

THE ECONOMICS OF ONLINE POSTSECONDARY EDUCATION:
MOOCS, NONSELECTIVE EDUCATION, AND HIGHLY SELECTIVE EDUCATION

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Online Appendix:
Evidence for the Two Extreme Models of Postsecondary Education

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In "The Economics of Online Postsecondary Education," I consider how online postsecondary education, including massive open online courses (MOOCs), might fit into economically sustainable models of postsecondary education. I contrast nonselective postsecondary education (NSPE) in which institutions sell fairly standardized educational services in return for up-front payments and highly selective postsecondary education (HSPE) in which institutions invest in students in return for repayments much later in life. The analysis suggests that MOOCs will be financially sustainable substitutes for some NSPE, but there are risks even in these situations. The analysis suggests that MOOCs will be financially sustainable substitutes for only a small share of HSPE and are likely to collapse the economic model that allows HSPE institutions to invest in advanced education and research. I outline a non-MOOC model of online education that may allow HSPE institutions both to sustain their distinctive activities and to reach a larger number of students.

In the paper, I draw stylized portraits of NSPE and HSPE. In this appendix, I support these portraits with evidence.

For NSPE, I use four-year and two-year institutions that require only a high school diploma or GED for admission ("open enrollment" institutions). For HSPE, I use institutions in Barron's "most competitive" category whose median student scores at or above the 95th percentile on college assessments (the SAT I or the ACT Comprehensive).¹

I. Data

I rely on data from the Integrated Postsecondary Education Data System ("IPEDS," U.S. Department of Education, 2013), the Delta Cost Project Database ("DELTA," U.S. Department of Education, 2012), NCES-Barron's Admissions Competitiveness Index ("Barron's," U.S. Department of Education, 2010), the Annual Survey of Colleges ("ASC," The College Board, 2011), the 2004/2009 Beginning Postsecondary Student study ("BPS," U.S. Department of Education, 2011), the 2004/2009 Beginning Postsecondary Student Transcripts study ("BPS Transcripts," U.S. Department of Education, 2012), the 2004 National Survey of Postsecondary Faculty ("NSOPF," U.S. Department of Education, 2006), and the faculty survey of the Higher Education Research Institute ("HERI," Higher Education Research Institute 2010). All statistics for NSPE or HSPE institutions, students, and courses are weighted by the number of students enrolled.²

II. Evidence for the Stylized Portrait of NSPE

A. The full cost of a student's education is paid for as he or she receives it.

The payments may come from the student, his family, grants (privately or publicly funded), or loans. What is essential is that NSPE institutions do not pay for the cost of students' education from alumni gifts.

The evidence for this is that income from the endowment and current alumni gifts

¹ The variables used to classify institutions come from ASC, IPEDS, and Barron's.

² To obtain figures that are nationally representative at a student level, I use the appropriate sample weights in the BPS. When computing course-level statistics based on the NSOPF and HERI, I not only employ the sample weights for faculty but take account of the number of students enrolled in the faculty member's course.

account for only about 1 percent of NSPE institutions' total revenue. Gross tuition and fees account for 91 percent of the revenue of the average *private* NSPE institution. At the average *public* NSPE institution, gross tuition, fees, and current government appropriations account for 85 percent of costs.³

B. Course material is fairly standardized.

36 percent of NSPE courses cover basic or general material that is contained in standard textbooks (BPS transcript study). Among the courses that account for at least one percent of NSPE course-taking are pre-collegiate algebra (which alone accounts for 6 percent!), basic accounting, data entry, and basic reading comprehension. Other courses that account for at least one percent of NSPE course-taking are introductory psychology, introductory U.S. history, introductory sociology, introductory biology, introductory literature, and introductory chemistry.

C. Multiple-choice and other easily-graded assignments are a primary basis for assessment.

At NSPE institutions, 69 percent of courses use multiple-choice examinations which are often supplied with the textbook (NSOPF). 35 percent of courses require students to grade one another's work in class--a procedure that is possible only when problems and answers are straightforward (NSOPF). Only 5 percent of students write term or research papers that are graded by the instructor himself (BPS).

D. Many people are competent to explicate the material for students. Of course, the instructor's charisma, articulateness, and ability to entertain may vary, but an NSPE instructor evidently does not need to be a cutting-edge researcher to explain the material.

Evidence for this is that the average NSPE instructor has 0.2 recent refereed publications, 1 other recent publication, and 0.03 recent patents.⁴ Only 13 percent of NSPE instructors have a Ph.D, and only 6 percent have a Ph.D. from a university classified as Most Competitive by Barron's.

E. Students often drop out of courses, and dropping-out is a key means by which students with inadequate preparation or interest end up not taking certain courses.

Transcripts of NSPE students show that they drop out (*after* the add/drop deadline) of 13 percent of the courses that they initiate (BPS). This means that a good share of instructor-student and student-student interactions would be disrupted if they were to take place. (It is not obvious that much interaction has, in fact, taken place.)

F. Instructor-student and student-student interactions are not ubiquitous.

Using students' reports of their academic experience and activities, the BPS constructs indices of students' academic integration and social integration at their postsecondary institutions. The index of academic integration for a student's freshman year has a mean of 68 and a standard deviation of 45. The index of social integration for the freshman year has a mean of 35 and a standard deviation of 48.

On the index of academic integration, the average NSPE freshman has a score of 56. This low score reflects the fact that only 29 percent of NSPE students meet informally with faculty, only 57 percent meet an academic advisor, and only 39 percent participate in study groups (BPS).

³ The source for this paragraph is DELTA.

⁴ The source for this paragraph is NSOPF and Barrons. NSOPF defines recent as the previous 2 years.

On the index of social integration, the average NSPE freshman has a score of only 18. This very low score reflects the fact that only 19 percent of NSPE students engage in cultural activities at the institution and only 13 percent participate in school clubs (BPS).

G. Students often attend part-time or episodically. There is little cohort cohesion in the sense of a entering class progressing and graduating together.

Among students who started their postsecondary education at a NSPE institution, only 7 percent obtained a baccalaureate degree within 5 years and only 14 percent obtained an associates' degree within 5 years. Thus, "graduating with one's class" is not a meaningful notion at NSPE institutions. 58 percent of NSPE students attended part-time during their first two years of study, and 50 percent stopped attending all together for one or more terms. 48 percent attended more than one postsecondary institution as part of their undergraduate education (including summer school classes).⁵

H. Distance learning was prevalent well before the introduction of modern online courses.

Among students who began PE in 2004, 13 percent of NSPE students took some of their courses in a distance form (BPS). Interestingly enough, this percentage is almost identical for NSPE students who began in 1996 and in 1990.⁶ The 1990 students entered well before the introduction of "modern" online education. At the time, most distance learning was "one-way" and not interactive, yet NSPE students enrolled in it (U.S. Department of Education, 1997).

I. A good share of NSPE education can be sufficiently summarized by certificates. A successful NSPE student often earns certificates from outside groups that attest to his having mastered some body of material. The NSPE institution's own degree does not appear to convey more than the sum of these certificates.

Among NSPE students who achieve a degree, 26 percent earn certificates from an outside organization and 20 percent report needing such a certificate on their first job. NSPE students who obtain the same certificates have same earnings *regardless of where they obtained their degree*. Specifically, if one regresses the 2009 log earnings of BPS students who have at least one certificate on an indicator variable for each certificate and for each institution, the hypothesis that the certificates do not explain earnings is rejected with a p-value of less than 0.0001. The hypothesis that the institutions do not explain earnings is *not* rejected (p-value of 0.76).

III. Evidence for the Stylized Portrait of HSPE

A. For the average student, less than 20 percent of the cost of his education is paid for when he attends HSPE.

The remainder of the cost is covered by endowment income (past donations) or current donations (DELTA). Even HSPE students who receive no financial aid pay for only 49 percent of the cost of their education (BPS and DELTA). All students are heavily subsidized by past students.

B. Without such institutional investments, a substantial share of students who are well prepared for HSPE could not pay for its full cost even if they exhausted their capacity to obtain grants and loans.

⁵ The source for this paragraph is BPS.

⁶ The sources for this sentence are the 1996-2001 Beginning Postsecondary Student survey (U.S. Department of Education, 2003) and the 1990-1994 Beginning Postsecondary Student survey (U.S. Department of Education, 1996).

Most students who acquire HSPE could not do so if the institutions themselves did not cover most of the cost at the time they enroll. Specifically, fewer than 10 percent of HSPE students in the BPS could cover the full cost of their education if they took out the maximum available (subsidized and unsubsidized) Stafford, PLUS, and Perkins student loans, used all available non-institutional grants (federal and private sources like the National Merit Scholarship Corporation), and used the entirety of their family's expected family contribution.⁷

C. As a logical matter, HSPE institutions must be selective and, as a practical matter, they are. Therefore, HSPE instructors have virtually no experience teaching a diverse pool of students.

Verified college assessment scores of HSPE students show that only 10 percent have SAT I (math and verbal combined) or ACT comprehensive scores below the 90th percentile (BPS). These institutions also report being selective on a variety of other dimensions such as Advanced Placement examinations (AP). As a result, their courses are oriented toward students whose aptitude and preparation are uniformly high. Because their faculty lack experience with students outside this narrow range, there is little reason to think that HSPE instructors have an absolute advantage (and certainly not a comparative one) in teaching those whose aptitude and preparation are lower or even just more heterogeneous.

D. Many classes involve substantial instructor-student and student-student interaction.

53 percent of HSPE classes require students to come prepared to present material that they have studied outside of class (NSOPF). Only 12 percent of HSPE class time is devoted to instructors delivering prepared lectures that are relatively uninterrupted by interaction with students (HERI).

E. Course material is often original, developed for the specific class, and takes account of recent research.

Fewer than 20 percent of HSPE courses cover material that is contained in standard textbooks. 54 percent of HSPE instructors' courses are related to their own research, and 72 percent of courses teach students material derived from recent research (HERI). Although courses that account for at least one percent of course-taking on HSPE transcripts are few in number, those that are (calculus, principles of economics, organic chemistry, art history) cover considerably more advanced material than those prevalent among NSPE students. Interestingly, the only common HSPE courses that do not cover fairly advanced material are those in which interaction is important: language study and collegiate writing (BPS).

F. Multiple-choice examinations and easily-graded assignments are infrequently the primary basis for assessment.

At HSPE institutions, only 26 percent of student-weighted courses use multiple-choice examinations. Fully 100 percent of HSPE students report having written one or more term or

⁷ The sources are BPS and DELTA. The full cost is the cost of instruction, academic support, student services, institutional support, room, and board. Some students' expected family contribution covers tuition, fees, room, and board. For these students, it is not clear whether the family could cover the full cost of the students' undergraduate education if the institution were to charge it. (Since no HSPE institution attempts to charge the full cost up front, financial aid calculations do not consider the full cost.) I assume that families whose expected family contribution could cover tuition, fees, room, and board could have contributed 2 times their expected family contribution. Even with this generous assumption, the percentage of students who could cover the full cost is well below 10 percent.

research papers that were advised and graded by the instructor himself (BPS).

G. Few people are competent to explicate the material for students. I have already noted that the majority of HSPE courses contain material derived from recent research. This makes it likely that the instructor needs to be abreast of research to explain the material.

Evidence for this is that the average HSPE instructor has 4 recent refereed publications (20 times as many as NSPE instructors), 3 other recent publications (3 times as many as NSPE instructors), and 0.2 recent patents (7 times as many as NSPE instructors). 76 percent of HSPE instructors have a Ph.D (6 times as many as NSPE instructors), and 58 percent have a Ph.D. from a university classified as Most Competitive by Barron's (10 times as many as NSPE instructors).⁸

H. Instructor-student and student-student interaction is fairly ubiquitous.

On the index of academic integration, the average HSPE freshman has a score of 100 (more than a standard deviation higher than the index for the average NSPE student). This score reflects the fact that 60 percent of HSPE students report meeting informally with faculty, 90 percent report meeting with their academic advisors, and 85 percent participate in study groups (BPS).

On the index of social integration, the average HSPE freshman has a score of 114 (more than two standard deviations higher than the index for the average NSPE student). This score reflects behaviors such as 74 percent of HSPE students engaging in cultural activities at the institution and 81 percent participating in school clubs (BPS).

I. Students rarely drop out of courses.

Transcripts of HSPE students show that they drop out (after the add/drop deadline) of only 1 percent of the courses that they initiate (BPS). This means that little of the aforementioned instructor-student and student-student interaction is disrupted or "lost."

J. Full-time attendance is the norm, and students tend to progress and graduate with their entering cohort.

Among students who started their postsecondary education at a HSPE institution, 94 percent obtained a baccalaureate degree *at the institution where they initially enrolled* within 5 years. Thus, progressing and graduating with one's class is the dominant behavior at HSPE institutions. Only 8 percent of HSPE students ever attended part-time during their first two years, and only 17 percent ever stopped attending for a term (fewer than 1 percent stopped attending for more than one term). Only 10 percent attended more than one postsecondary institution as part of their undergraduate education (including summer school classes).⁹

K. Up until very recently, distance learning has been rare.

As recently as students who entered in 2004, fewer than 1 percent of HSPE courses were taken in a distance form (BPS). Those that were were typically taken at another institution for transfer credit, and students reported taking them for remediation or to fulfil prerequisites.

L. The HSPE institution's degree cannot be summarized by certificates.

Only 1 percent of HSPE courses lead to a certificate from an outside organization, and the

0. The sources for this paragraph are NSOPF and Barrons. HSPE faculty who do not have Ph.D.s nearly all have first professional degrees such as the M.D. A good share of HSPE faculty have Ph.D.s from foreign universities. These are, unfortunately, difficult to fit into American systems of classification.

⁹ The source for this paragraph is BPS.

alumni of these schools rarely report that their first job required one or more certificates. However, 81 percent of HSPE students report that their first job did require a baccalaureate degree (BPS).

Above, I report the results of a regression in which BPS respondents' 2009 earnings were regressed on a set of indicators for their certificates and their institution. Among students who had at least one certificate, it was the certificates and not the institution that explained earnings. One cannot conduct this test for HSPE students because so few of them earn certificates. This is *prima facie* evidence that their degrees cannot be summarized by certificates. Note, however, that a regression of HSPE students' earnings on institution indicator variables suggest that the institutions' identities do somewhat explain earnings. This is not to say that the institutions' causal effects differ. It is just to say that the identity of the institution on the degree matters.

IV. References

- Higher Education Research Institute. 2010. *HERI Faculty Survey 2010*. Custom report. Los Angeles, CA: Higher Education Research Institute, 2010. www.heri.ucla.edu
- The College Board. 2011. *Annual Survey of Colleges 2010-11*. Data file. New York, NY: The College Board.
- U.S. Department of Education, National Center for Education Statistics. 2011. *2004/2009 Beginning Postsecondary Students Longitudinal Study Restricted-Use Data File*. NCES 2011244. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 2012. *2004/2009 Beginning Postsecondary Students Longitudinal Study Restricted-Use Transcript Data Files and Documentation*. NCES 2012243. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 2010. *NCES-Barron's Admissions Competitiveness Index Data Files: 1972, 1982, 1992, 2004, 2008*. NCES 2010331 (restricted-use). Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 2003. *Beginning Postsecondary Students BPS: 96/01 Restricted CD*. NCES 2003160. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 1996. *Beginning Postsecondary Students Longitudinal Study Second Followup (BPS: 90/94) Restricted-Use Data File*. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 2013. *Integrated Postsecondary Education Data System*. Custom data file. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 2012. *Integrated Postsecondary Education Data System Analytics: Delta Cost Project Database 1987-2010*. Washington, DC: National Center for Education Statistics.
nces.ed.gov/ipeds/deltacostproject
- U.S. Department of Education, National Center for Education Statistics. 2006. *Restricted-Use Data File: 2004 National Study of Postsecondary Faculty (NSOPF: 04)*. NCES 2006183. Washington, DC: National Center for Education Statistics.
- U.S. Department of Education, National Center for Education Statistics. 1997. *Distance Education in Higher Education Institutions*. NCES 98-062. By Laurie Lewis, Debbie

Alexander, and Elizabeth Farris. Bernie Greene, project officer. Washington, DC:
National Center for Education Statistics.