



# The effects of class size in online college courses: Experimental evidence



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## ABSTRACT

Class size is a first-order consideration in the study of education cost and effectiveness. Yet little is known about the effects of class size on student outcomes in online college classes, even though online courses have become commonplace in many institutions of higher education. We study a field experiment in which college students were quasi-randomly assigned to either regular sized classes or slightly larger classes. Regular classes had, on average, 31 students and treatment classes were, on average, ten percent larger. The experiment was conducted at DeVry University, one of the nation's largest for-profit postsecondary institutions, and included over 100,000 student course enrollments in nearly 4,000 classes across 111 different undergraduate and graduate courses. We examine class size effects on student success in the course and subsequent persistence in college. We find little evidence of effects on average or for a range of course types. Given the large sample, our estimates are precise, suggesting that small class size changes have little impact in online settings.

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## 1. Introduction

Class size is a perennial issue in the economics of education. It has implications for both the cost and production of education. In K-12 education, the effects of class size have been vigorously debated (e.g. Angrist & Lavy, 1999; Hanushek, 2002; Hoxby, 2000; Krueger 2002; Krueger & Whitmore, 2001; Mosteller, 1995; Woessmann and West, 2006; Leuven, Oosterbeek, & Ronning, 2008; Dynarski, Hyman, & Schanzenbach, 2013; Gary-Bobo & Mahjoub, 2013; Chetty, Friedman, Hilger, Saez, Schanzenbach, & Yagan, 2011). Additionally, several states have attempted to regulate class size as a means of improving K-12 education (e.g. Morgan-Hart Class Size Reduction Act in California). Class size in college has received some, though far less, attention (Bandiera, Larcinese, & Rasul, 2010; Bettinger & Long, 2015; De Giorgi, Pellizzari, & Woolston, 2012).

Our setting focuses on class size in virtual classrooms. Online college courses are becoming more and more important in higher education. About one-third of students in the US take at least one course online during their college career, and the proportion of

students who take at least one course online has tripled over the past decade (Allen & Seaman, 2013). According to the US Department of Education (2014), in the fall of 2012, 12.5% of students in Title IV institutions exclusively enrolled in distance education classes and another 13.3% enrolled in some, but not all, distance education classes. Further, of the students who take some, or all of their classes online, 19.6% do so in for-profit institutions.<sup>1</sup> More than 70% of public colleges now have some programs that occur completely online. Online classes have an even larger presence in DeVry University, the setting of this study, where 60% of course credits are earned through online courses. The growth of the online education space has come with a spectrum of courses that vary in accessibility and size. Many higher education institutions have chosen to create virtual classrooms, an online analog of the traditional brick-and-mortar classroom. Unlike the “Massive Open Online Courses” (MOOCs), which have garnered so much attention, these virtual classes are only available to students enrolled in the university and are approximately the same size as the same class offered in-person on campus.

Analyzing class size in the online context presents a different set of financial and educational production challenges than class

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<sup>1</sup> Authors' calculation from US Department of Education (2014).

size for in-person classrooms. For example, the cost of adding an additional student is often negligible in online settings. No new desks and no new equipment are needed. The new costs are only incurred through additional staff time necessary to provide education to a larger group of students. Additionally, whereas class size might affect students through peers or congestion (e.g. Lazear, 2001) in traditional classrooms, interactions are substantially different in an online setting where discussion boards are the primary forum through which peers interact. While online courses present an opportunity to reduce higher education costs, attempted cost savings through increased class size may affect students' educational outcomes. No research that we know of sheds light on this question.

In estimating the effect of class size on students, selection issues are pervasive. These selection issues are likely more pronounced at the collegiate level, as compared to the K-12 level, because students have substantial flexibility in choosing their course of study. Class size varies across fields and average student outcomes also vary across fields, unlikely driven only by class sizes differences. Similarly, professors of perceived higher quality can attract more students and their outcomes could vary because of both size and professor quality. Higher achieving students in turn might have preferences for small classes, making it difficult to separate student quality from class size effects.

To measure the effects of college class size while addressing these empirical difficulties, we analyze over 100,000 student course enrollments at DeVry University in 2013–14. DeVry serves 5% of the for-profit college market, placing it among the 8–10 largest for-profit institutions in 2010. Two-thirds of undergraduate courses occur online, the other third occur at nearly 100 physical campuses throughout the United States. DeVry's online model focuses on recreating the features of a traditional classroom in an online context. The classes are open only to students enrolled in the university, and the average class size of 31 students is on par with class size in conventional in-person classes at the university.

In the fall of 2013, DeVry conducted a class size field experiment. Over the span of four academic terms, more than 4000 course sections (classes) of 111 courses were randomly assigned to either regular sized classes or slightly larger classes. The average size of regular classes was 31 students and treatment classes had, on average, 34 students. This difference translates to an average class size increase of 10%, though some classes experienced as much as a 25% increase in size. Students were not randomly assigned to sections; however, the DeVry registration process makes student assignment to sections quasi-random (plausibly ignorable) conditional on student registration date and time. This registration process also resulted in variation in peer quality. In Section 3 we detail the assignment mechanism, our identification strategy, and our approach to separating the peer effects from the class size effects.

We find, after addressing issues of selection, that small changes in online college class sizes have no discernable effect on student learning or persistence in college. This result is consistent across different types of courses where one might expect a meaningful exception. For example, classes which require substantial faculty work or where increased class size might crowd out meaningful interactions between faculty and students theoretically could generate meaningful class size effects. We find that even in these courses no meaningful effect is evident. When examining the effect of the largest increases in class size of 15%–25% we detect effects on student persistence. Even in this case we find evidence that the results are driven by a change in the types of peers present in the class rather than a change in the number of peers in the class.

The paper is organized as follows. Section 2 includes the background on class size and online schooling. Section 3 presents our data and methodology. Section 4 presents our baseline re-

sults. Section 5 presents heterogeneity results. Section 6 presents robustness checks and Section 7 concludes.

## 2. Background on class size

To date, most of the research on class size has focused on K-12 settings. As Hanushek (2002) and Krueger (2002) have illustrated, the quality of existing evidence and conclusions varies across studies. The most cited study is the Tennessee STAR experiment, where students from kindergarten through third grade were assigned to either small (~15) or large (~22) class sizes. Multiple studies of STAR provide some evidence that small classes generate positive impacts on short-run (Mosteller, 1995 on academic achievement), medium-run (Krueger & Whitmore, 2001 on college attendance and SAT scores), and long-run outcomes (Dynarski et al., 2013 on college completion; Chetty et al., 2011 on earnings). Some scholars have suggested that the STAR findings are the result of Hawthorne effects which led teachers to behave differently under experimental conditions rather than true class-size effects (Ding & Lehrer, 2010; Hoxby, 2000).

Other studies use a variety of approaches to adjust for selection in the estimation of class size effects with inconsistent findings. Angrist and Lavy (1999) exploit variation in class size in Israel arising from the application of Maimonides' rule to estimate the impact of class size. Other papers use similar rules (Gary-Bobo & Mahjoub, 2013), generally finding that small classes benefit students. In contrast, Hoxby (2000) and Leuven et al. (2008) use natural variation in cohort size (Leuven, Oosterbeek, and Ronning also use maximum class size rules) to estimate impacts of class size and find no effect on student outcomes.

On the collegiate level, there is some evidence that larger classes negatively affect student outcomes. Bettinger and Long (2015) use natural variation in cohort size in college to estimate the impacts of class sizes in introductory courses and find positive impacts of small classes. Johnson's (2010) use of hierarchical linear modeling, and Bandiera et al.'s (2010) use of student fixed effects similarly find that small classes produce higher student outcomes. These results are further supported by De Giorgi et al. (2012), who leverage random assignment of students to teachers in an Italian university.

The findings to date, which are most often but not consistently positive for small classes, may or may not generalize to virtual college courses. Most studies focus on K-12 education, though the previous collegiate studies and a handful of other papers (Becker & Powers, 2001; Dillon, Kokkelenberg, & Christy, 2002; Kennedy & Siegfried, 1997) address higher education. None of the studies focus on virtual settings, even though those settings are increasingly common for students. The studies also define large and small classes differently. STAR compares class sizes of 15 and 22 students, a difference of 7 students. In Angrist and Lavy's (1999) study, the typical comparison was between classes of 39 and 27 students.<sup>2</sup> Changes in class size of approximately 10% for virtual classes have substantial implications for cost in the online setting but the extant research does not provide clear evidence on the likely effects of such a change on students.

### 2.1. Why might class size matter?

An increase in class size is likely to affect many, but not all, aspects of a class. In this setting the large and small versions of a class are structured in identical ways. Information traditionally disseminated via classroom lectures is available through pre-prepared

<sup>2</sup> At the closest discontinuity to the mean, the comparisons were between classes of 39 and 27. At the 90th percentile, the comparisons were between classes of 39 and 30.

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