Peer Effects, Learning, and Physician Specialty Choice

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Abstract

Sixty percent of medical students switch specialties between the first and fourth year of medical school. These changes have a profound impact on the students' future earnings because there are substantial income differences between specialties. In 1997, for example, the mean income ranged from $323,000 in orthopedic surgery to $133,000 in psychiatry. In this paper we use a unique data set that contains the universe of students who graduated from a U.S. medical school between 1996 and 1998 to examine factors that influence specialty choices. Residency positions in high-income specialties such as orthopedic surgery and dermatology are rationed, in part on the basis of performance during medical school. Using the universe of medical school graduates between 1997 and 1999, we estimate the effects of learning and one's peers on both the choice of specialty and human capital accumulation. We find strong evidence that learning through test scores affects specialty choice. Strong peer effects also exist, but disappear when school fixed effects are included.

1 Introduction

Sixty percent of medical students switch specialties between the first and fourth year of medical school. These changes have a profound impact on the students' future earnings because there are substantial income differences between specialties. In 1997, for example, the mean income ranged

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from \$323,000 in orthopedic surgery to \$133,000 in psychiatry. In this paper we use a unique data set that contains the universe of students who graduated from a U.S. medical school between 1996 and 1998 to examine factors that influence specialty choices.

There are several reasons why so many students switch specialties. One possibility is that switching occurs because residency positions in high-income specialties such as orthopedic surgery and dermatology are rationed, based in part on a student's performance during medical school. As students learn about their own performance during medical school and learn about the rationing rule – students who perform well in medical school have a higher probability of entering competitive, high-income specialties – they adjust their specialty choice accordingly. Another possibility is that the ability and specialty preferences of a student's peer group affects his own performance and specialty choice. Finally, schools might exert their own influence on a student's performance and specialty choice.

Nicholson (1999) is one of the few papers which examines the specialty choice decisions of medical students. To our knowledge, there has been no research on peer effects in medical school. Peer effects have been found, however, in other areas of education. The Coleman report (Coleman et. al 1966) claimed that peer groups were very important in student achievement.[1] Evans, Oates, and Schwab (1992) find strong peer effects in teenage pregnancy and school dropout behavior. However, these effects disappear in the latter paper once the authors account for neighborhood selection. With regard to medical students learning about their abilities, again there are no papers on the subject. Arcidiacono (1999) finds evidence of learning at undergraduate institutions which then influences the choice of major.

We divide the specialty decision into two parts. A student arrives at medical school aware of his ability, as measured by the Medical College Admission Test (MCAT) score, and his preferred specialty. Medical students take the Step 1 National Board of Medical Examiners test after their second year of school. In the first part of the model, first-year medical students forecast their performance on the board exam based on their ability, the average ability of their medical school classmates (the ability peer effect), their current preferred specialty, and the school they attend. The first-year specialty preference is included to account for the possibility that students with similar levels of unobserved ability will select the same specialty, and students who plan to enter competitive specialties might work harder in order to increase the likelihood of entering the specialty. The error term from the regression of the board score on the forecasting variables is interpreted as a "performance shock" – new information a student receives regarding his or her performance in school. In the second part of the model, the probability that a fourth-year student chooses a high-paying specialty is assumed to be a function of their predicted performance on the board exam,

[1] See Glaeser, Sacerdote, and Scheinkman (1996) for an example of peer effects in crime.

the performance shock, their first-year specialty preference, the first-year specialty preferences of their classmates (the specialty preference peer effect), and the school they attend.

The sample consists of 37,000 medical students who graduated from one of the 127 U.S. medical schools in 1996, 1997, or 1998. We have information on students' ability prior to medical school, their performance during medical school, and their specialty preferences at the beginning and end of medical school. A student's pre-matriculation ability is represented by their test score on the biology, chemistry, and reading components of the MCAT, a uniform exam given to all medical school applicants. The Step 1 board score, also a uniform national exam, measures a student's performance in medical school. Students are surveyed by the Association of American Medical Colleges in their first and fourth years of medical school and asked to indicate their preferred specialty. Because we have the universe of U.S. medical students, we can measure ability and preference peer effects: the average pre-matriculation ability of each school's students and the proportion of each school's first-year students who prefer each specialty.

Among first-year students, there are no substantial differences in MCAT scores between specialties. By the fourth year, however, students with high board scores are more likely to be in high-income specialties. Students who receive a positive performance shock – a higher board score than they expected – are more likely to switch to a high-income specialty relative to other students. Women are more likely than men to choose a low-income specialty in the fourth year, conditional on their board score and initial specialty preference. Peer effects are an important determinant of board scores and specialty choices, but these effects disappear when we include school-specific fixed effects.

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 presents the model and the empirical approach. Results are presented in section 4 while section 5 concludes.

2 Data

The sample for this paper is the universe of medical students (n=47,755) who graduated from a U.S. medical school in 1996, 1997, or 1998. Students were surveyed in the Fall of their first year and the Spring of their fourth year of medical school by the Association of American Medical Colleges (AAMC). On this survey students were asked to indicate their preferred specialty or to indicate if they were undecided about a specialty. Medical students do not need to formally declare a specialty until March of their senior year when most students enter the National Resident Matching Program and explicitly rank their preferred residency programs. The response rate among the first-year and fourth-year students to the AAMC surveys was 90.5 percent and 86.7 percent, respectively.

Medical school applicants take the Medical College Admission Test (MCAT) before applying.

The MCAT is a uniform, national exam with three sections that are separately graded: physics, biology, and reading. The National Board of Medical Examiners (NBME) administers the Step 1 board exam to all students between the second and third year of medical school. The Step 1 exam, referred to hereafter as 'the board exam,' is important because it is one of three tests that an individual must pass in order to be licensed to practice medicine in the United States. After consolidating the AAMC and NBME data sets and eliminating observations with missing values, we have complete data for 35,152 students across the 127 U.S. medical schools.

Sample means are reported in Table 2.1. Forty-two percent of the students are female and 6.6 percent are black. Each of the three components of the MCAT exam has a maximum of 15 points. Two variables are created to capture the ability and specialty preferences of a student's peer group. For most of the analysis we define a peer group as all students who graduate from a particular school in a particular year (e.g., 1997 graduates of Jefferson Medical College). In some analyses we define the peer group more narrowly as all female or all black students who graduate from a particular school in a particular year. The ability peer effect is defined as the mean MCAT score of a student's classmates; the specialty peer effect is defined as the proportion of a student's classmates who indicated a preference for a certain specialty in their first year of school. The mean combined MCAT score for a medical school class ranges from a low of 16.8 (out of a possible 45) at one school to 34.0 at the highest-scoring school. The mean ability peer effect across all 127 schools and all three years is 28.1.

On the AAMC survey students can select a preferred specialty from a list of about 20 possible specialties. We create six aggregated specialty categories for purposes of presenting the descriptive data. We group together specialties that have similar work activities, mean national income, and length of residency training. Surgery and medical sub-specialties (e.g., cardiology) are grouped together because they require lengthy residency training and have high mean incomes. Radiologists, anesthesiologists, and pathologist (RAP) require four years of residency training, earn high incomes on average, are based in hospitals rather than in private offices, and have less direct contact with patients than other physicians. Obstetricians/gynecologists are treated as a separate group. Internal medicine and emergency medicine have similar mean incomes and require three years of residency training. Likewise, family practice, pediatrics, and psychiatry are grouped together due to similarities in income. Students undecided about a specialty constitute the sixth specialty choice category.

For most of the regression analysis we further aggregate the specialties into a high-paying category and a low-paying category. The following specialty categories with a mean income of $220,000 or higher during the 1991 to 1997 time period are classified as high-paying specialties: surgery and medical sub-specialties, radiology, anesthesiology, pathology, and obstetrics. Low-paying specialties include internal medicine, emergency medicine, pediatrics, family practice, and psychiatry. Students undecided about a specialty constitute a third specialty category under this more aggregated scheme. The mean proportion of first-year students who prefer a high-paying specialty across all medical schools and years is 0.43. The standard deviation of 0.50 for the specialty peer effect indicates there is considerable variation across medical schools in the specialty preferences.

We rank specialties in Table 2.2 according to the mean income of practicing physicians. Surgeons and medical sub-specialists earned an average of $257,000 per year between 1991 and 1997, versus an average of $137,000 for family practitioners, pediatricians, and psychiatrists. Because there is a persistent excess demand for residency positions in high-paying specialties, students who perform well in medical school are more likely to apply to high-paying specialties, and more likely to be accepted conditional on applying.

We estimate the probability that a medical student who expresses an interest in a particular specialty in their fourth year of medical school will actually be training as a resident in that specialty the following year. These predicted probabilities are reported in Table separately for a student with the median board score, and a score at the 5th and 95th percentiles. A fourth-year student who wants to be a surgeon and has the median board score has a estimated probability of 0.75 of entering the specialty. A student atttempting to match in surgersy with a board score at the 95th percentile adds 3.5 percent points to the student's probability of successfully matching than the median. In general the probability of entering a specialty is inversely related to the average income of the specialty, and the board score has a stronger effect on entry probabilities in high-paying specialties than low-paying specialties.

The entry probabilities in Table 2.2 most likely understate the importance of medical school performance on specialty choice because many students will self-select into specialties prior to the Match. In Table 2.2 we also present data on the distribution of board scores according to fourth-year students' specialty choice. It is generally the case that specialties with high earnings and low probabilities of matching draw higher ability students. There is also anecdotal evidence that students who perform well during medical school are more likely to receive encouragement from faculty members and medical school administrators to enter high-paying specialties relative to other students. A book that many second-year medical students use to help prepare for the board exam advices students regarding how well they need to do on the board exam in order to have a good chance of entering various specialties. Students who would like to enter dermatology, ENT, orthopedic surgery, and ophthalmology are advised to "ace the exam"; students who would like to enter emergency medicine, ob/gyn, radiology and general surgery are advised to "beat the mean"; and students who plan to enter pediatrics, family practice, internal medicine, anesthesiology, and psychiatry need only "comfortably pass" the exam (Le, Bhushan, and Amin, 1998). The importance of board scores is also understated here because it is not matching in the specialty that may be important, but perhaps the location and prestige of the residency program may be important in the students' decisions. Those interested in the more competitive specialties may find it more difficult to match in the locations they desire.

3 The Model and the Empirical Approach

We divide the specialty decision into two parts. Students arrive at medical school with knowledge of their ability, as measured by their MCAT score, and a preferred specialty. Medical students take the Step 1 National Board of Medical Examiners test after their second year of school. In the fist part of the model, first-year medical students forecast their performance on the board exam based on their ability, the average ability of their medical school classmates (the ability peer effect), their current preferred specialty, and the school they attend. The first-year specialty preference is included to account for the possibility that students with similar levels of unobserved ability will select the same specialties, and that students who plan to enter relatively competitive specialties will work harder in order to increase the likelihood of entering the specialty. The error term from the regression of the board score on these forecasting variables is interpreted as a 'performance shock' – new information to a student regarding his or her performance in school. In the second part of the model, the probability that a fourth-year student chooses a high-paying specialty is assumed to be a function of their predicted performance on the board exam, the performance shock, their first-year specialty preference, the first-year specialty preferences of their classmates (peer effects), and the school they attend.

3.1 Peer Effects

Manski (1993) outlines three ways in which behavior across groups can vary: endogenous effects, where an individual's behavior is affected by the group's behavior; exogenous effects, where the behavior of the individual is affected by the characteristics of the group; and correlated effects where individuals behave similarly because they have similar characteristics or are in similar environments. This third effect is actually an unobserved variables problem, not a peer effect. Manski highlights the problems associated with seperately identifying the three effects.

Here we restrict our analysis to the last two effects. In particular, we examine the effect the average observed ability and the initial specialty interests of the individual's peers. The individual's peers are the students who enroll at the same school in the same year. If peer effects exist, then we expect these variables to influence both the individual's board score and specialty choice. Separating out whether these variables really affect the outcomes of interest (board scores and specialty choice) is left to section 1.4.

We also experiment with defining peer groups by race and gender within a medical school class. This is particularly important in light of affirmative action programs. If peer effects within racial groups are important, and affirmative action programs lower the average ability of a racial peer group as well as lower the percentage of minorities interested in the high-paying specialties, then affirmative programs may be discourage individuals who otherwise would have attended a high-paying specialty. If there are no racial peer effects, on the other hand, then affirmative programs will not alter the outcomes for minority students who would have been accepted without the benefit an affirmative action program. Further, if peer effects are not racial but are the student's whole cohort, then affirmative action programs may increase the number of minorities choosing the high-paying specialties.

3.2 Board Scores

A student's score on the Step 1 Board exam, taken after the second year of medical school, is our measure of human capital, H. The more human capital one has, the more likely a student will choose a high paying specialty.[2] Individuals with higher board scores are more likely to receive a residency position in the Match and are more likely to be encourage by faculty and medical school administrators to enter competitive, high-paying specialties. We hypothesize that human capital accumulation is a function of an individual's own ability (A_o), the ability of their peers at medical school j ($\overline{A_{oj}}$), initial specialty choices of both the individual and his peers (k and $\overline{Pr}(k|j)$), and a vector of demographic characteristics (X). Those with high intial human capital levels are then more likely to have higher levels of human capital in the future. Further, students at medical schools with high ability individuals might accumulate more human capital by learning from their peers.

The relationship between the individual's initial specialty choice and board scores is not to be interpreted as causal. Rather, this variable is included because students interested in the high paying specialties may exert more effort during medical school than their peers. The initial specialty choice of an individual's peers, however, may have a causal relationshiop as being around individuals who are exerting more effort may make it easier for you to exert effort as well.

Specifically, we choose the following parametric form:

$$\begin{aligned} H_{ijk} &= \beta_0 + \beta_1 X_i + \beta_2 A_{oi} + \beta_3 (d_{ik} = 1) + \beta_4 \overline{A_{oj}} \\ &\quad + \beta_5 \overline{Pr}(k = 1|j) + \epsilon_{1ijk} \end{aligned} \tag{1}$$

where '1' indicates the choice of a high paying specialty. Equation (1) is treated as a forecasting

[2] This could be because of a number of reasons including the ability to match in the preferred specialty and future salary.

equation; everyone has same expectations of ϵ_{ijk}. The forecasting error, ϵ_{ijk}, is then interpreted as new information the individual uses to revise his specialty choice.

3.3 Choice of Specialty

Individuals enroll in medical school with preferences for particular specialties. The specialty an individual chooses in their senior year depends on these preferences and new information the individual acquires. If peer effects exist, then an individual's decision should also depend on the interests of his peers. We express the utility differential for choosing a high paying specialty versus a low-paying specialty as follows:

$$\begin{aligned} U_{ij1} &= \alpha_1 Z_i + \alpha_2 \hat{H}_i + \alpha_3 H_{Si} \\ &\quad + \alpha_4 Pr(1_{t-1}|j) + \alpha_5 (d_{i,t-1} = 1) + \epsilon_{2ij1} \end{aligned} \tag{2}$$

Z_i represents the demographic characteristics that may influence the choice of specialty. $\hat{H}$ is the amount of human capital an individual expects to have given his observed abilities and is still expected to affect the specialty choice. Consider two people identical in every way except that one has higher initial abilities than the other. Further, the two people initially choose a low paying specialty. The one with the higher initial ability is more likely to be 'on the fence' and it will take less of a shock for him to switch to a more lucrative specialty.[3]

The shock individuals receive to their human capital is represented by H_{Si} and is the residual from the board scores regression. Individuals are suprised by this information and should respond differently to shock to human capital than to information about future human capital which was already known. Note that any information which is known to the individual but not to the econometrician will then bias the estimates of this coefficient downward. The difference beetween α_{2k} and α_{1k} then represent how much learning through board scores affects the specialty choice. Since α_{2k} may be biased downward and both coefficients are expected to have a positive sign, this difference is a lower bound.

The ϵ_{2ij1} represents the unobservable preference differential that the individual has for the high paying specialties relative to the low paying specialties. We assume that this preference differential comes from a logistic distribution allowing us to estimate the parameters using a logit model.

Here, the peer effect is captured by the average probability of choosing the kth major initially conditional on attending the jth school. That is, individuals may be influenced by the preferences

[3]Another interpretation is individuals do not know the relationship between board scores and the desirability of particular specialties upon entry into medical school. This is supported by the mean MCAT scores not varying by first year specialties.

of their peers when making their senior specialty choice.[4]

3.4 Unobserved Ability

A natural criticism of the proposed specification is that, since students choose their college qualities, there exists a variable A_{ui} which is correlated both with the average ability and the specialty choices of the students. Those who have high values for this unobserved ability also may be at schools where the level of unobserved ability of their peers is also high. Hence, not being able to directly control for this unobserved ability may lead to estimates of the effect of peers that are biased upwards as choice of peers may be picking up some of the effect of the individual's own unobserved ability. It is here that we take advantage of the panel aspect of our data. In particular, we control for school specific fixed effects to remove the average quality of students at a particular school.

Suppose individuals did not know what their unobserved ability was but did know the average unobserved ability for their school through rankings or match rates. Let the rankings not vary over time. Then individuals in different cohorts would have the same expectations regarding unobserved ability conditional on attending the same school. Further, any affect that the school has on the choice of specialty is not expected to vary from year to year. Hence, if one individual arrives at school j in a cohort that happens to have many students interested in the lucrative specialties, if peer effects exist he will be more likely to choose a lucrative specialty then someone who enters the same school in a different cohort.

It is here that we try to seperate out the correlated effects from the exogenous effects. To the extent that the school itself or the unobserved ability of the student is affecting the board scores and choice of specialty results, these are correlated effects. Hence, changing an individuals peer group would not affect their choices and human capital accumulation, though, of course, the institutions themselves may. By allowing for a school specific intercept in both the board score and specialty choice regressions, we hope to seperate out the effects of the institution or the unobserved ability from the effects of the peer groups.

Note that this still gives an upper bound on the peer effects. If particular cohorts have, on average, more unobserved ability, those cohorts will see a higher percentage choose the more lucrative specialties even if there is no unobserved ability spillovers. Our peer effects variables may still pick up this phenomenon.

[4]There is a way to look at the multiple equilibria associated with coordinating on particular specialties as discussed in Brock and Durlauf (1999). This would involve using the senior year choices as opposed to the initial choices and the econometric framework would need to be extended. We leave this to future work.

4 Results

4.1 Descriptive Analysis

We begin by reviewing some descriptive data on the dynamics of specialty choice and the characteristics of students in each specialty. Table 4.1 presents a cross tabulation of students according to their preferred specialty in the first year (rows) and fourth year (columns) of medical school. The most popular specialty among first-year students is family practice/pediatrics/psychiatry, which is also the specialty category with the lowest mean income. First-year students who prefer this specialty have a mean MCAT score of 27.7. Although the differences in mean MCAT scores among first-year students between most specialties are significantly different from zero, the magnitudes of these differences are small. For example, first-year students who prefer surgery and medical sub-specialties have an average score that is 0.7 points higher than first-year students who prefer family practice/pediatrics/psychiatry. This difference is one-sixth of the standard deviation of the combined MCAT score in the sample. One possible explanation for the differences in ability between specialties is that first-year students do not realize that residency positions in high-paying specialties are rationed, performance in medical school is one of the rationing mechanisms, and ability and performance are highly correlated. If one considers a student who was initially undecided as switching, sixty-three percent of the students in the sample switched specialties during medical school. For example, of the 8,380 students who indicated a preference for surgery or a medical sub-specialty in the first year, only 44.5 percent maintained this preference by the fourth year. The mean board score by specialty among fourth-year students is reported in the last row of Table. These differences between specialties in the fourth year of school are much larger than the differences between specialties in the MCAT score in the first year of school. Fourth-year students who intend to become surgeons and medical sub-specialists have a mean score of 215.8, while students who intend to become family practitioners, pediatricians, or psychiatrists have a mean score of 205.4. This difference is larger than one-half of the standard deviation of the board score. With the exception of obstetrics/gynecology, the ordering of board scores by specialty among fourth-year students corresponds perfectly with relative specialty incomes.

The sorting of students into specialties according to their performance during medical school is even more striking if one examines specialties at a disaggregated level. In Table 4.2 we report the mean MCAT score by specialty according to the first-year students' preferred specialty, and the mean MCAT score, board score, and board score difference by specialty according to the fourth-year students' preferred specialty. The 'board score difference,' a measure of performance relative to one's peers, is the difference between a student's board score and the mean board score of their medical school classmates. The specialties are arranged in descending order according to the mean national income in 1997. As before, the differences in the mean MCAT score by specialty among first-year students are small. By the fourth-year, however, students in most of the high-income specialties have substantially higher average board scores than students in low-income specialties. First-year students who wanted to become ear, nose, and throat (ENT) surgeons had the sample average MCAT score. Fourth-year students who chose ENT, on the other hand, had the highest average board scores of any specialty. ENT and dermatology are widely regarded as two of the most difficult specialties to enter because of the high incomes and relatively desirable non-monetary attributes (e.g., predictable hours).

The descriptive data in Tables 4.1 and 4.2 suggest that students who receive a relatively high board score tend to switch to higher-paying specialties, and students who receive a relatively low board score tend to switch to lower-paying specialties. It is not clear from these tables, however, whether students are able to predict their board score. One could argue that first-year students in ENT, for example, have high levels of unobserved ability and therefore expect to receive high board scores. Or, one could argue that first-year students who want to enter ENT work harder than other students; the higher board score is an effect of an initial specialty choice rather than the cause of a subsequent change in specialties.

To further analyze this issue with the descriptive data we focus in Table 4.3 on specialty transitions in orthopedic surgery. In the first column we divide students into four mutually exclusive categories. At the top are the 906 students who selected a specialty other than orthopedic surgery in their first year but chose orthopedic surgery in their fourth year. Below this group are the 657 students who maintained their preference for orthopedic surgery throughout medical school, the 1,757 students who dropped out of orthopedic surgery, and the large group of students who never chose orthopedic surgery. The four groups of students look quite similar in their first-year. If one believes that students sort themselves into specialties in the first year according to unobserved ability, and students who plan to enter a competitive specialty will exert more effort, then the only difference between the students who remained in orthopedic surgery and the students who dropped out is that the former group received new information that confirmed they were capable of applying to competitive orthopedic surgery programs.

4.2 Estimates of the Forecasting Equation

In Table 4.4 we present results of the ordinary least squares regression of the board score on characteristics known by first-year students. The second column reports results of the same regression but includes school indicator variables to control for time invariant characteristics of medical schools. Students with high initial ability, as measured by a student's score on the three components of the MCAT exam, also perform well on the board exam. The score on the biology part of the

MCAT exam has an effect on the board score that is three times the magnitude of the reading score. Students who chose a high-paying specialty or were undecided about their specialty in the first year of school received slightly higher board scores relative to students who initially chose a low-paying specialty. Although this effect is small, it does imply that students who plan to enter high-paying specialties either work harder to prepare for the board exam, or students who initially select high-paying specialties have relatively high unobserved ability. In column one, the ability peer effects are positive; students who attend schools where first-year students have relatively high MCAT scores subsequently receive relatively high board scores themselves. The specialty preferences of a student's peer group also appear to affect his score, conditional on his own specialty choice and the average ability of the medical school class. The coefficient on the proportion of a student's first-year classmates who prefer a high-paying specialty is positive and statistically significant. One explanation for this is that students who are trying to enter high-paying, competitive specialties will work harder, which has a spillover effect on all students.

Although the specialty preference peer effect is statistically significant, its magnitude is small. Forty-three percent of first-year students in the sample preferred a high-paying specialty. If a student were to enroll in a medical school where 70 percent of the first-year students preferred a high-paying specialty, their predicted board score would be 1.3 points higher relative to enrolling at a school where 43 percent of the students preferred high-paying specialties. This represents a 0.5 percentage point increase in the board score. Furthermore, the coefficients on the ability and specialty peer effects variables are insignificant in column two of Table 4.4 when we include school fixed effects. The peer effect coefficients are now identified by changes within a school over time in the average MCAT score and specialty preferences of the first-year students. The school indicator variables are jointly significant. A student who attends a school that has high ability students will perform relatively well on the board exam. However, this improvement appears to be transmitted through the school (e.g., curriculum, faculty) rather than through the students.

4.3 Specialty Choice Estimates

Estimated coefficients from the specialty choice logit regression are reported in Table 4.5. The dependent variable is a one if at student selects a high-paying specialty in the Spring of their fourth year of medical school and a zero otherwise.

The coefficients on the three MCAT score variables from Table 4.4 are used to create a predicted board score for each student. This variable represents the information the indvidual initially. Comparing the coefficient on this variable to the coefficient on the performance shock variable provides a lower bound on the ability learning component of specialty choice. The positive coefficient on a student's predicted board score indicates that students with high levels of initial ability are more likely to choose a high-paying specialty in their fourth year, regardless of whether they chose a low-paying specialty, a high-paying specialty, or were undecided in the first year. The coefficient on a student's predicted board score is one-third the size of the performance shock coefficient, providing evidence that at least a portion of the residual from the forecasting equation was unknown to the individual.

The marginal effect of the performance shock is reported in Table 4.6. The first column of this table reports the probability that a representative fourth-year student will choose a high-paying specialty, conditional on three different specialty choices in their first year. The second column reports the probability the representative person will choose a high-paying specialty if the student received a board score that was 14.6 points higher than he expected (one standard deviation). For example, the predicted probability that a student who was undecided about their specialty in the first year ultimately chooses a high-paying specialty is 0.28 with a performance shock of zero versus 0.37 with a large positive performance shock. The probability that an undecided first-year student with a predicted board score that is one standard deviation above the sample mean will choose a high-paying specialty is 0.30, versus 0.28 for a student with the mean predicted board score.

The coefficient on the proportion of a student's peers who select a high-paying specialty in the first year of medical school is positive and significant. The magnitude of the peer effect is very large in column one of Table 4.5 when school indicators are not included. As reported in Table 4.6, a representative student who prefers a low-paying specialty in their first year and attends a school where 43 percent of first-year students prefer a high-paying specialty (the mean value), has a probability of 0.12 of selecting a high-paying specialty at the end of medical school. By comparison, if this same person attended a school where 93 percent of the students prefer a high-paying specialty (a one standard deviation increase), the probability they would ultimately select a high-paying specialty would be 0.23.

Female medical students are much less likely than male students to choose a high-paying specialty. The penultimate column of Table 4.6 reports the probability that a female student will choose a high-paying specialty, separately for each of her three possible initial choices. A majority of women who choose a high-paying specialty in their first-year subsequently switch to a low-paying specialty, versus 38 percent of men who make such a switch. This effect is conditional on students' board score performance.

The regression results also indicate that the proportion of fourth-year students selecting a high-paying specialty increased between 1996 and 1998. The probability that a student who entered medical school in 1992, was undecided about a specialty in their first-year, and selected a high-paying specialty in their fourth year was 0.28. A similar student who entered medical school two years later had a five percentage point higher probability of choosing a high-paying specialty when they graduated (see Table 4.6). This trend is somewhat puzzling given the income gap between physicians practicing in high-and low-paying specialties was narrowing between 1991 and 1997. One explanation for this trend is that medical students' expected income in the high-paying specialties decreased substantially when it appeared the Clinton administration would fundamentally reform the U.S. health care system, but rebounded when the reforms became minor revisions.

In column two of Table 4.6 we report the estimated logit coefficients when indicator variables are included to control for school-specific fixed effects. The 126 school indicator variables, which are not reported in Table 4.6, are jointly significant. The only coefficient that changes substantially when school fixed effects are included is the specialty preference peer effect variable, which is now identified by variations over time within a school in the proportion of first-year students who prefer high-paying specialties. The magnitude of the peer effect falls by over 50 percent and is no longer statistically significant once we control for school effects. Although a student's ultimate specialty choice appears to be influenced by the school they attend, the transmission mechanism does not appear to be the specialty preferences of a student's classmates.

It is possible that the specialty preferences of peer groups do have a substantial affect on an individual's specialty choice but the relevant peer group is smaller than we have defined above. To examine this possibility, we calculate gender-specific peer effect variables: the proportion of female students in each a medical school class who prefer a high-paying specialty, and likewise for male students. Coefficient estimates for the specialty choice model with gender-specific peer effects are reported in Table 4.7. The gender-specific peer effect coefficient is positive and significantly different from zero at the one percent level when school effects are excluded, and positive and significant at the 10 percent level when school effects are included. This provides evidence that peer effects might be present when peer groups are defined to be more homogenous.[5]

5 Conclusion

Earnings across physcian specialties vary dramatically. As many people switch specialties during the course of their medical school career, it is important to understand what leads to these switches. We show that ability realizations through a test during the second year of medical school has a large effect on specialty choice. Further, there are strong peer effects in terms of specialty choice. That is, if the other individuals at one's school are interested in high-paying specialty then one is more likely to also choose a high-paying specialty. However, once school specifice effects are included, the peer effect disappears. Identification of the peer effect then comes from cross cohort variation within medical schools.

[5]Racial peer groups produced significant peer effects when school specific fixed effects are not included. However, the effect disappears when controlling for school fixed effects.

References

[1] **Arcidiacono, Peter.** "Option Values, College Quality, and Earnings: Results froma Dynamic Model of College and Major Choice." manuscript (1999).

[2] **Brock, William and Steven Durlauf.** "Interactions-Based Models." forthcoming in J. Heckman and E. Leamer, eds., *Handbook of Econometrics vol. 5* (1999).

[3] **Coleman, James S., et al.** *Equality of Educational Opportunity.* Washington: Government Printing Office, 1966.

[4] **Evans, William, Wallace Oates, and Robert Schwab** "Measuring Peer Group Effects: A Study of Teenage Behavior." *Journal of Political Economy,* 100, 1996, pp. 966-991.

[5] **Glaeser, Edward, Bruce Sacerdote, and Jose Scheinkman.** "Crime and Social Interactions." *Quarterly Journal of Economics,* 1996, pp. 507-548.

[6] **Le, Bhushan, and Amin** *First Aid*, 1998.

[7] **Manski, Charles.** "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies,* 60, 1993, pp. 531-542.

[8] **Nicholson, Sean.** "Physician Specialty Choice Under Uncertainty." manuscript, 1999.

Table 2.1

Sample means

	Mean	Standard Deviation
Female	0.42	0.49
Black	0.066	0.25
Graduated in		
- 1996	0.313	
- 1997	0.346	0.476
- 1998	0.341	0.474
MCAT score		
- biology	9.54	1.80
- physics	9.34	2.04
- reading	9.34	1.81
Step 1 NBME board score	210.1	18.3
Ability peer effects:		
- biology	9.51	0.814
- physics	9.32	0.964
- reading	9.29	0.730
Specialty preference peer effects (proportion of first-year students who choose a high-paying specialty)	0.431	0.093
Gender-specific specialty peer effect	0.433	0.133

Table 2.2

The Relationship Between Medical School Performance and the Likelihood of Entering a Specialty

		Probability of Being Accepted in the Match			Board Score of Match Applicants		
Specialty	Mean Income, '91-'97, ($000)	5^{th} Percentile Board Score	Median Board Score	95^{th} Percentile Board Score	5^{th} Pctile	Median	95^{th} Pctile
Surgery/medical sub-specialties	$257	0.712	0.749	0.785	185	217	243
Radiology/Anesthesiology/ Pathology	$244	0.946	0.967	0.981	181	212	242
Obstetrics/gynecology	$237	0.861	0.940	0.979	180	208	236
Internal medicine/emergency medicine	$164	0.924	0.958	0.908	181	212	241
Family practice/pediatrics/ psychiatry	$137	0.951	0.961	0.970	179	205	235

Table 4.1

Specialty Transitions During Medical School

Preferred Specialty in Fourth Year of Medical School

Preferred Specialty in First Year of School	Surgery	RAP	Ob/gyn	IM/EM	FP/Peds/ Psych	Total	Mean MCAT Score
Surgery/medical sub-specialties	3,730 (45%)	685	520	2,076	1,369	8,380	28.4*
Radiology/Anesthesiology/ Pathology	285	448 (28%)	98	446	313	1,590	28.0
Obstetrics/gynecology	184	64	631 (34%)	373	582	1,834	27.0*
Internal medicine/emergency medicine	825	337	332	2,700 (48%)	1,474	5,668	28.4*
Family practice/pediatrics/ psychiatry	913	308	646	2,167	5,848 (59%)	9,882	27.7
Undecided	1,794	682	596	3,126	2,576	8,774	28.8*
Total	7,731	2,524	2,823	10,888	12,162	36,128	28.2
Mean board score	215.8*	211.4	207.6*	211.6*	205.4	210.1	

* = statistically different at the five percent level from the value for family practice/pediatrics/psychiatry

Table 4.2
Medical School Performance By Specialty: First- and Fourth-Year Students

Specialty	Mean Income 1997, ($000)	First Year of Medical School MCAT	Fourth Year of Medical School MCAT	Board Score	Board Score Difference
Orthopedic surgery	$331	28.4	28.9	217.7	8.00
Surgical sub-specialty	327	28.6	29.5	217.9	7.02
Radiology	273	28.8	29.0	213.3	4.26
Urology	238	27.5	28.5	215.3	5.34
Anesthesiology	236	26.9	28.4	206.2	-2.90
ENT	230	28.2	29.9	224.1	13.6
OB/GYN	229	27.0	27.0	207.6	-1.27
General surgery	225	28.2	28.5	213.0	3.44
Dermatology	224	26.5	28.7	218.7	8.63
Opthamology	222	28.1	28.6	213.1	3.28
Pathology	201	27.6	28.8	213.4	4.27
Emergency medicine	197	28.0	28.6	210.8	1.48
Neurology	188	29.9	29.4	211.6	1.74
Internal medicine	176	28.5	28.6	211.8	2.24
Pediatrics	144	27.7	28.0	207.2	-2.40
Family practice	141	27.8	27.4	204.3	-3.93
Psychiatry	136	28.0	28.2	203.5	-5.31
Undecided	N/A	28.8	N/A	N/A	N/A
Total		28.2	28.2	210.1	0.10

Board score difference: student's score - average board score of his/her class

Table 4.3

Orthopedic Surgery Specialty Choices: Changes During Medical School

First Year	Step 1 Board Exam	Fourth Year
Other Specialties (n = 906)		
MCAT = 28.9 MCATdif = 0.64	Board score = 218.3 Board diff = 8.57	
Orthopedic Surgery (n = 657)		**Orthopedic Surgery** (n = 1,563)
MCAT = 28.7 MCATdif = 0.42	Board score = 216.9 Board diff = 7.20	
Orthopedic Surgery (n = 1,757)		
MCAT = 28.2 MCATdif = 0.30	Board score = 209.2 Board diff = 0.24	
Other Specialties (n = 34,504)		**Other Specialties** (n = 36,261)
MCAT = 28.2 MCATdif = 0.05	Board score = 209.7 Board diff = 0.38	

Table 4.4: Peer Effects in Board Scores

Dependent variable is board score

	OLS Estimates without School Effects	OLS Estimates with School Effects
MCAT reading	1.139	1.117
	(0.053)	(0.052)
MCAT biology	3.106	3.067
	(0.062)	(0.061)
MCAT physics	1.859	1.832
	(0.056)	(0.056)
SMCAT read	**1.377**	**-0.800**
	(0.221)	**(0.588)**
SMCAT biology	**0.069**	**0.355**
	(0.453)	**(0.741)**
SMCAT physics	**-0.352**	**-0.228**
	(0.383)	**(0.653)**
cohort 2 (grad '97)	1.620	1.874
	(0.203)	(0.231)
cohort 3 (grad '98)	3.739	3.829
	(0.212)	(0.282)
Fresh. Spec. HiPay	0.590	0.595
	(0.189)	(0.186)
Fresh. Spec. Undecided	0.638	0.533
	(0.204)	(0.202)
Percent High Pay	**4.837**	**0.982**
	(0.953)	**(1.742)**

34942 Observations

Table 4.5: Peer Effects in Specialty Choice

Estimates of Utility Function Parameters for Choosing a High Paying Specialty

	Logit Results w/o School Effects	Logit Results w/ School Effects
Ability Shock	0.0183	0.0189
	(0.0008)	(0.0008)
Weighted MCAT	0.0063	0.0061
	(0.0013)	(0.0016)
cohort 2 (grad '97)	0.0491	0.0308
	(0.0298)	(0.0313)
cohort 3 (grad '98)	0.1463	0.1062
	(0.0314)	(0.0365)
Percent High Pay	**0.8837**	**0.3527**
	(0.1392)	**(0.2634)**
Fresh. Spec. HiPay	1.4951	1.5090
	(0.0282)	(0.0283)
Fresh. Spec. Undecided	0.6067	0.6185
	(0.0307)	(0.0310)
Log Likelihood	20754	20607

Table 4.6

Marginal Effects on the Probability of Choosing a High-Paying Specialty in Fourth Year

Specialty in First Year of School	Baseline Prob. of Choosing High-Paying[1]	Performance shock of 14.6 pts. (1 std. dev.)	1 Std. Dev. Increase in MCAT Score	1 Std. Dev. Increase in Peer Effect	Female	Graduated in 1998	
Low-paying	0.116	0.155	0.130		0.225	0.062	0.147
Undecided	0.278	0.342	0.302		0.441	0.176	0.329
High-paying	0.618	0.685	0.645		0.770	0.483	0.672

[1] Baseline student is male, white, graduated in 1996, has an performance shock of zero (i.e., receives his expected board score), has an average MCAT score (predicted performance), and attended a school with the mean proportion (0.43) of first-year students in a high-paying specialty.

Table 4.7: Gender Peer Effects in Specialty Choice

Estimates of Utility Function Parameters for Choosing a High Paying Specialty

	Logit Results w/o School Effects	Logit Results w/ School Effects
Ability Shock	0.0183	0.0189
	(0.0008)	(0.0008)
Weighted MCAT	0.0064	0.0061
	(0.0013)	(0.0016)
cohort 2 (grad '97)	0.0408	0.0277
	(0.0297)	(0.0302)
cohort 3 (grad '98)	0.1313	0.1004
	(0.0309)	(0.0324)
Percent Same Sex High Pay	**0.6741**	**0.2730**
	(0.1144)	**(0.1557)**
Fresh. Spec. HiPay	1.4908	1.5050
	(0.0283)	(0.0285)
Fresh. Spec. Undecided	0.6053	0.6167
	(0.0308)	(0.0308)
Log Likelihood	20757	20607