Class meeting frequency, start times, and academic performance

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ABSTRACT

This paper examines the relationship between the start time and meeting frequency of college courses and the academic performance of students. Using administrative data from a large public university, we account for both student and instructor fixed effects. Consistent with a large literature, we find a positive time of day effect. That is, students earn higher grades in classes that start later. However, contrary to previous literature, we find students earn higher grades in classes with fewer meeting times when not accounting for instructor fixed effects. This effect is entirely explained by instructor sorting on course schedules. Instructors that assign higher grades, either due to quality of instruction or grade leniency, are more likely to meet twice a week rather than three times a week. Including instructor fixed effects, we find no difference in two-day a week classes and three-day a week classes. However, grades are lower in classes that meet just once a week.

Would you rather have the pizza sliced into three pieces or two? Three, I am really hungry today.

1. Introduction

Increasingly, decision makers are recognizing that both the start times of classes and the frequency of their delivery can potentially affect student performance. This has led to many high schools starting later and deviating from the traditional 50 min periods to block scheduling, where classes meet less frequently, but with longer classes per meeting. One motivation is to better align class times with the students' circadian rhythm (Cardinali, 2008). The hope being that later start times would lead to fewer sleep deprived students and better performance in class.

A substantial literature exists on the relationship between sleep, start times, and academic performance. Not surprisingly, the amount of sleep adolescents get is positively associated with academic performance (Sabia, Wang, and Cesur, 2017; Eide and Showalter, 2012). Additional work has linked later start times of schools to better academic performance for students in middle school (Edwards, 2012), high-school (Hinrichs, 2011; Pope, 2016) and college (Carrell, Maghakian, and West, 2011; Diette and Raghav, 2017a,b).

A number of papers have measured the effect of the adoption of block scheduling in high-schools, with mixed results (Rice, Croninger, and Roellke, 2002; Hughes, 2004). There is also some work on the organizational structure of schools (Eren and Millimet, 2007) and the length of the school week (Anderson and Walker, 2015). Less studied is

the effect of course meeting frequency, especially among colleges.

At colleges, the most common course meeting frequencies and times are twice a week for 75 min or three days a week for 50 min. Generally, courses that meet once a week meet for 2.5 h. Conceptually, meeting more frequently might allow for students to have greater time in between concepts in which to more deeply absorb the ideas. This "spacing effect" might be offset by a competing transactions cost if each time the course meets a certain amount of time is required to refresh the student on the material being studied and reinforce connections between concepts.

Competing pressures, unrelated to the optimal format for learning, also determine whether courses are scheduled to meet in a one-day a week, two-day a week, or three-day a week format. First, administrators face space constraints that make three-day a week schedules more attractive. By dividing the day into more, but shorter blocks, more classes can be scheduled with the three-day a week format (Reed, 2015). Second, colleges face political pressure to not have underutilized space nor give the appearance of faculty and staff not working on Fridays. Finally, colleges may wish to have students in classes on Friday mornings to reduce student drinking on "Thirst-day" nights (Hafner, 2006). Of course, Friday classes might fail to reduce student drinking and instead just lead to more absences on Fridays.

Conversely, there are also pressures to reduce the number of Friday classes. Colleges may be able to save money on energy and other support costs when they have fewer Friday classes (David, 2008). Further, typically both students and professors wish to "stack" their schedules, in order to give themselves more days without classes (Reardon, et. al.

2008). This has the obvious advantage of reducing the number of required trips that must be made, but may also provide greater flexibility. For example, recently, the student government at the University of Texas system introduced a resolution to increase the number of times available for Monday/Wednesday (MW) classes as opposed to Monday/Wednesday/Friday (MWF) courses. Supporters point to the ability for students to work more with two-day a week schedules, and thus accumulate less debt and the possibility that greater flexibility will improve graduation rates (Voeller, 2014). While both from an administrative (e.g. university service) and research perspective, this flexibility is likely more efficient for faculty as well.

Dills and Hernández-Julián (2008) look at the effect of start times as well as the frequency of class meetings on student performance, in particular grades, at a large public university. They find that students do better when courses meet more frequently, but are unable to account for differences in teaching/grading across different instructors. In addition to Dills and Hernández-Julián, there are also a few papers that have tried to look explicitly at the effect of the frequency of class meetings on performance, but only for data from a single course. Thus, these papers do not have student fixed effects to control for student specific habits or ability. Nonetheless, there is some evidence of a negative effect on grades and pass rates for students when the course is taught 1-day a week (Henebry,1997; Gallo and Odu, 2009; Joyce et al., 2015). In a contemporaneous work to ours, Diette and Raghav (2017a, b) look at administrative data in a liberal arts college that allows them to control for instructor and student fixed effects over time. They find no statistically different effect from courses that meet fewer days a week.

Our paper follows closely from Dills and Hernández-Julián (2008) and shares many of the empirical advantages of a parallel work on meeting frequency by Diette and Raghav (2017a, b). Specifically, we look at the effect of start times and the frequency of class meetings, on student performance, as measured by grades. Similar to Dills and Hernández-Julián, we use data from a large public university across multiple semesters. These data allow us to account for course and class characteristics as well as to control for student specific fixed effects. However, unlike that paper, we also are able to incorporate instructor specific fixed effects. This is potentially important if certain instructors are given priority in terms of scheduling and those instructors differ in terms of quality or grade leniency. For example, if adjuncts, which generally give higher grades (Sonner, 2000), are more likely to be assigned to MWF class schedules, then this could bias the estimates. In this regard, our results on meeting frequency are more comparable to those of Diette and Raghav. However, we differ from Diette and Raghav in that we are looking at a large state university rather than a small liberal arts college. This is important in that there is greater variability in grades in our setting and the effects from course schedules might differ based on the types of students that attend different universities. Further, we compare our estimates to those without fixed-effects to address the possibility of instructor selection.

We find, in line with Dills and Hernández-Julián (and other research), that student grades are higher in classes that take place later in the day, although the size of the effect is about half as large as they document. There does not appear to be any substantial sorting by professor in terms of time of the day. With regard to course frequency, we find the opposite effect. Rather than an increase in grades, the greater the frequency is associated with a decrease in performance. However, once we account for professor fixed effects, we find no difference in outcomes between two-day a week classes and three-day a week classes. This implies that there is some substantive sorting by professors in terms of the format of the course. In particular, professors with higher average course grades (all else equal), who are potentially the best teachers, are less likely to teach three-day a week courses. However, there does appear to be a negative effect when classes are compressed to once per week. While, one-day per week classes are not as common, this does suggest that there is a limit to the extent to which classes can meet less frequently without affecting student performance.

The difference between our results and those of Dills and Hernández-Julián without fixed effects is intriguing. Given that we find substantive selection by instructors, one possibility is that the nature of the sorting varies by the institutional setting. For example, if the supply of adjunct instructors is larger near some universities, then they may be more likely to be assigned to less preferable three-day a week classes, than adjuncts in universities with a smaller pool of potential adjunct instructors.

These results suggest that colleges and universities do not necessarily sacrifice the quality of the instruction (at least as measured by grades) by adopting twice per week classes as opposed to three times a week classes. This is important as universities might worry, in light of previous findings, that accommodating faculty and student preferences for fewer three-times per week classes might sacrifice quality. We provide some additional evidence that start time matters, even when controlling for professor, student, and course fixed effects. Finally, the fact that there does seem to be substantive sorting by instructors based on the course schedule highlights the need to consider instructor fixed effects in college settings. If instructor sorting is common this also raises equity concerns as students with less flexible schedules, particularly those with work or family demands (often from lower income-households), are less likely to be able to enroll in classes with higher quality instruction.

2. Data and methodology

The data for this project are student course level grades obtained from administrative records at a large public university in the Midwest with bachelor, master, and doctoral programs.

We are able to observe the grade for each student in each section of all courses during the traditional Fall and Spring semesters from 2013–2015 (six semesters in total). Giving us 218,051 student-class observations for 17,244 unique students. Grades are recorded on a $+/-$ system with the highest grade being an A. We then convert this to a numerical score where an A is 4.0, A$-$ is 3.67, B$+$ is a 3.33, etc. We are able to identify the course and a unique identifier for the faculty member[1] that teaches each section as well as the scheduling format (MWF, etc.) and start/end time of the course. Within our analysis sample, courses may be scheduled once a week (night or day), twice a week (TR and MW), three days a week (typically MWF), or four days a week. Generally class schedules begin at 8:00 and are staggered every 110 min on three-day a week classes and every 140 min on two-day a week classes (inclusive of pass-period breaks).[2] Since we have the universe of students each semester, we can also calculate the size of the section that the student is enrolled in, so that the relative impact of variation in class size can be accounted for in all specifications. Overall, we are able to observe student grade, class semester, class format (e.g. weekly frequency), class time, class size, course credits, course subject/discipline (e.g. math, economics, history, etc.), course number/level (e.g. 101, 310, etc.), as well as a unique code to identify each student and instructor.[3]

The average class size (at the student observation level) is 42.3 students, the average GPA is 2.98 with a standard deviation greater than 1, and the average class start time is 11:53am.

In order to isolate the influence of course schedules on the grade a student receives, we estimate the following regression equation:

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[1] One limitation of this analysis is that other instructor characteristics are suppressed. Thus, we cannot in this analysis document how these characteristics are associated with instructor sorting.

[2] In less than 1% of the classes, the start time is before 8:00 a.m. or after 6:00 p.m.

[3] The sample under analysis contains over 1400 different courses, found in 71 different topic areas, and taught by 760 unique instructors.