April 2006: PRELIMINARY

Do Better Professors Produce Better Students?

The Effects of Objective and Subjective Measures of Teacher Quality on Academic Achievement

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Teaching is the central task colleges and universities perform for students. Differences in teaching quality, across instructors and institutions, therefore, may play a key role in determining students' academic experiences, interests, and successful transition into the labor force. Yet, research about the importance of teacher quality focuses almost exclusively on the primary or secondary level. This study uses administrative data from a large Canadian university between 1996 and 2005, matched to course instructors and instructors' teaching evaluations. The main approach is to use the fact that many entering first-year students end up with different instructors because of scheduling conflicts or year-to-year replacements. We estimate the overall influence of postsecondary instructors on course dropout, enrolment, and grade outcomes by estimating the variance of the value added that instructors contribute to various outcome measures of academic achievement. We also examine more direct effects by estimating the consequences of entering a class with an instructor who ranks high or low in subjective teaching evaluations. The main finding is that the variance among first year students taking same courses but with different instructors is small, but not trivial: a two standard deviation switch in instructor quality would be expected to lower the likelihood of dropping the course by 1.5 percentage points, and increase the number of course subjects enrolled in the following year by less than 0.05 of its standard deviation. We also find little evidence that student evaluations of teacher quality significantly relate to student achievement.

We are indebted to Marianne Lynham, Matthew Hendrickson, Josie Lalonde, Rick Hayward, and Karel Swift for helping obtain and work with the data for this project. We also thank Steve Rifkin, Brian Jacob, Jonah Rockoff, and Doug Staiger for helpful discussion. Oreopoulos thanks the Social Sciences and Research Council for financial support.

I. Introduction

Supporting post-secondary education remains a key priority among governments and policy makers. Providing merit and need-based aid, tax deferral incentives, regulated tuition, and direct funding for operations are major government investments designed to increase enrolment in post-secondary schools. Enrolment, however, is not the end objective of these policies. Higher education is promoted because it offers large potential gains from acquiring knowledge beyond high school and from interacting within an active academic environment.

Teaching may play a central role to reaching this objective. Policy administrators often emphasize teaching as the key determinant to a student's academic experience and successful transition into the labour force. Many university and college mission statements declare that graduates should leave with strong analytical abilities, communication skills, and be primed for fulfilling careers.[1] Students themselves, on the other hand often complain colourfully in teaching evaluations about how ineffective some instructors have been in helping them meet these goals. As post secondary school enrolment continues to increase, along with tuition, and retiring faculty are replaced, universities face renewed challenges in promoting teaching, and renewed calls for accountability.

Quantifying the impact teachers have on students is not an easy task. At the primary and secondary school level, the literature on the effects of teacher quality and how to measure it is extensive, at least in the United States. Starting with the Coleman report in 1966, many have argued that teacher quality matters little and that families and peers are far more important in determining test score and education attainment outcomes. Coleman found little evidence that primary or secondary teachers' subject expertise (measured by test scores and college performance), completion of advanced degrees, or experience relate to students' subsequent performance. Several, more recent,

[1] See, for example, the University of British Columbia's mission statement at http://www.ubc.ca/about/mission.html.

meta analyses (quantitative summaries of the estimates in the literature) suggest that, on balance, teacher quality does in fact lead to higher test scores, but the mixed conclusions across studies may indicate that the size of the influence may depend on the circumstance (Hedges et al., 1994). Studies that examine the relationship between teacher quality and longer-run outcomes, such as earnings, find more consistent evidence that teacher quality matters (e.g. Card and Krueger, 1992, 1996). Hanushek, Kain, and Rivkin (1998) also point out that teacher quality may differ in many ways not captured by qualifications or experience. Test score improvement differs substantially for students with different teachers, but in the same school and grade. Hanushek, Kain, and Rivkin conclude that although explanations for these differences are not readily captured by common measures of teacher quality, they nevertheless indicate teachers play an influential role.

Research about the connection between teacher quality and student outcomes at the post-secondary level is virtually non-existent. A few studies focus on the effect of particular types of graduate assistants, but these studies rely on relatively small samples and do not have much information on student background. For example, Borjas (2000) analyzes the impact of foreign teaching assistants on economics students' performances at Harvard. More recently, Ehrenberg and Ziang (2005) examine the effects of adjuncts (part-time faculty) on student dropout rates using institutional-level data from a sample of U.S. universities. They find a negative relationship between student persistence and adjunct usage, although they cannot rule out this could be driven by the tendency for schools with higher proportion of adjuncts to also be more likely to have students on the margin of dropping out. The most closely related study to the one proposed here is by Bettiniger and Long (2004, 2005), who estimate from an administrative dataset of public four-year universities in Ohio the effects of adjunct professors on course selection and dropout rates using year-to-year and class-to-class variation in first year instructors. They estimate adjuncts have insignificant influence on students' subsequent course selection (relative to full-time faculty), but adversely increase the likelihood that students dropout in the second year.

Missing from this sparse literature is an analysis of the effects of other, and more direct, measures of teacher quality. The analysis of the effects of adjuncts versus full-time faculty on student outcomes does not explore further the effects of teaching styles and other characteristics that differ vastly across instructors. Administrators care about what teaching traits matter most to students' success. This knowledge could help lead to policies that help promote these traits and benefit students.

This study uses administrative data from a large Canadian university between 1996 and 2005, matched to course instructors and instructors' teaching evaluations. The main approach is to use the fact that many entering first-year students end up with different instructors because of scheduling conflicts or year-to-year replacements. We estimate the overall influence of postsecondary instructors on course dropout, enrolment, and grade outcomes by estimating the variance of the value added that instructors contribute to various outcome measures of academic achievement. We also examine more direct effects by estimating the consequences of entering a class with an instructor who ranks high or low in subjective teaching evaluations. The main finding is that the variance among first year students taking same courses but with different instructors is small, but not trivial: a two standard deviation switch in instructor quality would be expected to lower the likelihood of dropping the course by 1.5 percentage points, and increase the number of course subjects enrolled in the following year by less than 0.05 of its standard deviation. We also find little evidence that student evaluations of teacher quality significantly relate to student achievement.

II. Data

The study uses student and instructor administrative data from a large Canadian university for the school. The data cover the Fall and Winter school year periods between 1996 and 2005. We focus on the 41,402 students that entered into a full-time undergraduate Arts and Science program, and were 17 to 20 years old on September 1 in the year of entry. Full-time status means that all students were initially enrolled in

courses offering credits that sum to at least 3.5. A typical student must attain 20 credits to complete an undergraduate degree.

The raw student data come in four files. The Enrolment File contains student application information, including gender, date of birth, mother tongue (English, French, or Other), citizenship, entering program of study, and high school grade average. The High School File contains more detailed secondary school transcript information, including specific courses taken and corresponding grades, as well as high school identifiers. High school data are missing for some out-of-province students and we restrict our sample to the 36,144 students with non-missing high school grades. The Registration File records registration status at the start of each Fall and Winter term between 1996 and 2005. This file indicates the number of credits a student is enrolled in, financial status with the university, whether in good standing (which generally means not on academic probation, enrolled in a full-time program with fees paid), cumulative and current Grade Point Average (GPA), program of study, and graduation status. The Course File contains information on courses enrolled in and credits received for each year on September 1, November 1, January 1, March 1, and the most current status. An advantage of this file is that it allows us to match to courses that students first enrolled in before their first day of class, and regardless of whether they completed the course or not. The Course File also includes course section information and final grade received.

Table 1 displays descriptive statistics of our individual student data. Means and standard deviations are shown for student background characteristics for the full sample and by mother tongue category, citizenship, and declared program at entry. The means are typical for undergraduate students in Canada. Age at entry is 18.6, a majority of students that enrol are female, and high school grade averages are tightly distributed around the mean of about 85 percent.[2] GPA is on a 4.0 point scale, with one point roughly

[2] Before 2003, students typically completed 5 years of high school (up to Grade 13) before enrolling in postsecondary education. In 2003, the provincial curriculum changed to remove Grade 13 and facilitate high school graduation in 4 years.

corresponding to one letter grade.[3] Annual Fall registration status shows that about 10 percent of our first-year students in our sample did not continue to register into the Fall of their second year of the program. The graduation rate among those who started before 2000 was 78 percent. One third of all students report a mother tongue other than English (or French), and 10 percent are of Asian citizenship. Program at entry is almost evenly split between Science, Social Science, and undeclared.

Most courses in first year are full-year and worth 1 credit. About 15 percent of courses are Fall semester courses and another 15 percent are Winter courses, worth .5 credits. Students take, on average, 4.5 course credits. Table 2 shows descriptive data categorized by student and first year course. This is our baseline dataset used for in the analysis. The unit of observation is the student and the course. The average number of courses taken in the first year of the same subject is 1.2 – some students take more than one mathematics course, for example. As students specialize in higher years, the average number of upper year courses in the same subject as the first year course declines, while the standard deviation increases. The variable 'subject year 2' is zero if a student does not take any courses in second year. The subject grade average is also included for students that took subsequent courses in upper years of their program. The subject average increases into fourth year.

Instructor evaluations are distributed near the end of semester in each class. The form is anonymous and identical across all Arts and Science courses. Table 5 lists the main questions asked. The two that faculty focus most on for tenure decisions and teaching review are question 11: "All things considered, this instructor performs effectively as a university teacher" and the retake question, "Considering your experience with this course, and disregarding your need for it to meet program or degree requirements, would you still have taken this course? Most possible responses are on a 7 point scale, ranging from 1 (extremely poor) to 7 (outstanding). Across 1,852 first year instructors, the 'mean of the mean' for question 11, 'Effective Overall', is 5.6 (for both the weighted and

[3] F (0-49%) = 0.0 grade point value (GPV), D- to D+ (50-59%) = 0.7 to 1.3 GPV, C- to C+ (60-69%) = 1.7 to 2.3 GPV, B- to B+ (70-79%) = 2.7 to 3.3 GPV, A- (80-84%) = 3.7 GPA, and A to A+ (85% or more) = 4.0 GPV.

unweighted sample), and a standard deviation of .60. The 25th percentile instructor and the 75th percentile instructors differ by almost exactly two standard deviations (5.2 versus 6.2). The mean of the fraction of students that say they would take the course again is 67.8 percent, with a standard deviation of 15.4. The 25th percentile instructor has a retake response of 51 percent, while the 75th percentile instructor has a retake response rate of 80 percent. The evaluations data also include the name of the instructor, the corresponding course, section, and year, the number enrolled in the course and the number who filled out the forms. In a few instances, more than one instructor co-taught a section of a course. In these cases, teacher characteristics are averaged over both, and the pair is counted as one 'instructor'.

Some students in first year take uncommon courses or upper year courses. Over the data's 9 year period, this increases the count of courses substantially, to 1,017. Course selection, however, is concentrated among the 48 largest courses, with more than 200 students, on average, per section. From our data of students and course, 78 percent of courses taken are these large courses. To explore the importance of instructor quality variation among the smaller courses in our analysis, we also compare results using only the 'large course' sample. Each large course is listed and described in Table 6.

The evaluation data are matched to the student*class data, thus creating a student-instructor match, along with instructor evaluation characteristics.[4] We drop evening courses (courses taken after 5 PM). We also have data for class dates, ,time, and location, but only since 1999.

III. Methodology

After finding that observable teacher characteristics across primary and secondary schools are often weakly correlated with student performance, several researchers have attempted to estimate instead teacher specific 'value added', which can be defined as the

[4] In near future work, we hope to also match instructors to other characteristics such as rank, lecturer and adjunct status, gender, education, age, and whether received a teaching award.

expected increase or decrease in a student's outcome from attending a class with a particular instructor, relative to the mean outcome. The methodologies used in this literature often estimate the variance or standard deviation of the value added effects, but not necessarily the effects for each teacher. The variance indicates the extent to which teachers mater in determining student performance. A zero variance, for example implies it makes no difference, on average, to a student's performance which teacher she is assigned. A large variance, on the other hand, indicates important differences in performance outcomes due to differences in teacher assignment.

Kane, Rockoff, and Staiger (2006) estimate the standard deviation for teacher valued added to elementary and secondary normalized student test scores (with mean zero and standard deviation one) is about 0.13. Sorted by value added, the difference between the teacher with the 25^{th} percentile value and the 75^{th} percentile value is about 2 standard deviations. The results suggest that a change from one teacher to the other would affect a student's test score by about one quarter of a standard deviation. Aaronson, Barrow, and Sander estimate that one semester with a high school teacher rated two standard deviations higher in value added would add 0.3 to 0.5 grade equivalents, or 25 to 45 percent of an average school year, to a student's math score performance. Rockoff (2004) finds the standard deviations in the value added for New Jersey elementary students' normalized reading vocabulary and math computation test scores are 0.11. Rivkin, Hanushek, and Kain (2005) also arrive at similar estimates for Texas elementary students. They find a one standard deviation increase in teacher value added raises average student math test scores by 0.11 standard deviations of the total score

The two chief problems with trying to estimate value added variances is student selection and measurement error. We adopt an approach that is similar in spirit to Kane, Rockoff, and Staiger (2005), who look at the year-to-year teacher covariance in mean student test scores across classes, schools, and time. The covariance estimation approach is also similar to one used by Page and Solon (2003) to estimate 'value added' to earnings from

growing up in a particular neighbourhood.[5] Page and Solon estimate that a one standard deviation in value added neighbourhood quality would increase expected earnings by up to 18 percent.

Consider the outcome of interest, y_{iktps}, for student i, in course k, in year t, with instructor (professor) p, in section s. We decompose y_{iktps} by the following:

$$(1) \qquad y_{iktps} = \delta_{kt} + \delta_p + \delta_{kts} + \delta_{iktps}$$

where δ_{kt} is a year-by-course fixed effect. δ_p is an instructor fixed effect and the variance (or standard deviation) of δ_p is the primary measure of interest. The outcome may depend on a class specific effect, δ_{kts}, independent of instructor. This may be because the class is held early in the morning, or a because of a particular disruption (a fire alarm, perhaps). The outcome also depends on student specific factors, δ_{iktps}, and other factors other than instructor, course, time, or section.

Even in the absence of students selecting instructors or classes, unbiased estimates of instructor value added, $\hat{\delta}_p$, will contain measurement error, u: $\hat{\delta}_p = \delta_p + u$. Measurement error will bias the estimate of $\text{var}(\delta_p)$ upwards [$\hat{\sigma}^2_{\delta_p} = \sigma^2_{\delta_p} + \sigma^2_u$] and previous researchers have found this bias can be substantial. Positive sorting by students so that $\text{cov}(\delta_p, \delta_{iktps}) > 0$ will also bias estimates of $\text{var}(\delta_p)$ upwards.

We address these issues by estimating outcome covariances of students with the same instructor among students taking the same course. Students will end up taking a course with different instructors either because of multiple sections offered in the same year, or because of year-to-year changes in who teaches. Using within course variation leads to a

[5] For comparison, Page and Solon estimate that a one standard deviation in value added neighbourhood quality would increase expected earnings by up to 18 percent. Also for comparison, the authors estimate sibling earnings covariances to be about 0.35. This would imply a one standard deviation in 'family value added' would increase earnings by 59 percent!

conceptually appealing counterfactual: how would a student's outcome differ if she took the same course but with a 'better' or 'worse' instructor (with better or worse determined by deviations in value added). We use variation from students in the same course but in different sections, and students in the same course but in different years. First, consider the residual after differencing the mean course-by-year outcome, which we do in our estimation procedure with course-by-year fixed effects (with and without individual background controls):

$$(2) \qquad y_{iktps} - E_{kt}(y_{iktps}) = \left[\delta_p - E(\delta_p \mid k,t)\right] + \left[\delta_{kts} - E(\delta_{kts} \mid k,t)\right] + \left[\delta_{iktps} - E(\delta_{iktps} \mid k,t)\right] .$$

The first part of the right-hand-side of equation (2), $\left[\delta_p - E(\delta_p \mid k,t)\right]$, is the within-course value added to student course performance, relative to the course mean for each year. Deviations from the mean may also be due to class specific factors, $\left[\delta_{kts} - E(\delta_{kts} \mid k,t)\right]$ and individual factors, $\left[\delta_{iktps} - E(\delta_{iktps} \mid k,t)\right]$. Abbreviate equation (2) as follows:

$$(3) \qquad \mathrm{y}'_{\mathrm{iktps}} = \delta'_p + \delta'_{kts} + \delta'_{iktps} .$$

The within section covariance in outcomes is:

$$(4) \qquad C(\mathrm{y}'_{\mathrm{i=1,ktps}}, \mathrm{y}'_{\mathrm{i\neq 1,ktps}}) = V(\delta'_p) + V(\delta'_{kts}) + 2\mathrm{C}(\delta'_p, \delta'_{kts}) + 2\mathrm{C}(\delta'_p, \delta'_{iktps}) + 2\mathrm{C}(\delta'_{kts}, \delta'_{iktps})$$

We focus on first year courses because students are less likely to choose a section based on the instructor than in higher years. Entering first year students choose courses during the summer before they begin their program and are likely more concerned about course scheduling. They also have less access to a network of upper year students who can advise them about which instructors are 'better'. Many courses also do not list the name of the instructor. However, students may select by section, to be with friends, or because students in similar programs end up in similar classes. The within section covariance will be biased upwards by this type of sorting. To address this, we also calculate the within

class but across section covariance. If professors are assigned to sections in a manner that is independent of section fixed effects[6], then the across section covariance is:

$$(5) \qquad C(y'_{i=1,k,t,p,s=1}, y'_{i\neq 1,k,t,p,s\neq 1}) = V(\delta'_p) + 2C(\delta'_p, \delta'_{iktps}) .$$

To remove further possible student selection by instructors, we also consider year-to-year instructor changes for courses with only one section per year. We include year fixed effects to control for overall trends. For this sample, student selection is very unlikely, since it would require first year students to change the year they take the course.

It is important to note that the estimated value added variance is relative to the within course mean outcome. Equation (2) highlights that if Professor Jones taught 3 sections and Professor Smith taught the other 1 section, the value added variance would be mechanically smaller than if both professors taught 2 sections. (At the extreme, if Professor Jones taught 100 students and Professor Smith taught 1, even if the value added effect from being with Professor Smith was large, the variance around the mean would be small). This issue arises for all value added studies.

To see this more clearly, Figure 1 shows the demeaned kernel density for the students' retake willingness response rate for the total student-by-course sample. The response rate varies widely, with a standard deviation of 15.4 percentage points. Figure 1 overlays this with the kernel density of the retake variable residuals after subtracting course means. The within course standard deviation of the retake response rate is 6.5. We can increase the within course variance of this measure of instructor quality by restricting the sample to students in courses where no instructor teaches more than 50 percent of students. Figure 2 shows the kernel density using this sample, which is 41 percent of the full sample. The standard deviation of the retake residual variable is now 9.1. Thus, in courses with a greater balance of more than one instructor, the within course variation in instructor characteristics is significantly closer the total sample variation. Figure 3 shows

[6] This assumption may not be true if instructors prefer teaching at a particular time of day, taught over less than the 9 year period the data span. In these cases, the across section covariance will be higher.

the density after restricting the sample to students in courses where no instructor teachers more than 30 percent. Now the standard deviation is 10.6, but this sample is only 8 percent of the total sample. We estimate student covariances for the total sample and these two sub-samples to examine the sensitivity of the results.

Another related caveat is that the value added variance is driven by across section or across year differences in instructors. If first-year course instructors do not differ considerably in quality, then we should not expect to see much difference in outcomes. Casual inspection of most first-year classes and of the figures discussed above, however, suggests that instructors do differ, by experience, rank, and overall style.

We estimate the value added effects for each teacher using an empirical Bayesian estimation approach adopted by Kane, Rockoff, and Staiger (2005).

Estimation Procedure

The estimation is as follows. For the base sample using same course and year but different sections, we obtain outcome residuals from the OLS regression of outcomes on course and year fixed effects, with and without individual background controls. The control variables we condition on are high school grade average, indicator variables for age, gender, ethnicity, entry program, and mother tongue. We also tried including high school fixed effects, which produced similar results, but took much longer to estimate. We also examine the results for the sample with only one section per year, and include separate course and year fixed effects.

Once the residuals are generated, we calculate the outcome covariance between students with the same instructor, within sections and across years. We follow the covariance estimation procedure used by Solon and Page (2003) for common neighbors. In the case without individual controls, let $y'_{iktps} = y_{iktps} - \bar{y}_{kt}$ be the outcome variable minus its course-by-year mean. The within course-by-year outcome covariance is calculated as:

$$(6) \qquad \hat{C}(y'_{i,ktps}, y'_{i',ktps}) = \left[\sum_{k'=1}^{K} \sum_{t'=1}^{T} \sum_{p'=1}^{P} \sum_{s'=1}^{S_{ktp}} \sum_{i=1}^{I_{ktps}} \sum_{i'=1}^{I_{ktps}} y'_{i,k't'p's'} y'_{i'\neq i,k't'p's'} \right] / N' \ ,$$

where I_{ktps} is the number of individuals within section ktps, S_{ktp} is the number of sections kt, T is the number of courses, K is the number of years, and N' is the number of observations in the numerator. For the sample with one section per year, the covariance is calculated as:

$$(7) \qquad \hat{C}(y'_{i,k,t,p}, y'_{i',k,t',p}) = \left[\sum_{k'=1}^{K} \sum_{t=1}^{T} \sum_{t'=1}^{T} \sum_{p'=1}^{P} \sum_{i=1}^{I_{ktps}} \sum_{i'=1}^{I_{ktps}} y'_{i,k'tp'} y'_{i',k't'\neq t,p'} \right],$$

where N'' is the number of observations in this numerator. Ninety-five percent confidence regions are estimated by bootstrap.

IV. Results

Table 7: Results with full sample, possibly downward biased from including several courses dominated by one or two similar professors. Estimates show very small outcome covariances in outcomes for students with the same instructor after controlling for course.

Table 8: Standard deviations higher after restricting the same to those in courses with fewer than half in the course taught by one instructor. But covariances are within section, which may bias estimates upwards because of time or class specific factors not directly related to race.

Table 9 examines outcome covariances for students with the same instructor but in different sections. Estimates of the covariances are small, but not zero. The estimates using only cross-year variation in instructors are tiny.

All results will be bootstrapped. Initial bootstrapping indicate that these estimates are accurate, with very small confidence intervals (as expected with such a large sample set).

The other set of tables explore more directly the effects of teacher quality, measured by high or low teaching evaluations, on student performance. Table 10 shows a small correlation between teaching evaluation characteristics and high school grade, indication a small level of sorting.

Tables 11A and 11B show small but significant estimated effects of being with an instructor better evaluated on effectiveness on likelihood of dropping the course, and subjects taken in following years. The implied effects are smaller than those reported for the value added. Compare these results with the high school grade coefficient, which is by far the strongest predictor of subsequent student performance.

Lastly, Table 12 aggregates the course data to the individual, and matches individuals taking the same set of courses. This lets us explore more interesting data on overall first and second year student achievement. The regressions are almost the same but condition on same course curriculum instead of specific courses. The results suggest little difference in outcomes from taking the same set of courses, but with contrasting professors in different classes.

V. Conclusion

We use a new administrative dataset of students at a large Canadian university matched to their first year courses and corresponding instructors to analyze the importance of instructors in determining student achievement at the postsecondary level. Several researchers exploring teacher quality effects at the primary and secondary education level caution against the conclusion that teachers play little role in education from the finding that observable characteristics, such as experience and salary, are often weakly correlated with student test score achievement. They show that outcomes do differ significantly across instructor, even though few characteristics are correlated to these differences.

This paper adopts a similar approach by first estimating the extent of variation in student outcomes by instructors, within a given course. The within-course analysis provides an intuitive counterfactual question of interest: how would a student's subsequent achievement differ if she enrolled in the same course but with a different instructor? We estimate the variance of the value added that instructors contribute to different outcomes, which can then be used to approximate the impact from switching to a professor who differs in value added by one or two standard deviations. We address the possibility of student selection by instructor in several ways. First, we focus on first years, who choose courses in the summer prior to their start of college and with little information on the traits of each instructor. The course calendar for the university examined in this study often does not list the instructor's name at the time of registration. Second, we examine the sensitivity of the results after conditioning out several observable background characteristics such as high school grade. More importantly, we examine similarities among students with the same instructor but in different sections or in different years. The instructor year-to-year variation in particular is unlikely significantly related to systematic sorting.

The main finding is that the variance among first year students taking same courses but with different instructors is small, but not trivial: a two standard deviation switch in instructor quality would be expected to lower the likelihood of dropping the course by 1.5 percentage points, and increase the number of course subjects enrolled in the following year by less than 0.05 of its standard deviation. The value-added approach provides an overall sense of the importance of instructor variation within course, whether we can measure this importance in other ways with observable characteristics or not. But this approach may not generate interesting findings in situations where one instructor teaches most of the students in a class – the variance in instructor fixed effects would be small. We find similar results, however, when we restrict the sample to courses where no one instructor teachers more than half of the students.

To provide an alternative, more direct, measure of the effects of teacher quality on student performance, we estimate the within course effect from being with an instructor

of better rank in his or her teaching evaluations. Conditional on course and year, we regress student outcomes on the mean overall effectiveness given by students to the instructor, or the fraction of students that agree they would have taken the course again. This analysis also indicates a small, but statistically significant effect from differences in subjective teacher quality.

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Table 1: Descriptive Statistics by student, individual data

	full sample	language			citizenship			program enrolled		
		english	french	other	north american	asian	other	science	social science	unknown
age at entry	18.6	18.6	18.5	18.6	18.6	18.8	18.6	18.4	18.6	18.8
	(0.73)	(0.71)	(0.75)	(0.77)	(0.71)	(0.84)	(0.83)	(0.75)	(0.72)	(0.69)
female	0.60	0.59	0.70	0.62	0.59	0.63	0.63	0.56	0.62	0.62
highschool grade	85.7	85.5	86.2	86.2	85.6	86.7	85.2	87.4	84.1	77.9
	(5.6)	(5.7)	(4.7)	(5.4)	(5.4)	(5.4)	(7.2)	(5.2)	(5.5)	(4.7)
GPA year1	2.5	2.5	2.6	2.5	2.5	2.4	2.5	2.6	2.5	2.5
	(0.91)	(0.88)	(0.86)	(0.96)	(0.89)	(1.02)	(0.94)	(0.95)	(0.88)	(0.88)
GPA year 2	2.6	2.6	2.8	2.5	2.6	2.4	2.6	2.6	2.6	2.6
	(0.86)	(0.85)	(0.71)	(0.89)	(0.85)	(0.92)	(0.90)	(0.90)	(0.83)	(0.86)
GPA year 3	2.7	2.8	2.9	2.6	2.8	2.5	2.7	2.8	2.7	2.7
	(0.81)	(0.79)	(0.69)	(0.82)	(0.79)	(0.85)	(0.84)	(0.83)	(0.78)	(0.80)
GPA year 4	2.9	2.9	3.1	2.7	2.9	2.6	2.7	2.9	2.8	2.9
	(0.80)	(0.78)	(0.69)	(0.81)	(0.78)	(0.83)	(0.86)	(0.82)	(0.76)	(0.80)
GPA year 5	2.7	2.7	3.1	2.5	2.7	2.3	2.6	2.7	2.6	2.7
	(0.89)	(0.89)	(0.63)	(0.90)	(0.89)	(0.92)	(0.88)	(0.90)	(0.91)	(0.88)
total credits year 1	4.5	4.6	4.5	4.4	4.5	4.2	4.5	4.5	4.4	4.6
	(0.81)	(0.77)	(0.89)	(0.86)	(0.78)	(0.97)	(0.79)	(0.81)	(0.89)	(0.67)
total credits year 2	3.9	3.9	3.8	3.9	3.9	3.8	3.8	4.0	3.9	3.8
	(1.6)	(1.6)	(1.6)	(1.5)	(1.6)	(1.5)	(1.6)	(1.5)	(1.6)	(1.6)
total credits year 3	3.9	3.9	4.0	3.9	3.9	3.8	3.8	4.0	3.9	3.8
	(1.6)	(1.6)	(1.6)	(1.5)	(1.6)	(1.5)	(1.6)	(1.5)	(1.6)	(1.6)
total credits year 4	3.7	3.7	3.9	3.5	3.7	3.3	3.5	3.8	3.8	3.5
	(1.7)	(1.7)	(1.5)	(1.7)	(1.7)	(1.8)	(1.8)	(1.6)	(1.6)	(1.9)
total credits year 5	1.3	1.3	1.3	1.3	1.3	1.2	1.5	1.5	1.2	1.2
	(1.8)	(1.8)	(1.9)	(1.8)	(1.8)	(1.8)	(1.9)	(1.9)	(1.8)	(1.8)
good standing year 1	0.78	0.80	0.78	0.74	0.80	0.68	0.76	0.78	0.77	0.80
	(0.41)	(0.40)	(0.41)	(0.44)	(0.40)	(0.47)	(0.43)	(0.41)	(0.42)	(0.40)
good standing year 2	0.74	0.75	0.72	0.71	0.75	0.66	0.71	0.68	0.76	0.78
	(0.44)	(0.43)	(0.45)	(0.46)	(0.43)	(0.47)	(0.46)	(0.47)	(0.43)	(0.41)
good standing year 3	0.64	0.64	0.68	0.64	0.64	0.62	0.64	0.58	0.60	0.76
	(0.48)	(0.48)	(0.47)	(0.48)	(0.48)	(0.48)	(0.48)	(0.49)	(0.49)	(0.43)
good standing year 4	0.58	0.60	0.60	0.56	0.59	0.55	0.58	0.50	0.55	0.69
	(0.49)	(0.49)	(0.49)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)	(0.50)	(0.46)
good standing year 5	0.22	0.23	0.30	0.19	0.22	0.17	0.25	0.20	0.17	0.26
	(0.41)	(0.42)	(0.46)	(0.39)	(0.42)	(0.38)	(0.43)	(0.40)	(0.38)	(0.44)
fall reg year 1	0.99	0.99	0.97	0.99	0.99	0.98	0.98	0.99	0.98	1.00
	(0.11)	(0.11)	(0.16)	(0.11)	(0.11)	(0.12)	(0.12)	(0.11)	(0.14)	(0.06)
fall reg year 2	0.89	0.88	0.87	0.90	0.89	0.90	0.88	0.90	0.90	0.87
	(0.32)	(0.32)	(0.34)	(0.30)	(0.32)	(0.30)	(0.33)	(0.31)	(0.30)	(0.34)
fall reg year 3	0.83	0.82	0.84	0.84	0.83	0.84	0.82	0.83	0.84	0.82
	(0.38)	(0.38)	(0.37)	(0.37)	(0.38)	(0.37)	(0.38)	(0.38)	(0.37)	(0.38)
fall reg year 4	0.77	0.77	0.75	0.77	0.77	0.76	0.76	0.77	0.80	0.74
	(0.42)	(0.42)	(0.43)	(0.42)	(0.42)	(0.43)	(0.43)	(0.42)	(0.40)	(0.44)
fall reg year 5	0.32	0.33	0.33	0.31	0.32	0.29	0.36	0.35	0.32	0.30
	(0.47)	(0.47)	(0.47)	(0.46)	(0.47)	(0.46)	(0.48)	(0.48)	(0.47)	(0.46)
undergraduate degree: all observations	0.44	0.45	0.47	0.42	0.45	0.41	0.41	0.29	0.34	0.76
undergraduate degree: entry data before 2000	0.78	0.77	0.79	0.81	0.78	0.84	0.75	0.78	0.77	0.78
dropped early	0.07	0.07	0.07	0.08	0.07	0.11	0.08	0.08	0.11	0.01
dropped late	0.05	0.05	0.06	0.06	0.05	0.08	0.05	0.06	0.08	0.01
number of observations	39926	23695	172	10894	29705	3470	1536	10426	13697	10758
sample fraction	1	0.66	0.00	0.33	0.84	0.10	0.05	0.35	0.36	0.29

Notes: weighted means used; includes individuals who entered at an age between 16 and 20; does not include evening courses; weight=number of observations per student; 1% missing observations for citizenship; 40% missing observations for variable hsgrade; north_america includes Canada&US; science includes engineering, computer science, all natural sciences and combined programs; social science includes humanities, economics, business&commerce and combined programs; "undergraduate degree: all observations" is the graduation rate, including those which are still in university; "undergraduate degree: entry data before 2000" only includes those which entered university in September 1999 and earlier; "number of observations" is the number of individuals in the sample; not every variable is observable for all individuals.

Table 2: Descriptive Statistics by student and course, individual data

	full sample	language			citizenship			program enrolled		
		english	french	other	north american	asian	other	science	social science	other
subjects year 1	1.20	1.19	1.21	1.21	1.20	1.18	1.27	1.28	1.10	1.22
	(0.69)	(0.69)	(0.70)	(0.70)	(0.68)	(0.71)	(0.77)	(0.70)	(0.66)	(0.70)
subjects year 2	0.72	0.73	0.63	0.71	0.72	0.69	0.77	0.66	0.75	0.77
	(1.2)	(1.2)	(1.1)	(1.2)	(1.2)	(1.2)	(1.3)	(1.2)	(1.2)	(1.3)
subjects year 3	0.52	0.53	0.53	0.50	0.52	0.49	0.57	0.39	0.57	0.62
	(1.3)	(1.2)	(1.2)	(1.3)	(1.2)	(1.3)	(1.4)	(1.2)	(1.3)	(1.3)
subjects year 4	0.37	0.39	0.44	0.33	0.37	0.32	0.38	0.22	0.41	0.49
	(1.1)	(1.1)	(1.3)	(1.1)	(1.1)	(1.0)	(1.2)	(0.9)	(1.2)	(1.3)
subjects year 5	0.08	0.08	0.11	0.07	0.08	0.06	0.11	0.06	0.07	0.12
	(0.49)	(0.50)	(0.59)	(0.48)	(0.49)	(0.44)	(0.65)	(0.44)	(0.43)	(0.61)
subject credits year 1	0.60	0.60	0.60	0.60	0.60	0.59	0.63	0.64	0.55	0.61
	(0.34)	(0.34)	(0.35)	(0.35)	(0.34)	(0.36)	(0.38)	(0.35)	(0.33)	(0.35)
subject credits year 2	0.36	0.36	0.32	0.35	0.36	0.34	0.38	0.33	0.37	0.39
	(0.61)	(0.61)	(0.54)	(0.60)	(0.61)	(0.59)	(0.64)	(0.58)	(0.62)	(0.63)
subject credits year 3	0.26	0.26	0.27	0.25	0.26	0.25	0.29	0.19	0.29	0.31
	(0.63)	(0.62)	(0.62)	(0.64)	(0.63)	(0.63)	(0.69)	(0.58)	(0.64)	(0.67)
subject credits year 4	0.18	0.19	0.22	0.17	0.19	0.16	0.19	0.11	0.21	0.25
	(0.56)	(0.57)	(0.63)	(0.54)	(0.56)	(0.53)	(0.58)	(0.45)	(0.59)	(0.64)
subject credits year 5	0.04	0.04	0.06	0.03	0.04	0.03	0.05	0.03	0.03	0.06
	(0.25)	(0.25)	(0.30)	(0.24)	(0.25)	(0.22)	(0.32)	(0.22)	(0.22)	(0.31)
subject grades year 1	69.17	69.13	69.47	69.23	69.25	68.69	68.82	70.33	68.25	68.83
	(13.7)	(13.4)	(12.4)	(14.3)	(13.5)	(15.3)	(14.4)	(14.0)	(13.7)	(13.2)
subject grades year 2	69.44	69.86	72.00	68.59	69.71	67.54	68.77	69.00	70.02	69.31
	(13.2)	(13.0)	(9.7)	(13.5)	(13.0)	(14.3)	(14.2)	(14.3)	(12.3)	(12.9)
subject grades year 3	71.06	71.74	73.37	69.55	71.51	67.64	70.52	70.39	71.65	70.88
	(12.6)	(12.4)	(12.4)	(12.8)	(12.3)	(14.1)	(14.1)	(14.0)	(11.5)	(12.6)
subject grades year 4	72.45	73.19	75.09	70.61	72.89	68.78	71.96	71.21	73.35	72.18
	(12.3)	(12.1)	(13.6)	(12.6)	(12.0)	(13.6)	(13.7)	(14.1)	(11.1)	(12.3)
subject grades year 5	69.77	70.41	75.47	68.07	70.23	65.90	69.07	69.29	70.77	69.30
	(15.2)	(15.4)	(9.5)	(14.7)	(15.0)	(15.1)	(17.1)	(16.0)	(14.7)	(15.1)
number of observations	134676	88765	626	44702	113627	14026	6136	47714	48478	38484

Notes: 1% missing observations for citizenship; 40% missing observations for variable hsgrade; north_america includes Canada&US; science includes engineering, computer science, all natural sciences and combined programs; social science includes humanities, economics, business&commerce and combined programs.

Table 3: Descriptive Statistics by student, aggregate data

	full sample	language			citizenship			program enrolled		
		english	french	other	north american	asian	other	science	social science	unknown
age at entry	18.5	18.5	18.4	18.5	18.5	18.7	18.5	18.4	18.6	18.6
	(0.70)	(0.68)	(0.73)	(0.74)	(0.67)	(0.83)	(0.81)	(0.72)	(0.69)	(0.64)
female	0.60	0.58	0.68	0.63	0.59	0.66	0.64	0.60	0.60	0.61
highschool grade	86.5	86.3	86.5	86.9	86.5	87.4	86.0	87.9	84.4	80.0
	(5.4)	(5.6)	(4.6)	(5.2)	(5.2)	(5.3)	(7.6)	(5.0)	(5.3)	(7.0)
GPA year1	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.7	2.5	2.6
	(0.89)	(0.86)	(0.76)	(0.94)	(0.87)	(1.00)	(0.97)	(0.92)	(0.85)	(0.86)
GPA year 2	2.7	2.7	2.8	2.6	2.7	2.5	2.6	2.7	2.6	2.7
	(0.84)	(0.83)	(0.64)	(0.88)	(0.83)	(0.92)	(0.90)	(0.87)	(0.80)	(0.85)
GPA year 3	2.8	2.9	2.9	2.7	2.8	2.6	2.7	2.8	2.7	2.8
	(0.80)	(0.78)	(0.52)	(0.82)	(0.78)	(0.86)	(0.83)	(0.82)	(0.77)	(0.79)
GPA year 4	2.9	3.0	3.2	2.8	3.0	2.7	2.8	3.0	2.8	3.0
	(0.77)	(0.76)	(0.54)	(0.80)	(0.76)	(0.84)	(0.88)	(0.80)	(0.74)	(0.77)
GPA year 5	2.7	2.8	3.2	2.6	2.8	2.4	2.7	2.8	2.6	2.8
	(0.88)	(0.87)	(0.44)	(0.91)	(0.87)	(0.95)	(0.90)	(0.90)	(0.90)	(0.86)
total credits year 1	4.6	4.7	4.6	4.6	4.7	4.4	4.6	4.7	4.5	4.8
	(0.68)	(0.65)	(0.92)	(0.73)	(0.66)	(0.85)	(0.63)	(0.68)	(0.83)	(0.37)
total credits year 2	4.1	4.1	4.0	4.0	4.1	4.0	3.9	4.1	4.0	4.1
	(1.5)	(1.5)	(1.5)	(1.4)	(1.5)	(1.4)	(1.5)	(1.4)	(1.5)	(1.5)
total credits year 3	4.0	4.1	3.9	4.0	4.1	3.9	3.9	4.1	4.0	4.0
	(1.5)	(1.5)	(1.6)	(1.5)	(1.5)	(1.5)	(1.6)	(1.4)	(1.5)	(1.5)
total credits year 4	3.8	3.9	4.0	3.7	3.8	3.6	3.7	3.9	3.8	3.6
	(1.7)	(1.7)	(1.4)	(1.7)	(1.7)	(1.7)	(1.8)	(1.6)	(1.5)	(1.9)
total credits year 5	1.2	1.2	1.1	1.2	1.2	1.1	1.4	1.4	1.1	1.1
	(1.8)	(1.7)	(1.7)	(1.8)	(1.8)	(1.7)	(1.9)	(1.8)	(1.7)	(1.7)
good standing year 1	0.84	0.86	0.84	0.81	0.85	0.76	0.80	0.84	0.80	0.89
	(0.37)	(0.35)	(0.37)	(0.39)	(0.36)	(0.42)	(0.40)	(0.37)	(0.40)	(0.31)
good standing year 2	0.79	0.81	0.75	0.75	0.80	0.71	0.74	0.73	0.84	0.84
	(0.41)	(0.40)	(0.43)	(0.43)	(0.40)	(0.45)	(0.44)	(0.44)	(0.37)	(0.36)

good standing year 3	0.66 (0.47)	0.67 (0.47)	0.67 (0.47)	0.65 (0.48)	0.66 (0.47)	0.63 (0.48)	0.66 (0.47)	0.60 (0.49)	0.63 (0.48)	0.81 (0.39)
good standing year 4	0.59 (0.49)	0.60 (0.49)	0.63 (0.48)	0.56 (0.50)	0.59 (0.49)	0.56 (0.50)	0.58 (0.49)	0.49 (0.50)	0.57 (0.50)	0.73 (0.44)
good standing year 5	0.19 (0.39)	0.20 (0.40)	0.26 (0.44)	0.17 (0.38)	0.20 (0.40)	0.16 (0.37)	0.21 (0.41)	0.17 (0.38)	0.14 (0.35)	0.25 (0.43)
fall reg year 1	0.99 (0.09)	0.99 (0.09)	0.96 (0.19)	0.99 (0.09)	0.99 (0.09)	0.99 (0.09)	0.99 (0.11)	0.99 (0.08)	0.98 (0.13)	1.00 (0.02)
fall reg year 2	0.91 (0.28)	0.91 (0.29)	0.88 (0.33)	0.92 (0.28)	0.91 (0.29)	0.92 (0.27)	0.89 (0.31)	0.91 (0.28)	0.91 (0.28)	0.90 (0.30)
fall reg year 3	0.85 (0.35)	0.85 (0.36)	0.86 (0.35)	0.86 (0.35)	0.85 (0.35)	0.86 (0.35)	0.83 (0.37)	0.84 (0.36)	0.87 (0.34)	0.85 (0.36)
fall reg year 4	0.79 (0.40)	0.80 (0.40)	0.76 (0.43)	0.79 (0.40)	0.79 (0.40)	0.79 (0.41)	0.79 (0.41)	0.79 (0.41)	0.83 (0.37)	0.77 (0.42)
fall reg year 5	0.30 (0.46)	0.30 (0.46)	0.31 (0.46)	0.30 (0.46)	0.30 (0.46)	0.27 (0.45)	0.34 (0.47)	0.33 (0.47)	0.30 (0.46)	0.28 (0.45)
undergraduate degree: all observations	0.44	0.46	0.45	0.40	0.44	0.40	0.39	0.29	0.38	0.81
undergraduate degree: entry data before 2000	0.82	0.81	0.88	0.85	0.82	0.88	0.82	0.81	0.85	0.82
dropped early	0.05	0.05	0.08	0.06	0.05	0.08	0.06	0.05	0.10	0.00
dropped late	0.04	0.04	0.06	0.05	0.04	0.07	0.04	0.04	0.08	0.00
number of observations	16469	10905	80	5484	14084	1635	697	7033	5548	3935
sample fraction	1	0.63	0.00	0.36	0.84	0.11	0.04	0.48	0.29	0.23

Notes: weighted means used; includes individuals who entered at an age between 16 and 20; does not include evening courses; weight=number of observations per student; 1% missing observations for citizenship; 40% missing observations for variable hsgrade; north_america includes Canada&US; science includes engineering, computer science, all natural sciences and combined programs; social science includes humanities, economics, business&commerce and combined programs; "undergraduate degree: all observations" is the graduation rate, including those which are still in university; "undergraduate degree: entry data before 2000" only includes those which entered university in September 1999 and earlier; "number of observations" is the number of individuals in the sample; not every variable is observable for all individuals.

Table 4: Descriptive Statistics by student and course, aggregate data

	full sample	language			citizenship			program enrolled		
		english	french	other	north american	asian	other	science	social science	unknown
subjects year 1	1.2	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.0	1.1
	(0.54)	(0.52)	(0.58)	(0.57)	(0.53)	(0.59)	(0.57)	(0.60)	(0.55)	(0.28)
subjects year 2	0.69	0.69	0.49	0.69	0.69	0.66	0.71	0.62	0.82	0.66
	(1.1)	(1.2)	(0.9)	(1.1)	(1.2)	(1.1)	(1.2)	(1.1)	(1.3)	(1.1)
subjects year 3	0.46	0.47	0.28	0.45	0.46	0.44	0.51	0.33	0.67	0.48
	(1.2)	(1.2)	(0.8)	(1.2)	(1.2)	(1.2)	(1.3)	(1.1)	(1.4)	(1.2)
subjects year 4	0.32	0.33	0.18	0.30	0.32	0.30	0.34	0.18	0.48	0.40
	(1.1)	(1.1)	(0.8)	(1.0)	(1.1)	(1.0)	(1.1)	(0.8)	(1.3)	(1.2)
subjects year 5	0.06	0.06	0.02	0.05	0.06	0.04	0.07	0.04	0.06	0.09
	(0.43)	(0.44)	(0.25)	(0.41)	(0.43)	(0.34)	(0.51)	(0.38)	(0.40)	(0.55)
subject credits year 1	0.58	0.57	0.56	0.60	0.58	0.59	0.61	0.64	0.52	0.53
	(0.27)	(0.26)	(0.29)	(0.29)	(0.26)	(0.30)	(0.29)	(0.30)	(0.27)	(0.14)
subject credits year 2	0.34	0.34	0.25	0.34	0.34	0.33	0.36	0.31	0.41	0.33
	(0.57)	(0.58)	(0.45)	(0.57)	(0.58)	(0.54)	(0.60)	(0.54)	(0.65)	(0.55)
subject credits year 3	0.23	0.23	0.14	0.23	0.23	0.22	0.26	0.16	0.34	0.24
	(0.60)	(0.59)	(0.40)	(0.61)	(0.60)	(0.61)	(0.66)	(0.53)	(0.70)	(0.61)
subject credits year 4	0.16	0.17	0.09	0.15	0.16	0.15	0.17	0.09	0.24	0.20
	(0.53)	(0.54)	(0.39)	(0.52)	(0.53)	(0.52)	(0.55)	(0.40)	(0.65)	(0.59)
subject credits year 5	0.03	0.03	0.01	0.03	0.03	0.02	0.04	0.02	0.03	0.05
	(0.22)	(0.22)	(0.12)	(0.21)	(0.22)	(0.17)	(0.26)	(0.19)	(0.20)	(0.28)
subject grades year 1	70.3	70.0	69.1	70.8	70.3	70.5	69.3	71.3	68.5	70.3
	(13.0)	(12.7)	(10.6)	(13.5)	(12.7)	(14.6)	(14.4)	(13.1)	(13.0)	(12.5)
subject grades year 2	69.6	69.9	70.7	69.0	69.8	68.3	68.0	69.3	70.0	69.5
	(13.0)	(12.8)	(9.9)	(13.4)	(12.8)	(14.2)	(14.5)	(13.8)	(11.9)	(12.8)
subject grades year 3	70.9	71.6	71.7	69.5	71.3	67.9	70.9	70.1	71.5	71.1
	(12.5)	(12.2)	(11.3)	(12.8)	(12.2)	(14.2)	(12.9)	(13.5)	(11.4)	(12.4)
subject grades year 4	72.4	73.3	77.4	70.6	73.0	69.0	71.3	70.6	73.3	73.1
	(12.2)	(11.8)	(6.4)	(12.7)	(11.6)	(13.7)	(15.2)	(13.8)	(10.8)	(12.0)
subject grades year 5	69.1	69.8	76.7	67.5	69.8	65.5	64.6	67.9	70.5	69.1
	(16.0)	(15.9)	(4.0)	(16.1)	(15.2)	(17.8)	(21.4)	(16.9)	(14.7)	(16.1)
number of observations	67808	42829	310	24412	56998	7350	2949	32823	19412	15573

Notes: 1% missing observations for citizenship; 40% missing observations for variable hsgrade; north_america includes Canada&US; science includes engineering, computer science, all natural sciences and combined programs; social science includes humanities, economics, business&commerce and combined programs

Table 5: Descriptive Statistics by course

	full sample	large courses
avg. section size	259.0 (314.4)	332.6 (320.1)
number of sections	2.6 (2.1)	2.9 (2.2)
full year courses	0.69 (0.46)	0.71 (0.45)
spring courses	0.15 (0.36)	0.14 (0.34)
fall courses	0.16 (0.36)	0.16 (0.36)
response rate	0.57 (0.17)	0.57 (0.17)
communicates clearly (Question 2)	5.3 (0.47)	5.3 (0.46)
organized (Question 4)	5.4 (0.56)	5.4 (0.55)
explains concepts clearly (Question5)	5.4 (0.56)	5.4 (0.56)
enthusiastic (Question 6)	5.6 (0.64)	5.5 (0.64)
answers questions well (Question 7)	5.4 (0.51)	5.3 (0.49)
available to meet (Question 8)	5.3 (0.50)	5.2 (0.49)
grades fairly (Question 9)	5.0 (0.50)	4.9 (0.46)
effective overall (Question 11)	5.6 (0.56)	5.5 (0.57)
would take course again (Question 20)	67.9 (15.4)	65.7 (15.1)
grade	69.3 (13.9)	69.2 (13.9)
number of observations	1017	48
sample fraction (weighted)	1	0.78

Notes:big courses defined as below; weight=number of observations per course; "full sample" uses all courses in the sample, also second year and higher courses taken by first year students.

Table 6: Summary statistics of courses used in aggregate sample

	number of obs	section size	number of sections	grade	response rate	Effective overall	Would take course again
Introduction to Architecture	350	78.8 (25.8)	1 (0)	72.8 (9.9)	0.61 (0.00)	5.2 (0.04)	80.3 (1.1)
Contemporary Architecture	370	82.8 (24.4)	1 (0)	72.9 (14.1)	0.68 (0.03)	4.9 (0.07)	71.8 (4.1)
Sun and its neighbours	621	76.3 (26.5)	1.8 (0.40)	70.5 (11.1)	0.37 (0.06)	5.3 (0.20)	71.7 (4.6)
Organisms in the Environment	5099	878.2 (159.7)	1 (0)	72.1 (11.7)	0.77 (0.03)	5.4 (0.07)	67.8 (0.3)
General Chemistry	683	170.8 (0.0)	4 (0)	70.4 (13.8)	0.56 (0.18)	5.9 (0.24)	66.4 (2.1)
Introduction to Organic Chemistry	4698	480.5 71.0	2 (0)	72.8 (13.7)	0.58 (0.01)	5.7 (0.22)	68.4 (3.7)
Principles of Physical Chemistry	4683	480.3 (75.0)	2 (0)	71.6 (12.9)	0.46 (0.05)	5.2 (0.11)	52.3 (4.0)
The Why and How of Computers	147	30.2 (7.5)	1 (0)	68.4 (13.5)	0.56 (0.03)	5.8 (0.07)	74.1 (1.7)
Introduction to Computer Programming	1091	57.1 (18.6)	4.2 (1.26)	72.8 (15.1)	0.59 (0.10)	5.9 (0.44)	75.4 (3.6)
Introduction to Computer Science	883	47.3 (12.8)	4.1 (0.97)	67.5 (17.2)	0.54 (0.07)	5.8 (0.41)	72.4 (6.8)
Mathematical Expression and Reasoning	164	34.6 (12.0)	2.7 (0.59)	65.1 (20.4)	0.52 (0.03)	5.5 (0.76)	48.4 (8.5)
Introduction to Economics	2680	188.7 (40.5)	3 (0)	68.5 (14.3)	0.52 (0.10)	5.5 (0.51)	74.8 (7.9)
Effective Writing	546	19.5 (4.7)	5.8 (0.45)	74.4 (7.4)	0.69 (0.09)	5.9 (0.35)	83.2 (8.1)
Narrative	697	39.1 (7.7)	4.2 (0.98)	70.9 (11.5)	0.67 (0.11)	6.0 (0.37)	84.2 (7.1)
Literature for Our Time	498	98.7 (35.3)	1.4 (1.01)	71.1 (13.8)	(0.52) (0.05)	6.0 (0.42)	86.0 (6.8)
Introduction to History of Art	229	50.7 (16.8)	1 (0)	73.0 (10.0)	0.52 (0.01)	5.8 (0.07)	89.0 (0.4)
Urbanization	339	69.1 (21.6)	1 (0)	71.3 (10.1)	0.58 (0.05)	5.7 (0.44)	75.5 (4.7)
Statecraft and Strategy	830	181.6 (43.9)	1 (0)	69.5 (11.6)	0.51 (0.06)	6.2 (0.25)	79.2 (2.4)
European Civilization, 1350 - 1945	598	133.6 (40.6)	1 (0)	68.1 (12.5)	0.64 (0.01)	5.9 (0.41)	82.8 (3.0)
Civilization and Culture of Asia	531	122.1 (31.2)	1 (0)	71.3 (9.8)	0.68 (0.02)	4.9 (0.15)	61.5 (1.3)
1st year siminar in Humanities	242	12.0 (3.0)	4.4 (1.31)	77.3 (7.0)	0.86 (0.09)	6.2 (0.42)	86.6 (11.4)
Introduction to Film Study	488	53.9 (13.3)	2 (0)	69.5 (11.5)	0.63 (0.07)	5.8 (0.55)	86.2 (5.8)
Western Tradition	438	25.5 (4.1)	4.1 (0.82)	71.0 (12.1)	0.58 (0.12)	6.0 (0.54)	85.0 (9.1)
Calculus and Linear Algebra for Commerce	1582	64.2 (20.5)	5.4 (0.50)	64.9 (15.5)	0.45 (0.15)	5.3 (0.63)	51.1 (7.0)
Calculus fo Science I	5152	113.4 (20.3)	7.8 (0.38)	70.3 (13.8)	0.52 (0.28)	5.6 (0.86)	56.5 (11.3)

Introduction to Rigorous Calculus	1440	48.7 (18.1)	6.3 (1.46)	64.1 (18.6)	0.47 (0.16)	5.5 (0.69)	46.3 (10.7)
Linear Algebra I	346	31.6 (10.5)	2.6 (0.90)	62.9 (19.5)	0.36 (0.08)	4.8 (0.56)	39.6 (7.4)
Financial Accounting I	1583	120.8 (30.1)	2.9 (0.33)	69.8 (13.8)	0.58 (0.01)	5.0 (0.36)	60.5 (5.4)
Management Accounting I	871	128.4 (21.7)	2.4 (0.50)	65.1 (14.5)	0.45 (0.00)	6.0 (0.80)	54.4 (4.2)
Introduction to Philosophy	1270	151.6 (56.4)	2.2 (0.53)	70.6 (11.3)	0.51 (0.06)	5.7 (0.14)	72.1 (6.1)
History of Western Philosophy	591	110.7 (30.8)	1.5 (0.50)	69.3 (12.8)	0.53 (0.08)	6.0 (0.43)	83.8 (2.8)
Basic Physics	567	95.7 (10.4)	1 (0)	71.8 (12.2)	0.30 (0)	4.6 (0)	35.8 (0)
Physics for Life Science I	3879	356.2 (297.5)	3.4 (1.84)	72.9 (10.4)	0.83 (0.30)	4.9 (0.24)	34.4 (3.4)
Critical Issues of Canadian Politics	425	103.7 (38.5)	1 (0)	69.7 (8.6)	0.54 (0.03)	5.7 (0.03)	67.9 (0.4)
Canada in Comparative Perspective	417	96.2 (28.6)	1 (0)	69.1 (11.5)	0.45 (0.04)	5.6 (0.08)	65.2 (2.0)
Global Networks	871	249.6 (70.5)	1 (0)	69.6 (11.4)	0.27 (0)	6.4 (0)	89.2 (0)
Cultures of Conflict	159	159.0 (0.0)	1 (0)	69.9 (9.9)	0.66 (0)	6.4 (0)	85.0 (0)
Democracy and Dictatorship	162	162.0 (0.0)	1 (0)	67.8 (13.5)	0.53 (0)	5.7 (0)	76.0 (0)
Introduction to Psychology	3177	590.2 (159.0)	1 (0)	68.0 (13.2)	0.61 (0.03)	6.1 (0.08)	77.7 (2.9)
World Religions	165	46.4 (11.7)	1 (0)	68.8 (11.9)	0.61 (0.04)	5.5 (0.04)	78.3 (3.6)
Introduction to Sociology	603	340.5 (101.3)	1 (0)	66.8 (10.7)	0.59 (0.00)	5.0 (0.14)	67.7 (0.5)
Spanish for Beginners	425	16.9 (4.0)	5.3 (0.60)	67.3 (15.1)	0.53 (0.10)	5.8 (0.25)	82.8 (5.6)
1st year seminar on Social Science	85	11.1 (2.1)	1.9 (0.84)	77.1 (15.4)	0.76 (0.07)	6.0 (0.44)	86.2 (9.1)
Introduction to Probability	614	71.8 (14.3)	1.9 (0.28)	70.4 (16.3)	0.58 (0.07)	5.7 (0.60)	59.9 (9.3)
Introduction to Semiotics and communication	647	166.6 (65.3)	1 (0)	78.2 (9.8)	0.31 (0.04)	6.3 (0.45)	95.6 (1.0)
Total	51936	301.3 (281.7)	2.9 (2.23)	70.5 (13.3)	0.57 (0.18)	5.5 (0.57)	64.6 (15.7)

Table 7: Estimated Standard Deviations of Instructor Fixed Effects, Using Same Instructor, Same Section Student Covariance

	Full sample	Full sample	Full sample	Full sample	Single section	Single section	Single section	Single section	Big courses	Big courses	Big courses	Big courses
[Covariance in Square Brackets]												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Outcome Residual												
Grade in class	**0.201** {0.040}	**0.031** {0.001}	**0.200** {0.040}	**V<0** {0.000}	**0.247** {0.061}	**0.088** {0.008}	**0.231** {0.053}	**0.086** {0.007}	**0.199** {0.040}	**0.041** {0.002}	**0.193** {0.037}	**0.018** {0.000}
Dropped Course	**0.239** {0.057}	**V<0** -{0.001}	**0.182** {0.033}	**V<0** -{0.001}	**0.248** {0.062}	**0.114** {0.013}	**0.206** {0.042}	**0.101** {0.010}	**0.185** {0.034}	**0.014** {0.000}	**0.144** {0.021}	**0.017** {0.000}
# Courses in Subject, Year 2	**0.306** 0.094	**0.034** 0.001	**0.283** 0.080	**0.029** 0.001	**0.449** 0.202	**0.178** 0.032	**0.396** 0.157	**0.166** 0.027	**0.302** 0.091	**0.042** 0.002	**0.275** 0.076	**0.039** 0.001
# Courses in Subject, Year 3	**0.321** {0.103}	**V<0** -{0.001}	**0.279** {0.078}	**V<0** -{0.001}	**0.408** {0.166}	**0.229** {0.052}	**0.286** {0.082}	**0.218** {0.048}	**0.319** {0.102}	**V<0** {0.000}	**0.271** {0.073}	**V<0** {0.000}
GPA in Subject, Year 2	**0.171** {0.029}	**V<0** -{0.001}	**0.171** {0.029}	**V<0** -{0.002}	**0.178** {0.032}	**0.040** {0.002}	**0.181** {0.033}	**0.061** {0.004}	**0.181** {0.033}	**V<0** -{0.001}	**0.161** {0.026}	**V<0** -{0.002}
Adj GPA in Subject, Year 2	**0.180** {0.032}	**V<0** {0.000}	**0.184** {0.034}	**V<0** -{0.001}	**0.239** {0.057}	**0.058** {0.003}	**0.218** {0.048}	**0.070** {0.005}	**0.180** {0.032}	**0.026** {0.001}	**0.026** {0.001}	**V<0** {0.000}
Year Fixed Effects	No	No	No	No	No	Yes	No	Yes	No	No	No	No
Course*Year FE.	No	Yes	No	Yes	No	No	No	No	No	Yes	No	Yes
With Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Number of Instructors	1852	1852	1852	1852	938	938	938	938	394	394	394	394

Notes:Standard Deviations are estimated by obtaining residuals after regressing the indicated course/individual outcome variable on fixed effects for either school year or for school year*course and, where indicated, additional cocntrols for high school grade average, age, gender, mother tongue, country of birth, time of day, and program at entry. Values are the square root of the residual covariance of students with the same instructor. V<0 indicates a negative variance estimate. Confidence intervals are obtained by bootstrap (100 repetitions) [TO BE COMPLETED]. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Estimated Standard Deviations of Instructor Fixed Effects, Using Same Instructor, Same Section Student Covariance Sample with No Instructor in Course Teaching More than 50% of Students

	Full sample	Full sample	Full sample	Full sample	Single section	Single section	Single section	Single section	Big courses	Big courses	Big courses	Big courses
[Covariance in Square Brackets]												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Outcome Residual												
Grade in class	**0.220** {0.048}	**0.089** {0.008}	**0.180** {0.032}	**0.054** {0.003}	**0.188** {0.035}	**0.060** {0.004}	**0.222** {0.049}	**0.081** {0.007}	**0.224** {0.050}	**0.090** {0.008}	**0.179** {0.032}	**0.055** {0.003}
Dropped Course	**0.255** {0.065}	**0.064** {0.004}	**0.194** {0.037}	**0.061** {0.004}	**0.186** {0.035}	**0.103** {0.011}	**0.155** {0.024}	**0.094** {0.009}	**0.228** {0.052}	**0.067** {0.005}	**0.176** {0.031}	**0.061** {0.004}
# Courses in Subject, Year 2	**0.389** 0.151	**0.102** 0.010	**0.313** 0.098	**0.085** 0.007	**0.487** 0.237	**0.200** 0.040	**0.427** 0.183	**0.201** 0.041	**0.490** 0.240	**V<0** -0.003	**0.397** 0.158	**V<0** -0.003
# Courses in Subject, Year 3	**0.402** {0.162}	**V<0** -{0.004}	**0.344** {0.119}	**V<0** -{0.004}	**0.259** {0.067}	**0.095** {0.009}	**0.214** {0.046}	**0.088** {0.008}	**0.404** {0.163}	**V<0** -{0.003}	**0.341** {0.116}	**V<0** -{0.003}
GPA in Subject, Year 2	**0.230** {0.053}	**V<0** -{0.009}	**0.114** {0.013}	**V<0** -{0.006}	**0.197** {0.039}	**V<0** -{0.009}	**0.161** {0.026}	**V<0** -{0.011}	**0.231** {0.053}	**V<0** -{0.007}	**0.101** {0.010}	**V<0** -{0.006}
Adj GPA in Subject, Year 2	**0.454** {0.206}	**V<0** -{0.005}	**0.399** {0.159}	**V<0** -{0.005}	**0.333** {0.111}	**V<0** -{0.006}	**0.299** {0.089}	**V<0** -{0.003}	**0.457** {0.209}	**V<0** -{0.003}	**0.394** {0.155}	**V<0** -{0.004}
Year Fixed Effects	No	No	No	No	No	Yes	No	Yes	No	No	No	No
Course*Year FE.	No	Yes	No	Yes	No	No	No	No	No	Yes	No	Yes
With Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Number of Instructors	481	481	481	481	234	234	234	234	112	112	112	112

Notes:Standard Deviations are estimated by obtaining residuals after regressing the indicated course/individual outcome variable on fixed effects for either school year or for school year*course and, where indicated, additional cocntrols for high school grade average, age, gender, mother tongue, country of birth, time of day, and program at entry. Values are the square root of the residual covariance of students with the same instructor. V<0 indicates a negative variance estimate. Confidence intervals are obtained by bootstrap (100 repetitions) [TO BE COMPLETED]. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9: Estimated Standard Deviations of Instructor Fixed Effects, Using Same Instructor, Same Section Student Covariance Sample with No Instructor in Course Teaching More than 50% of Students

	Full sample	Full sample	Full sample	Full sample	Single section	Single section	Single section	Single section	Big courses	Big courses	Big courses	Big courses
[Covariance in Square Brackets]												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Outcome Residual												
Grade in class	**0.189** {0.036}	**0.060** {0.004}	**0.115** {0.013}	**0.056** {0.003}	**0.165** {0.027}	**V<0** -{0.004}	**0.184** {0.034}	**V<0** -{0.003}	**0.185** {0.034}	**0.049** {0.002}	**0.102** {0.010}	**0.058** {0.003}
Dropped Course	**0.166** {0.027}	**0.046** {0.002}	**0.134** {0.018}	**0.047** {0.002}	**0.171** {0.029}	**0.078** {0.006}	**0.109** {0.012}	**0.054** {0.003}	**0.054** {0.003}	**0.047** {0.002}	**0.125** {0.016}	**0.046** {0.002}
# Courses in Subject, Year 2	**0.413** 0.171	**0.064** 0.004	**0.263** 0.069	**0.054** 0.003	**0.382** 0.146	**V<0** -0.002	**0.254** 0.064	**V<0** -0.003	**0.411** 0.169	**0.063** 0.004	**0.257** 0.066	**0.053** 0.003
# Courses in Subject, Year 3	**0.307** {0.094}	**0.034** {0.001}	**0.171** {0.029}	**0.027** {0.001}	**0.303** {0.092}	**0.064** {0.004}	**0.229** {0.052}	**0.057** {0.003}	**0.303** {0.092}	**0.029** {0.001}	**0.161** {0.026}	**0.029** {0.001}
GPA in Subject, Year 2	**0.187** {0.035}	**0.078** {0.006}	**0.192** {0.037}	**0.047** {0.002}	**0.207** {0.043}	**V<0** -{0.005}	**0.220** {0.049}	**V<0** -{0.007}	**0.191** {0.037}	**0.057** {0.003}	**0.184** {0.034}	**0.053** {0.003}
Adj GPA in Subject, Year 2	**0.195** {0.038}	**0.105** {0.011}	**0.186** {0.035}	**0.050** {0.002}	**0.186** {0.035}	**0.043** {0.002}	**0.230** {0.053}	**0.054** {0.003}	**0.190** {0.036}	**0.106** {0.011}	**0.178** {0.032}	**0.048** {0.002}
Year Fixed Effects	No	No	No	No	No	Yes	No	Yes	No	No	No	No
Course*Year FE.	No	Yes	No	Yes	No	No	No	No	No	Yes	No	Yes
With Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Number of Instructors	481	481	481	481	234	234	234	234	112	112	112	112

Notes:Standard Deviations are estimated by obtaining residuals after regressing the indicated course/individual outcome variable on fixed effects for either school year or for school year*course and, where indicated, additional cocntrols for high school grade average, age, gender, mother tongue, country of birth, time of day, and program at entry. Values are the square root of the residual covariance of students with the same instructor. V<0 indicates a negative variance estimate. Confidence intervals are obtained by bootstrap (100 repetitions) [TO BE COMPLETED]. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 10: Selection on teacher quality, using individual-course sample

	Full sample	Full sample	Full sample	Single section	Single section	Single section	Big courses	Big courses	Big courses
PANEL A - Dependent variable: effective overall									
highschool grade (sd=1)	0.01 [0.004]***	0.011 [0.004]***		0.005 [0.005]	0.005 [0.006]		0.013 [0.005]***	0.014 [0.005]***	
highschool grade: in [75,80)			0.013 [0.009]			-0.023 [0.017]			0.01 [0.012]
highschool grade: in [80,85)			0.01 [0.008]			-0.04 [0.021]*			0.01 [0.010]
highschool grade: in [85,90)			0.019 [0.009]**			-0.019 [0.022]			0.02 [0.012]*
highschool grade: in [90,95)			0.036 [0.013]***			-0.027 [0.024]			0.04 [0.017]**
highschool grade: in [95,100]			0.048 [0.020]**			0.037 [0.036]			0.057 [0.024]**
FE: session	No	No	No	Yes	Yes	Yes	No	No	No
FE: course/session	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
FE: course	No	No	No	Yes	Yes	Yes	No	No	No
Other controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	134676	133789	133789	24775	24613	24613	104875	104163	104163
R-squared	0.62	0.62	0.62	0.71	0.71	0.71	0.6	0.6	0.6
PANEL B - Dependent variable: would take course again									
highschool grade (sd=1)	0.005 [0.002]***	0.006 [0.002]***		0.003 [0.003]	0.003 [0.004]		0.007 [0.002]***	0.007 [0.002]***	
highschool grade: in [75,80)			0.004 [0.005]			-0.002 [0.011]			0.002 [0.006]
highschool grade: in [80,85)			0.001 [0.005]			-0.013 [0.013]			0.001 [0.006]
highschool grade: in [85,90)			0.007 [0.005]			-0.01 [0.014]			0.008 [0.006]
highschool grade: in [90,95)			0.011 [0.007]*			0.003 [0.015]			0.014 [0.008]*
highschool grade: in [95,100]			0.025 [0.010]**			0.019 [0.021]			0.029 [0.012]**
FE: session	No	No	No	Yes	Yes	Yes	No	No	No
FE: course/session	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
FE: course	No	No	No	Yes	Yes	Yes	No	No	No
Other controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	134676	133789	133789	24775	24613	24613	104875	104163	104163
R-squared	0.88	0.88	0.88	0.77	0.77	0.77	0.9	0.9	0.9

Notes:All specifications use full sample; robust standard errors in brackets; cluster by student number if FE for course-groups are used; * significant at 10%; ** significant at 5%; *** significant at 1%; "other controls" include age at entry to universit

Table 11A: Regressions on overall effectiveness of teacher, using individual-course sample, all students

	Full sample		Single section	
Explanatory variable:	overall effective	highschool grade	overall effective	highschool grade
PANEL A - Dependent variable: Dropping the course				
grade (sd=1)	0.043	0.531	-0.011	0.428
	[0.007]***	[0.009]***	[0.016]	[0.015]***
dropped	-0.017	-0.03	-0.038	-0.05
sd=1	[0.007]**	[0.005]***	[0.020]*	[0.010]***
subject courses, year 2	0.015	0.106	0.015	0.063
sd=1	[0.009]	[0.015]***	[0.015]	[0.014]***
subject courses, year 3	0.012	0.086	0.01	0.059
sd=1	[0.006]*	[0.020]***	[0.019]	[0.012]***
subject grade avg., year 2	0.023	0.482	-0.019	0.425
sd=1	[0.011]**	[0.013]***	[0.015]	[0.027]***
FE: session	No		Yes	
FE: course/session	Yes		No	
FE: course	No		Yes	

Notes: Robust standard errors in brackets; cluster by student number; * significant at 10%; ** significant at 5%; *** significant at 1%; all specifications but specification 1 "other controls" include age at entry to university, gender, mother

Table 11B: Regressions on overall effectiveness of teacher, using individual-course sample, all students

	Full sample		Single section	
Explanatory variable:	overall effective	highschool grade	overall effective	highschool grade
PANEL A - Dependent variable: Dropping the course				
grade (sd=1)	0.071	0.531	0.049	0.427
	[0.015]***	[0.009]***	[0.023]**	[0.015]***
dropped	-0.026	-0.03	-0.051	-0.05
sd=1	[0.013]**	[0.005]***	[0.031]*	[0.010]***
subject courses, year 2	0.038	0.106	0.027	0.063
sd=1	[0.019]**	[0.015]***	[0.029]	[0.014]***
subject courses, year 3	0.035	0.086	0.002	0.059
sd=1	[0.011]***	[0.020]***	[0.036]	[0.012]***
subject grade avg., year 2	0.015	0.482	0.009	0.425
sd=1	[0.022]	[0.013]***	[0.024]	[0.027]***
FE: session	No		Yes	
FE: course/session	Yes		No	
FE: course	No		Yes	

Notes: Robust standard errors in brackets; cluster by student number; * significant at 10%; ** significant at 5%; *** significant at 1%; all specifications but specification 1 "other controls" include age at entry to university, gender, mother

Table 12: Regressions on overall effectiveness of teacher, using aggregate sample

	Full sample		Low Highschool grades	
Explanatory variable:	overall effective	highschool grade	overall effective	highschool grade
PANEL A - Dependent variable: Good Standing				
Good Standing, Year 1	0.008 [0.007]	0.131 [0.006]***	-0.007 [0.025]	0.208 [0.033]***
Good Standing, Year 2	0.008 [0.008]	0.088 [0.006]***	0.005 [0.025]	0.145 [0.030]***
fall registration, year 2	0.008 [0.006]	0.023 [0.005]***	0 [0.019]	0.017 [0.021]
total credits, year 1	-0.001 [0.012]	0.119 [0.009]***	-0.016 [0.037]	0.117 [0.047]**
total credits, year 2	0.017 [0.032]	0.284 [0.023]***	-0.047 [0.091]	0.181 [0.106]*
GPA, year 1	0.038 [0.015]**	0.629 [0.011]***	-0.013 [0.043]	0.47 [0.053]***
GPA, year 2	0.029 [0.018]	0.518 [0.014]***	-0.006 [0.056]	0.305 [0.070]***

Notes: Robust standard errors in brackets; cluster by student number; * significant at 10%; ** significant at 5%; *** significant at 1%; all regressions contain fixed effects by course/session-groups and highschool fixed effects; all specifications but sp

Figure 1
Variation in Teacher Demeaned Retake Response Rate for Total Sample (with standard deviation = 15.4) and for within Section Residual Variation (with standard deviation of 6.5)

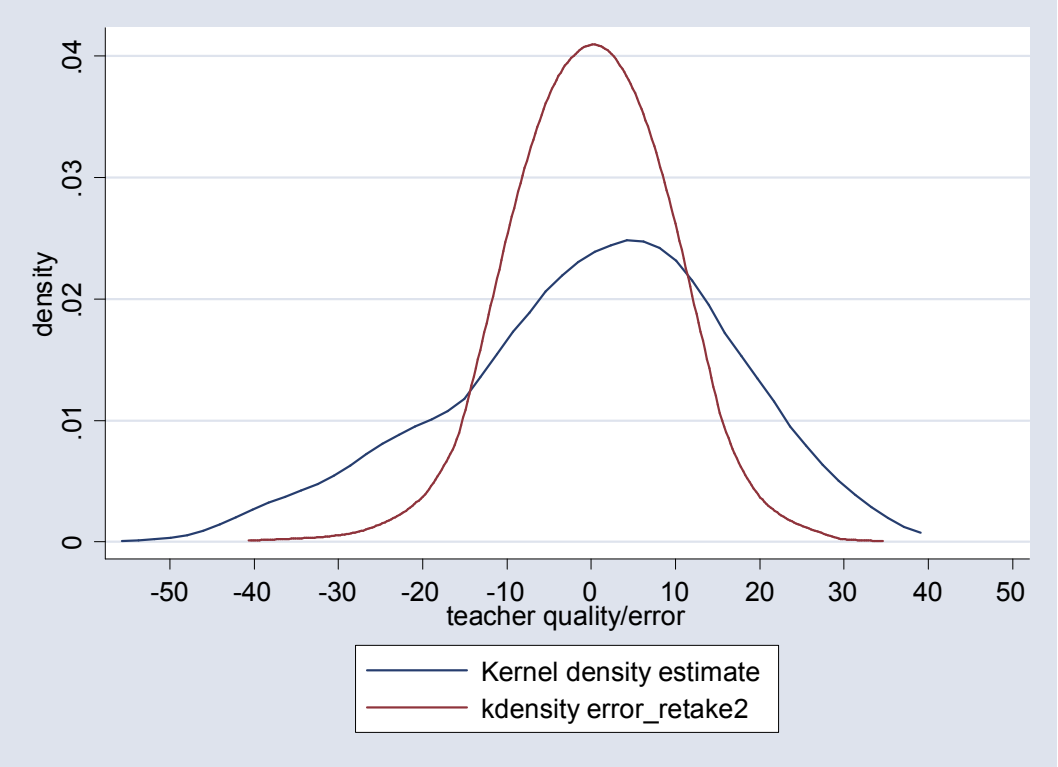


Figure 2
Variation in Teacher Demeaned Retake Response Rate for Total Sample (with standard deviation = 15.4) and for within Section Residual Variation, No Instructor with more than 50% of Students (with standard deviation of 9.1) [40% of total sample]

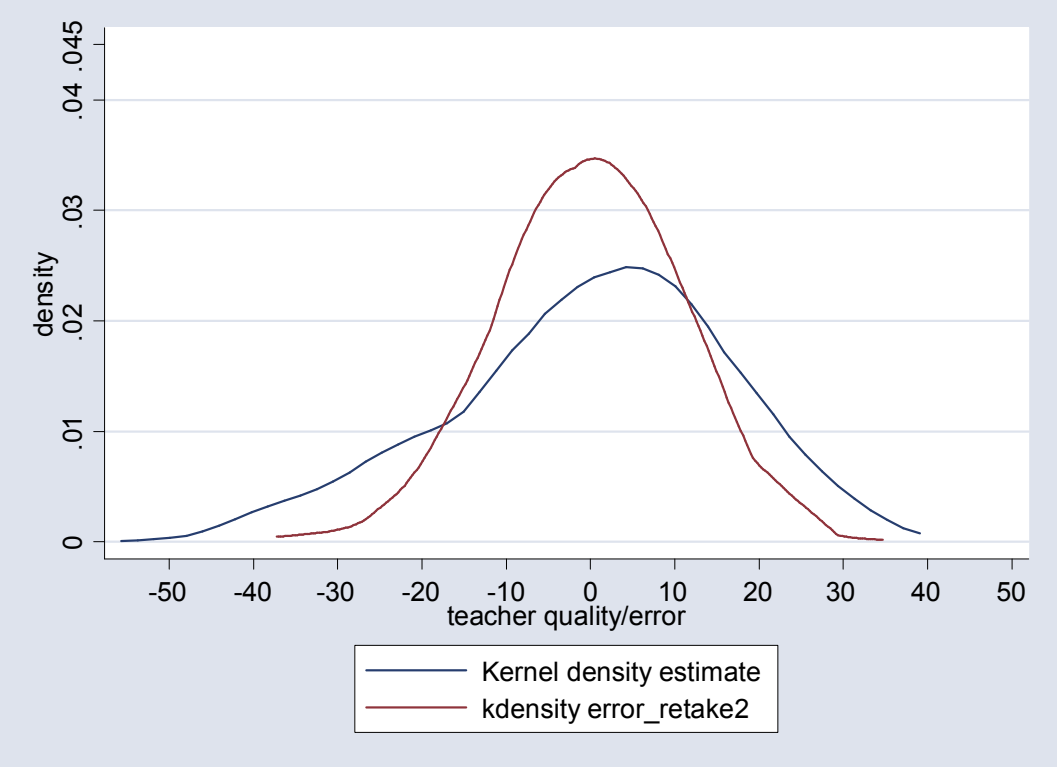


Figure 3
Variation in Teacher Demeaned Retake Response Rate for Total Sample (with standard deviation = 15.4) and for within Section Residual Variation, No Instructor with more than 30% of Students (with standard deviation of 9.1) [9% of total sample]

