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

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The Economics of Online Postsecondary Education: MOOCs, Nonselective Education, and Highly Selective Education

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ABSTRACT

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.

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Rather than starting with online postsecondary education (online PE), this paper starts by describing the two extremes of traditional American PE--nonselective (NSPE) and highly selective (HSPE). I describe the logic of each model and why each is economically sustainable. This focus on the extremes is without much loss of generality because other PE is, essentially, a weighted average of the two models. To keep the economics clear, I focus on undergraduate education.¹ Having explained the economics of the two extreme models, I assess how each type could incorporate online PE in a financially sustainable way. I explicitly assess massive online open courses (MOOCs) but also consider different models of online PE.

I. Two Very Different Models of Postsecondary Education

In this section, I outline models of NSPE and HSPE. Although the models are stylized, they are amply supported by the facts, described in the next section.

A. Non-Selective Postsecondary Education

NSPE is the simple selling of current educational services for current payments. The typical NSPE course covers standardized material and does not differ much from courses offered by secondary schools. Indeed, a non-trivial share of NSPE courses cover the *same* material that appears in secondary school curricula.² Most NSPE courses are designed for students who are no more than minimally college-ready, as defined by ACT.³

Because they offer fairly standardized courses and can therefore employ instructors of whom there is an elastic supply, the full cost of NSPE (instruction plus academic support, student services, and institutional support) is not great. It can be financed by virtually all students using a combination of federal grants (for instance, the Pell Grant), federal loans (Stafford, PLUS, and Perkins), and family resources (their family's expected family contribution as computed by Federal Student Aid). Although state governments appropriate funds to public NSPE institutions that enable them to keep tuition below costs, the tuition subsidies are sufficiently modest that

virtually all students could finance the public NSPE *without* the subsidies.

NSPE institutions are paid up front for the education they provide--that is, they are paid at the time they provide the education. Thus, they can afford to be fairly indifferent as to whether the students they enroll are fully prepared for their courses or are underprepared and drop out midway. Because a good share of NSPE courses are standardized, there is little intrinsic reason for students to take all of their courses at the same institution.⁴

NSPE in specialized subjects often leads to certificates granted by external bodies. On the job market, these certificates may be as or more important than the degree from the NSPE institution.

B. Highly Selective Postsecondary Education

In other studies, I model HSPE institutions as venture capitalists in advanced human capital because (i) they invest massively in each student whom they educate and (ii) they earn an equity-like return on their investments (Hoxby, 2012). That is, the HSPE institution itself covers the majority of the cost of a student's undergraduate education using donations from alumni.⁵ Even HSPE students who receive *no* financial aid pay for only some of the full cost of their education.

HSPE alumni donate a share of their perceived returns on the educational investment made in them, and most donations occur decades after graduation. Because HSPE alumni earn returns that exhibit a highly right-skewed distribution (in each class, there are many alumni with solid professional careers but only a few Steve Jobs), it matters that donations are analogous to *shares* of returns and not to the repayment of a loan (the institution's investment plus some fixed rate of return).

It is crucial for understanding HSPE institutions' viability that they are modeled as investors, not as the sellers of a service. If an HSPE institution does not infuse value-added into students that is proportional to the institution's investment, alumni cannot pay the institution back

later in life, no matter how much they wish to do so. Thus, at least on average, HSPE institutions' investments *must* earn returns or they will go bankrupt. Interestingly, the alumni who are the most generous donors are those who needed financial aid as students and who attribute their later success to the institution.⁶

Of course, this financing system only works if former students do in fact pay back the institution later in life. The methods by which HSPE institutions achieve this intergenerational virtuous circle are therefore crucial and discussed below.

Why do HSPE institutions use this method of financing education rather than asking for current payments equal to their current costs? The answer is akin to that for venture capital projects proposed by an entrepreneur. There exist students who can earn market rates of return on advanced human capital investments that are large because they (the investments) require cutting-edge instruction and complex infrastructure. Despite being able to earn good rates of return on such large investments, most such students cannot finance them themselves even if they exhaust their capacity to obtain grants and loans. Thus, they must find an investor--the HSPE institution--expert enough to recognize their aptitude and able to provide them with the specialized resources they need. An additional advantage of the venture capital model (as opposed to institutional loans) is that an HSPE institution shares risk across its portfolio of advanced human capital investments (across all its students).

It should now be obvious that, as a logical matter, HSPE institutions *must* be selective. They cannot afford to invest in students who do not have the aptitude and motivation to benefit from the advanced education they provide.

Because HSPE institutions have no means of enforcing repayment of their investment many years after enrollment, they must cause their alumni to feel adherence and to believe in the institutions' continuing contributions to society. In particular, alumni must believe sufficiently in the institutions' judgement and methods that they give back to their alma mater to finance the

education of students who, though strangers to them, have been picked by the same institution to benefit from similar investments. Although there is no magic formula for creating these beliefs, it seems likely that instructor-student and student-student interactions are important. It seems likely that such interactions must combine intellectual and social experiences. It seems likely that alumni must actually find that they were prepared in a more advanced way than were the alumni of much less selective institutions.⁷

II. Evidence for the Two Extreme Models of Postsecondary Education

So far, I have drawn stylized portraits of NSPE and HSPE. In this section, 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).⁸

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.⁹

A. 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 account for only about 1 percent of NSPE institutions' total revenue. Gross tuition and fees account for 94 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 97 percent of costs.¹⁰

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, 70 percent of courses use multiple-choice examinations which are often supplied with the textbook (NSOPF). 36 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.¹¹ 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 78 and a standard deviation of 40. The index of social integration for the freshman year has a mean of 76 and a standard deviation of 43.

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).

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 18 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. 59 percent of NSPE students attended part-time during their first two years of study, and 51 percent stopped attending all together for one or more terms. 52 percent attended more than one postsecondary institution as part of their undergraduate education (including summer school classes).¹²

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 1990.¹³ 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, 24 percent earn certificates from an outside organization and 21 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).

B. Evidence for the Stylized Portrait of HSPE

a. For the average student, only about 20 percent of the cost of his education is paid for when he attends HSPE (DELTA).

The remainder of the cost is covered by endowment income (past donations) or current donations. Even HSPE students who receive no financial aid pay for only 48 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.

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.¹⁴

c. As a logical matter, HSPE institutions must be selective and, as a practical matter, they are.

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 (ASC). 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. Only 12 percent of HSPE class time is devoted to instructors delivering prepared lectures that are relatively uninterrupted by interaction with students (NSOPF).

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 (BPS). 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 HPSE institutions, only 25 percent of student-weighted courses use multiple-choice examinations. Only 12 percent of courses have students grade one another's assignments (NSOPF). This suggests that the problems or answers are insufficiently straightforward for a fellow student to judge. Fully 100 percent of HPSE students report having written one or more term or 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).¹⁵

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 89 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 0.7 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).¹⁶

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 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 rejects the hypothesis that the institutions' identities do not 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.

3. The Compatibility of NSPE and Online Education, Especially MOOCs

MOOCs are characterized by open enrollment, online assessments, interactive forums in which students can help one another, and (sometimes) students assessing one another's work

through crowd-sourcing. The potentially massive nature of a MOOC precludes intensive faculty-student interaction or forms of assessment in which the faculty member must evaluate students' work on an individual basis. Forums may be lightly "moderated" by teaching assistants, and some faculty answer questions that a very limited number of students (are allowed to) pose. The vast majority of students who begin a MOOC drop out before completing it. This may simply reflect trial and error since the cost of initiating most MOOCs is small. However, a consequence is that faculty or teaching assistant effort expended on individual students has a very high probability of being wasted.

MOOCs are clearly compatible with some share of NSPE education--mostly obviously the 13 percent that has been conveyed as distance education for the past two decades. It is highly likely that modern online education is an improvement on non-interactive courses. In addition, NSPE institutions offer numerous standardized courses to fairly small classes. There is reason to think that a massive, similarly standardized course taught by an instructor who is an extraordinarily charismatic and able communicator would be a good substitute. After all, a good share of NSPE courses are already characterized by multiple-choice assessments and assignments graded by other students.

In MOOCs, students' interactions with instructors and other students are necessarily constrained and are probably less "authentic" or integrating than are in-person interactions. However, NSPE students already have limited interaction with faculty and their fellow students, so the change from an in-person course to a MOOC course may change their academic and social integration only slightly.

Similarly, the high drop-out rate and episodic nature of MOOC enrollment already characterizes a substantial share of NSPE enrollment. Thus, it would be surprising if most NSPE courses are currently designed in such a way that they are disrupted by students' departures and sporadic enrollment. This suggests that MOOCs could be substituted for them.

Conferring a degree based on MOOC courses has been a problem that is largely unresolved. However, conferring a certificate for a student completing a course's assignments and passing its exam has not been so problematic. This suggests that MOOCs may provide viable substitutes for NSPE courses that are already effectively summarized by certificates.

Thusfar, I have emphasized that NSPE institutions need not select students because the institution is paid up front for providing education. If many students' term bills are paid and they then drop out part way through the term, an NSPE institution remains viable. One might think that this logic would translate easily to MOOCs, but it does not because--unlike traditional NSPE--MOOCs have little ability to control access to their content so there is *no* guarantee of up front payment. Although MOOCs are not yet sufficiently popular to attract expert hackers and professional efforts to share their content, they will eventually face all of the same problems faced by the film and recording industries: scraping, bootleg versions of content, unauthorized mirror websites, file sharing, parallel certification bodies that do not pay the organization that hosts the MOOC, and so on. The film and recording industries have not found miraculous ways to deal with these problems. Instead, they have dealt with the problems largely by pricing their content so cheaply (99 cent songs, for instance) that experts have little incentive to capture their content and undersell them. It is not clear whether there is a price at which MOOC content is cheap enough to be safe from underselling yet expensive enough to cover the costs of creating and hosting the content. The answer depends on demand and supply functions about which we currently know next to nothing. The lack of clarity is not only due to the infancy of the MOOC movement (which makes it hard to estimate demand) but also to the current well-intentioned but ultimately confusing tendency of PE institutions to give content to MOOCs for free (making it *impossible* to estimate supply). I return to this point below because it is a key source of confusion and fragility for the financial sustainability of online PE.

People often assume that, owing to economies of scale, MOOCs will be much cheaper

than providing numerous similar courses that cover standardized material. This seems likely but the outcome is not as obvious as is often suggested. People usually fail to take account of the fact that MOOC "stars"--the few instructors who are such extraordinarily charismatic and effective communicators that they can replace many in-person instructors--will ultimately need to be paid like stars. With MOOCs, we are currently in a period much like that of the early Hollywood studios: film stars were paid little and the studios captured all the rents. This system did not last because, ultimately, it was the stars and not the studios that were scarce. Today, actors whose presence can ensure that a film is profitable are paid the rents associated with their special qualities. If MOOCs become popular, the most sought-after instructors would end up with the rents. They would not continue to work for whatever salary their home institution pays them. The current pay structure is obviously unsustainable.

Summing up, MOOCs seem likely to be effective substitute for a good share of NSPE instruction. It is not proven whether MOOCs can be financially viable, especially because their current financial models (acquiring content for free, being too small to attract underselling organizations, paying their future stars none of the rents) are unsustainable. NSPE institutions might, at a minimum, start to distinguish between their courses that are likely to be substituted by MOOCs and their courses that are unlikely to be so substituted. For instance, courses that require students to interact with local businesses, local clients, or other local students may be relatively unaffected by online PE.

4. The Compatibility of HSPE and Online Education

A. HSPE and MOOCs

Let us first consider MOOCs. They would seem to be substitutes for only a small share of current HSPE--mainly "service" courses taught to freshmen to ensure that they have the prerequisites in an area in which they will not major but in which they need certain skills.

Calculus and statistics classes are common ones. These courses seem compatible with MOOCs because they cover standard material. Indeed, at HSPE institutions, these courses are often taught by non-tenure track instructors or organized to ensure that all mathematics and statistics graduate students obtain some employment.

In other respects, MOOCs are incompatible with HSPE. Because MOOCs do not practice up-front selection, they *cannot* give students much opportunity for instructor-student interaction or student-student interaction that is highly moderated by the instructor. Such interactions would allow underprepared students and future drop-outs to waste massive resources. Similarly, MOOCs cannot use assignments or assessments that require individualized advice or grading from the faculty. MOOCs cannot require students to use complex infrastructure (a lab or archive, say) that is unavailable to most people. Thus, an HSPE student who takes a MOOC is likely to experience a very different course than he would have experienced in-person.

This raises the question of how employers, graduate schools, and others should evaluate the transcript of a student who has an undergraduate education's worth of MOOCs. For example, what should we conclude about student A who was not admitted to Harvard and who has not spent any time there but who has, at a cost of perhaps a few hundred dollars, completed 32 MOOCs led by Harvard-based instructors?¹⁷ What about student B who *was* admitted to Harvard, did *not* enroll, and completed exactly the same MOOCs? What about student C who was admitted to Harvard and who enrolled for four years (paying something like 2000 times as much as students A and B in the process) and who completed exactly the same MOOCs? Are any of students A, B, or C equivalent to student D--a traditional Harvard student who took in-person versions of 32 courses with similar titles?

If Harvard's *degree* matters in some way that is greater than the sum of Harvard-led courses offered as MOOCs, then Harvard will destabilize the value of its degree by giving credit to its own students for MOOCs led by its own faculty. Why would anyone be student C who

pays for a Harvard degree but who cannot effectively distinguish himself from student B, who pays 1/2000th or less? A tragedy of the commons may occur: no one will want to pay for the creation of a course that is offered for free. Yet, Harvard courses cannot be created costlessly. Not only does current instruction cost something, but the long-term creation of the content that makes up an original course is very costly.

Of course, Harvard need not accept for credit the MOOCs authored by its own faculty. The university might argue that, although its MOOCs are solid courses, they insufficiently challenge students and insufficiently engage them in original material to count for Harvard credit. But, if Harvard-authored MOOCs do not count for credit, why are Harvard's faculty using their scarce time to author MOOCs rather than to pursue more complex teaching or research? We have already noted that it is unlikely that Harvard faculty have an absolute advantage (let alone a comparative advantage) in instructing a large group of students with diverse preparation.

Moreover, Harvard's and other HSPE institutions' financial models are not merely dependent on getting people like student C to pay tuition. The sustainability of their massive investments in students depend on alumni giving back. It is not obvious that a student C, having only experienced MOOCs, would feel sufficient adherence to make the financial model work. After all, he has interacted academically more with students of type B (outside of Harvard) than with anyone else. Indeed, both students C and D are likely to feel like mugs, having paid for material that others enjoyed for free. Even though they will *not* have paid the full cost of their education, their attitude is more likely to be one of resentment than gratitude. This is ominous for the continuance of the virtuous circle by which one generation of Harvard students pays for much of the education of another. Thus, it is not clear that HSPE institutions could afford financially to continue developing advanced human capital content.

A more subtle concern is the synergy between teaching and research. American HSPE faculty have long taught courses and conducted research side by side and, somewhat surprisingly,

have had greater *research* productivity than their foreign counterparts who have no or negligible teaching duties. It has often been argued that there are benefits to research of teaching that offset the costs. The benefits probably arise through synergies: new ideas generated by spontaneous interactions and fresh explanations. The costs are (obviously) time lost to research and (less obviously) the potential losses of intellectual property that occur when a faculty member conveys information to students while still working out his ideas. Intellectual property losses ultimately undermine the incentives to pursue research, just as a shorter patent length does. Currently, HSPE institutions rather finely adjust teaching and research duties to balance the benefits and costs of each. But, an HSPE-led MOOC would throw off this balance. Leading a MOOC would probably generate the same or fewer synergistic benefits for the instructor, owing to the lack of spontaneous interaction. It would undoubtedly generate greater costs, not just because preparing and offering MOOCs is time-consuming (unless faculty do not keep them up-to-date with advancements, in which case we are back to the standardized model irrelevant to this discussion) but because MOOCs--owing to their scale and the anonymity of students--inherently threaten massive losses of intellectual property (unless faculty merely teach standardized MOOCs irrelevant to this discussion).

Some enthusiasts of online education foresee and look forward to the day in which HSPE institutions' giving credit for MOOCs authored by their faculty destroys the institutions' intergenerational virtuous circle. Such enthusiasts apparently want to re-purpose the resources of HSPE institutions from advanced education (and research) to educating the masses. This would seem, however, to be a poorly thought-out scheme because HSPE institutions have no advantage in educating the masses and their resources, though considerable for the narrow purpose they pursue, are negligible relative to the problem of mass postsecondary education. Destroying them in their current form would therefore destroy one type of education without adding appreciably to another. If online postsecondary education is to reach the masses in a financially sustainable

way, it will be because the supply of and demand for MOOC-type education is such that it is economically viable on its own, without the infusion of the HSPE institutions' endowments.

Before leaving the subject of MOOCs, it is worth noting that the current tendency of HSPE institutions to give away course content that it is very costly for them to create is a risky procedure. Such give-aways are obviously not sustainable. If they were, HSPE education would be very cheap to provide. Moreover, the experience of news organizations suggests that giving away content on the internet sets a precedent in which consumers become unwilling to pay for it. Numerous news organizations have had to fold or greatly reduce their content development (original reporting) owing to the collapse of their subscription-based financial model. News organizations like the Wall Street Journal and Financial Times, which never made their content free, have fared better than news organizations like the New York Times, which did.

B. Is There an Alternative Model That Makes More Sense than MOOCs for HSPE?

Viable online education for HSPE must deal with two problems: (i) the selectivity necessary for offering advanced education and (ii) the experiences that build the beliefs and adherence that sustain the venture capital-like financial model.

Consider a system in which HSPE institutions created online versions of their courses that could be traded with other institutions whose students had similarly high aptitude and preparation. The exporting institution could maintain the advanced nature of the course by limiting enrollment to those outside students who were best prepared, by disallowing outside students whose home institutions had previously sent students who underperformed, or by insisting that the outside students receive support (interactions and assessment) from an instructor at their home institution who is trusted by the exporting faculty member. Exporting institutions might offer such courses at a sustainable cost.¹⁸ A student's home HSPE institution would continue to set his degree requirements, grant his degree, and be responsible for all other aspects of his PE experience.

This system would increase curricular breadth and depth for many students without undermining the sustainability of the HSPE model. The reach of each expert instructor could be extended to a greater number of seriously interested and prepared students. Highly selective liberal arts colleges might offer the "best of both worlds" to their students: the intimate, small college experience along with opportunities to take advanced classes on occasion at HSPE institutions with faculties large enough to be more specialized. Similarly, without being capable of themselves offering attractive courses for export, some foreign institutions would arguably be capable of selecting, preparing, and locally supporting very high aptitude students eligible for exported courses.

This would not be a model in which HSPE faculty were teaching a massive number of students, but--on the other hand--HSPE faculty would also not be wasting their scarce powers on instructing students whom others are capable of instructing just as well. Given the concentration of expert faculty at American institutions and the number of high aptitude, highly prepared students who currently have little access to such faculty, it is likely that all of America's highly selective institutions (including many that do not make it into my HSPE category) would be net exporters or have balanced trade.

5. Do Infant Industry Arguments Apply?

Postsecondary institutions' current tendency to give course content to MOOCs for free appears to stem from infant industry thinking. Specifically, postsecondary leaders appear to believe that the MOOC industry is in its infancy and has not yet reached the minimum efficient scale that it needs in order break even financially. They hypothesize that the MOOC hosting organizations that are most subsidized today will dominate the future MOOC industry. Thus, if these leaders' institutions seek to dominate the future MOOC industry, their subsidizing MOOCs now through content give aways might make sense.

Infant industry arguments have long been controversial in economics, probably because they are arguments that are often abused in practice (leading to industries that cannot be "weaned" off subsidies without dying). Although there are plausible economic models in which subsidies launch an industry that becomes self-sustaining, the conditions under this occurs are restrictive and usually require some form of natural monopoly. For instance, a firm that is subsidized might learn by doing or acquire a network to such an extent that entrant firms cannot compete with it.¹⁹ However, it is far from obvious that any MOOC could develop a natural monopoly over the standardized course content to which MOOC instruction is most suited. After all, there are not currently natural monopolies for textbooks that cover standardized content--the textbooks most used in NSPE. The textbook industry is competitive, and new textbooks regularly enter and displace previously popular ones (Greco *et al*, 2007).

Perhaps the infant industry argument applies not to standardized courses but to the development of innovative or advanced content? That is, perhaps HSPE institutions need a greater number of students in order to reach minimum efficient scale for fostering research and the innovative integration of new material into courses? This argument might hold in special cases, but it cannot hold generally because HSPE institutions already have far more applicants (and qualified applicants at that) than they accept as students.²⁰ Thus, if HSPE institutions needed a greater number of students in order to foster research and the creation of new course content, they would be accepting more applicants now. In fact, although online *education* may be an infant industry, research and original content creation is a mature industry in which HSPE institutions already have efficient scale and some natural market power (owing to the importance of faculty interactions). If anything, HSPE institutions weaken rather than strengthen their market power in research and original content creation when they increase their exposure on the internet (Kim, Morse, and Zingales, 2009)

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Endnotes

1. My functional definition excludes public highly selective postsecondary institutions. Their finances cannot be described without a thorough discussion of the large tuition subsidies that they derive from state appropriations. These tend to distort students' choices and cause redistribution *within* a cohort. Discussing these financial matters would add complication but no insight to the issues on which this paper is focused.
2. Such courses may be classified as remedial by NSPE institutions.
3. The benchmarks are scores on ACT tests required for students to have a 50 percent chance of obtaining a B or higher or a 75 percent chance of obtaining a C or higher in credit-bearing first-year college courses such as composition, college algebra, and introductory social science. The statistics behind the benchmarks are based on a nationally representative sample of about 90,000 students. See ACT 2013.
4. The paperwork involved in transferring credits among institutions is not, however, trivial.
5. Past donations to the endowment generate investment returns that are transferred to current revenue through a process governed by rules. Alumni also make current-use donations, especially to provide financial aid to current students.
6. As a logical matter, students whose families could not afford to pay the full cost of an HSPE education will themselves be unable to repay the investment unless the institution adds value. They cannot simply earn as much as their parents, on average. Of course, the logic does not prove *how* HSPE institutions add value. It is possible that demonstrating mastery of advanced human capital is an elaborate signaling mechanism for innate aptitude and motivation. The source for the last sentence in the paragraph is custom calculations based on the College and Beyond survey, performed by Matthew Chingos for the author. College and Beyond is useful for such studies because it contains students from an array of HSPE institutions and because alumni answer questions about the importance of their undergraduate experience to their later life. This

is important because sorting out the effects of perceived value-added from the effects of a student's pre-college family income can be extremely difficult. Clotfelter studies alumni giving (2001, 2003) using *College and Beyond*. Other important studies rely on administrative data from a single institution--for instance, Marr, Mullin, and Siegfried (2005), Holmes (2009), and Meer and Rosen (2012). Because they use administrative data, the latter studies focus on a student's receipt of financial aid, his family connections, and other aspects of his undergraduate experience recorded by the institution.

7. See Clotfelter (2003) for evidence on these points. It is not important that alumni perceive their HSPE institution to be different from other HSPE institutions. Suppose that a Harvard alumnus believes that Harvard and its fellow HSPE institutions perform a valuable public service by acting as venture capitalists in advanced human capital. If he is otherwise indifferent among the institutions, he will probably donate to Harvard because of the greater information that its development office will give him.

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

9. 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.

10. The source for this paragraph is DELTA.

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

12. The source for this paragraph is BPS.

13. 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).

14. 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 2.5 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.

15. 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.

16. The source for this paragraph is BPS.

17. Harvard requires 32 courses for graduation, and we may assume that the student has taken an array of MOOCs that satisfies the school's general education and concentration requirements.

18. In some cases, this would just be the marginal cost of providing instruction for an additional student. However, the opportunity to export would probably allow some faculty to create courses with new content for which there had previously been insufficient demand. In such cases, the

price would have to cover the cost of course creation.

19. The economic literature on infant industries is vast and, perhaps as a result, not well summarized in a recent review article. However, good examples of infant industry models may be found in Grossman and Horn (1988) and Melitz (2005).

20. Specific HSPE programs in fairly rarified areas do sometimes have difficulty finding a sufficient number of qualified and interested students. It is these programs that would probably benefit most from the trade model of online education described in the previous section. However, most HSPE programs (and all of their integral undergraduate programs) have more qualified applicants than they accept.