained from being associated with these groups comes from the identity, I_c, gained from being in the group. Students gain higher utility from being associated with groups of higher achievement, $I_H > I_M > I_L$. Each student i has an exogenous match value c_i indicating how well i matches with category c, where

$c_i = \{h_i, m_i, l_i\}$. The match values h_i, m_i, and l_i are positive and sum to one. The prescribed [2] or ideal match values for each category are $\bar{h} = 1$, $\bar{m} = 1$, and $\bar{l} = 1$ for the respective categories. For example, these values could represent how well a student matches with the ideal ability or socioeconomic characteristics of a category.

There is a social cost to the student for choosing a category in which he is not well suited. The loss in utility from being different from the group is represented by the distance between the match value and the ideal value,

$$\tau\left(\bar{c} - c_i\right) \tag{1}$$

where τ is a parameter scaling the utility loss from being different. It measures how difficult it is for students with different exogenous characteristics to fit into group c.

Each category also has a prescribed effort level, $e\left(c\right)$, with $e\left(H\right) > e\left(M\right) > e\left(L\right)$. The ideal effort level includes more than just the effort required to study and obtain a specific grade level. It also encompasses the effort needed to participate in other activities of the category. For example, to fit in with the high achievement category a student might need to exert effort to participate in music lessons, spelling bees, etc. There is a loss in utility from deviating from the prescribed effort level for each category,

$$\left(e_i - e\left(c\right)\right)^2 \tag{2}$$

Each student i simultaneously chooses effort and a category in which to belong. The portion of utility received from identity relating to the entire class is the identity, I_c gained from association with the category, minus the disutility from being different (1) and from any deviation from the prescribed effort level (2):

$$U_i^c\left(e_i\right) = I_c - \tau\left(1 - c_i\right) - \left(e_i - e\left(c\right)\right)^2 \tag{3}$$

3.2.2 The utility gained from the group

Students may also identify with a smaller group of classmates, g, and therefore receive utility from academic identity among them. Unlike with the entire class, in which a student identifies with one of three categories, here a student compares himself directly to the other students in the group. This group represent those peers with which a student has a better formed academic concept. A student gains utility from the academic identity within the group, which is a function of the relative ranking in the group,

[2] Akerlof and Kranton label the ideal characteristics for a category *prescriptions* which are similar to social norms.

$$I_g = I_g\left(R_i\right) \tag{4}$$

where I_g is decreasing in R_i, which is the rank of i among n students,

$$R_i = \sum_{j=1}^{n} \mathbf{1}\{A_j \geq A_i\} \tag{5}$$

For this portion of the utility function academic identity among the group, g is a function of the relative ranking of the student within the group. The ranking of student i depends upon the academic outcome A_i of the student,

$$A_i = A_i\left(\tilde{A}_i, X_i, e_i, \epsilon_i\right) \tag{6}$$

where $\tilde{A}_i$ represents the history of academic outcomes for student i, X_i are demographic variables and ϵ_i is a random shock to the academic outcome. An example of a random shock to the academic outcome would be an unexpectedly difficult exam, or being sick on test day.

In the group, the student can minimize loss from effort by exerting as much effort as the student directly ahead of him/her:

$$\left(e_i - e_{(R_i+1)}\right)^2 \tag{7}$$

where $e_{(R_i+1)}$ is effort level of the student ranked one ahead of the student. The motivation behind equation (7) is that with this smaller group, students have a better concept of their rank among the group and will try to exert enough effort to maintain or improve their rank. This effort will be relative to the effort their closest peer is exerting.

The utility from the student's identity in the group:

$$U_i^g\left(e_i\right) = I_g\left(R_i\right) - \left(e_i - e_{(R_i+1)}\right)^2 \tag{8}$$

The total utility a student receives is a weighted combination of the utility gained from class identity (eq. (3)) and group identity (eq. (8)).

$$U_i^{cg}\left(e_i\right) = \gamma\left[I_c - \tau\left(1 - c_i\right) - \left(e_i - e\left(c\right)\right)^2\right] + \left(1 - \gamma\right)\left[I_g\left(R_i\right) - \left(e_i - e_{(R_i+1)}\right)^2\right] + \mu_i$$

where μ_i is a random shock to the utility of student i, representing the unknown aspect of choosing a category and effort level. Maximizing this utility with respect to effort results in the optimal effort being a weighted combination of prescribed effort of the chosen classroom category c, $e(c)$, and that of the student closely ranked within the smaller group, $e_{(R_i+1)}$.

This is a simple model needing revision to better suit the psychology and economics literate. It provides a starting point in understanding the behavior of students. Upon revision, relevant comparative statics may help to inform the empirical model.

4 Data Description & Analysis

4.1 Description

The data used in this study are from the North Carolina Education Research Data Center (NCERDC). They contain pooled information from the North Carolina Department of Public Instruction (DPI), the U.S. Census, and the U.S. Department of Education. The DPI annually collects data on over 1.3 million North Carolina public school students from over 2,400 schools in 115 districts. The NCERDC also collects limited information from charter and private school.

In the state of North Carolina, students in grades 3rd through 8th are required to take an end-of-grade standardized test. When this test is administered, other information on the student is collected. The crucial characteristic of this data is that students' teachers are identified, making it possible to link classmates together. The NCERDC data also contain school and community information, student demographics, participation in reduced price lunch programs, parental education, and geocoded address at the census block-group level. The detail of these data make various definitions of peer groups possible.

4.2 Analysis

Once the data are cleaned I intend to examine the influence of different peer groups on the academic outcome of the student, as motivated by the model above. The base peer group is made up of a student's current classmates. The influence from this peer group is similar to that of the categories described in the theoretical model. The question set forth by this study is: Are there other peer groups which "compete" for influence on a student with his entire class peer group? Determining smaller peer groups that are still exogenous in formation is a challenge. I propose one such group to be former classmates of a student who are also current classmates. This peer group is one in which a student has previously developed an academic reputation and

self-image. Therefore a student might be more inclined to measure himself against this group in terms of academic outcomes, as well as effort. Another such group could be formed by students residing in the same neighborhood, based on geocoded addresses.

Here is a simple model estimating the effects of the first group mentioned:

$$A_{i,t} = \beta_1 \bar{A}_{(-i-g),t-1} + \beta_2 S_{(-i-g),t-1} + \beta_3 \bar{A}_{(g-i),t-1} + \beta_4 S_{(g-i),t-1} + X_{i,t}\beta_5 + Z_{i,t}\beta_6 + \lambda_s + \gamma_g + \epsilon_i \quad (9)$$

where $(-i-g)$ represent the new classmates of student i excluding the classmates from previous classes, and $(g-i)$ are the current classmates in which student i has previously shared a class. In this specification test score, A_i is regressed on lagged mean test score of new classmates, $\bar{A}_{(-i-g)}$, the standard deviation of lagged new classmate test scores, $S_{(-i-g)}$, the lagged mean test score and standard deviation of previous classmates who are also current classmates, $A_{(g-i)}$ and $S_{(g-i)}$, demographic variables of the student, X_i, and characteristics of the classroom, Z_i. Fixed effects for school, λ_s and former classmates, γ_g are included. Similar in nature to the work of Hanushek et al. (2003) and Vigdor and Nechyba (2004), equation (9) relies upon the majority of nonrandom sorting to exist at the school level, as well as idiosyncratic variation among cohorts. Comparisons of β_1 with β_3 should help to determine the impact of various groups on the academic outcomes of students. This specification is only one of many that can be used to more closely examine peer effects in the classroom setting.

In addition to data cleaning, further work includes reexamining the theoretical model, exploring different econometric techniques, and testing different models.

5 References

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