

2014/39



An economic appraisal of MOOC platforms:  
business models and impacts on higher education

Paul Belleflamme and Julien Jacqmin



**CORE**

DISCUSSION PAPER

Center for Operations Research  
and Econometrics

Voie du Roman Pays, 34  
B-1348 Louvain-la-Neuve  
Belgium

<http://www.uclouvain.be/core>

CORE DISCUSSION PAPER  
2014/39

**An economic appraisal of MOOC platforms:  
business models and impacts on higher education**

Paul BELLEFLAMME<sup>1</sup> and Julien JACQMIN<sup>2</sup>

September 2014

**Abstract**

We start by using various economic and pedagogical concepts to understand the specificities of MOOC (Massive Online Open Courses) platforms. We then discuss how the private provision of MOOCs, seen as pure public goods, can be sustained. Based on the theory of multisided platforms, we analyse five ways to monetize the MOOC business. Our conclusion is that the most sustainable approach is what we call the ‘subcontractor model’, flavored by touches of the other four models. We then claim that MOOC platforms can play a key transformative role in the higher education sector by making teaching practices evolve, rather than by replacing incumbent institutions. Finally, we derive a number of directions for public policy: governments should act to foster the cooperation between MOOC platforms and other higher education institutions, so as to improve the benefits that can arise from these technological innovations; a particular focus should also be given to professors in order to encourage them to innovate in their teaching practices.

**Keywords:** higher education, distance learning, multisided platforms.

**JEL classification:** I23, I21, L31, L86.

---

<sup>1</sup> Université catholique de Louvain, CORE & Louvain School of Management, B-1348 Louvain-la-Neuve, Belgium. E-mail: paul.belleflamme@uclouvain.be

<sup>2</sup> University of Montpellier, LAMETA, F-34960 Montpellier, France. E-mail: julien.jacqmin@univ-montp1.fr

A preliminary and incomplete version of this paper was published in French in *Regards Economiques* 110, under the title “Les plateformes MOOCs: Menaces et opportunités pour l’enseignement universitaire”. The second author gratefully acknowledges financial support from the “Labex Entreprendre”. We thank Muriel Dejemeppe, Vincent Blondel and Vincent Vandenberghe for useful suggestions and stimulating discussions. This version: September 2014.

## 1. INTRODUCTION

The year 2012 saw the emergence of a new player in the higher education landscape: MOOC platforms (which stands for “Massive Open Online Courses”). Following the decision of two Stanford professors, Peter Norvig and Sebastian Thrun, to put online and for free their ‘Introduction to artificial intelligence’ class, more than 160.000 students from all over the world enrolled and 23.000 received a certificate of course completion. Following this massive success, several private initiatives started to establish online platforms to organize these courses. Sebastian Thrun went on to create Udacity, a website that could provide other courses than his own. Andrew Ng and Daphne Koller, two other Stanford professors, founded Coursera while MIT and Harvard University jointly created edX.<sup>1</sup> The success was almost immediate and MOOCs quickly became a buzzword in the sector of online distance education, which was not used to be in the spotlights.<sup>2</sup> For example, as of early 2014, Coursera partnered with 108 institutions from all over the world, the vast majority of which being traditional higher education institutions, to provide more than 500 courses, which have attracted more than 7 million single users. In less than two years, Coursera also succeeded in attracting more than \$65 million in venture capital investment.

From an economic point of view, MOOCs differ from traditional higher education initiatives by having the potential to be a true public good, i.e., to exhibit both nonrivalness and nonexcludability. Nonrivalness is an inherent property of higher education in general: the ‘consumption’ of some education program by an individual does not reduce the ‘consumption’ possibilities of the same program for other individuals. Excludability (i.e., the capacity to exclude someone from consuming the good in question), however, depends on technological and organizational factors. It is in terms of technology that the difference is the most pronounced: by relying on the Internet and digital technologies, MOOC platforms manage to considerably loosen—if not eliminate—the capacity constraints that curb the provision of traditional higher education programs. As a result, MOOC platforms are able to attract hundred thousands students per course, and the marginal cost of teaching an extra student comes close to zero. A difference with traditional higher education also exists from an organizational point of view. As the second ‘O’ in the MOOC acronym attests to it, MOOCs are (at least for now) truly open: their access is free of charge and no other form of exclusion (e.g., contractual) is imposed. It is thus fair to state that contrary to traditional higher education programs, MOOCs are nonexcludable.

Nonexcludability has pros and cons from a social point of view. On the plus side, an enhanced access to courses magnifies the positive externalities of education for society as a whole. On the minus side, private provision of

---

<sup>1</sup>Udemy, Futurelearn, FUN and Iversity are other lesser known examples of MOOC platforms.

<sup>2</sup>The New-York Times declared 2012 as the “Year of the MOOCs”.

a nonexcludable good is typically problematic as no revenues can be raised from the sales of the good (as non payers cannot be excluded). Despite the latter difficulty, MOOCs are currently provided by private platforms with no (or very limited) public funding. How is this possible? Is such organization only temporary or can it be sustained in the long run? These are the questions that we aim to address in this article. For this purpose, we will describe the economic and pedagogical characteristics of MOOCs as highlighted by the scientific literature. We will argue that the peculiarity of their business model is that they are organized as multisided platforms. Using this framework, we will discuss the various ways that could be used to make revenues from providing free courses. Based on this argumentation, we will conclude that MOOC platforms will most likely complement rather than substitute the traditional system.

The rest of the article is organized as follows. Section 2 describes the characteristics of MOOC platforms and how they set them apart from traditional higher education institutions. Section 3 studies the various ways in which these platforms can monetize their business. Section 4 and 5 discuss the implications for, respectively, traditional higher education institutions and public policies. Finally, Section 6 concludes.

## 2. CHARACTERISTICS OF MASSIVE OPEN ONLINE COURSES PLATFORMS

We start this section by stressing the novelty aspects of MOOCs compared to earlier distance learning initiatives. We then propose a taxonomy of MOOCs and briefly describe their value-added in terms of learning. We close this section by emphasizing two economic characteristics of MOOCs and of the platforms on which they are delivered.

**2.1. Novelty of MOOCs.** MOOCs are not the first attempt in online distance learning in the higher education sector. However, compared to previous initiatives, they have three distinct peculiarities that were not jointly observed before, which clearly set them apart from other forms of online education.

The first characteristic relates to the first “O” of its acronym and how platforms define openness. Learners can follow MOOCs at a zero cost and there is no barrier of entry such as a pre-requirement, an entry exam or any other form of selection. This can be seen as a form of commitment by the platform to offer a non-excludable service. However, this peculiarity is not new in the online higher education landscape. This openness, for example, was already present in OpenCourseWare, which are videotaped lessons provided at some universities (the MIT OpenCourseWare being the most well known) and available for free on the Internet (OECD, 2007).

The second characteristic is that learners can receive a certificate of completion that proves that they have reached a minimum level of understanding

of the course material.<sup>3</sup> This is possible thanks to the various tests organized throughout the courses. OpenCourseware did not allow for this but a certification was already available for courses provided by for-profit universities (mainly in the U.S.) and by Open Universities active in several countries. For-profit universities now attract more than 10% of the U.S. population by providing a mix of live and online classes to their students (Breneham *et al.*, 2006). Their online classes are mainly used as a way to cut their costs of providing education. Open universities have been established in the second half of the last century as a way to ease the access to higher education to more learners with correspondence courses. Since the end of the nineties, they have also embraced Internet as a medium to provide their courses. Hence, both these institutions were granting certification for the completion of their courses long before the advent of MOOCs platforms.

The third characteristic concerns the presence of interactions between the learners and the platform and between the students themselves. These online interactions aim to emulate the live interactions taking place in the traditional, face-to-face, higher education. The interactions with the platforms take the form of automatically graded quizzes and essays. These are an attempt to circumvent the quasi absence of direct interactions between the professors and the students. They are possible thanks to the artificial intelligence programs developed by the platforms. The interactions between students are trying to reproduce peer effects online. They take place on forum, throughout online group projects or peer grading assessments. As we will discuss later, this characteristic offers a lot of room for innovation in order to improve the functioning of the platform and student's learning outcomes. These interactions are similar to the ones that are made possible via learning management systems, such as Moodle or Blackboard that are often used to complement traditional courses.

**2.2. A taxonomy.** Within the MOOC community, practices are far from being homogenous (U.K. Department for Business Innovation & Skills, 2013, and Gaebel, 2013) and tend to be located somewhere in between two approaches. The first approach is referred to as xMOOCs. It puts more emphasis on the automatic interactions between the platform and the students. The second is referred to as cMOOCs where 'c' stands for 'connectivist'. This approach puts more emphasis on the interactions among students, to the point where the content of the course emerges, at least partially, from these interactions. There, the role of the professor is not to provide content but to facilitate the student's learning experience.

In this work, we are mainly interested in understanding MOOCs provided near the xMOOCs side of the pedagogical spectrum. There are several reasons why we focus on this type. First, cMOOCs are, for now, at a more

---

<sup>3</sup>Up to now, these certificates can only be used as credits in very limited circumstances. At the time of this writing, we do not know of any MOOC accredited by an external accrediting body.

experimental stage and no empirical studies have examined their contributions on the students' learning outcomes. Secondly, as xMOOCs are focused on the transmission of knowledge, like traditional higher education institutions, they are more likely to affect the higher education system in one way or another. Finally, whereas cMOOCs tend to be the result of a bilateral relationship between a professor and students, xMOOCs are now essentially organized around multilateral platforms that are accessible to a large number of content providers (i.e., professors); such mode of organization raises new and important economic issues that are worth examining in detail.

**2.3. Benefits for learners.** What is the added value offered by MOOCs to learners compared with a face-to-face approach, as provided in the higher education sector? Aside from its flexibility and accessibility that were already possible with the famous invention of Gutenberg, we can classify their added value in three categories of advantages.<sup>4</sup>

First, MOOCs facilitate the implementation of a retrieval-based learning by providing feedbacks to the students using automatically graded tests and quizzes. According to this cognitive theory, these tests are not only a way to measure or assess what a student knows. Retrieving information has not only an impact on the students' short term memory but it also improves their long term memory. Many works have tested this hypothesis in a laboratory setting (see, e.g., Roediger and Karpicke, 2006, and Karpicke and Roediger, 2008). They have found a positive and significant relationship between the practice of retrieval and learning outcomes. Recently, Pennebaker *et al.* (2013) have also found a similar relationship in a study based on the use of retrieval tools during a full term course.

Secondly, because MOOCs are delivered on the Internet, they have the potential to facilitate the implementation of a student-centered learning experience. As discussed more generally for Internet markets in Levin (2011), this customization is possible thanks to the low cost of adapting the content provided to the students and the ability to utilize the data available on the platform. In the context of MOOCs, the Internet facilitates the implementation of a mastery learning environment thanks to the use of tests and possible remedial systems (Bloom, 1984). According to this approach, learning outcomes are improved and less heterogeneous when students go on to more advanced learning tasks only if they have shown a sufficient mastery of the previous learning units. MOOC platforms can, in addition to provide a more adapted content, offer a learning environment more adapted to the cognitive peculiarities of learners. For example, classes can be watched, re-watched and stopped at any time depending on the student's attention capacity. A multiple representation of the content (made possible by the simultaneously provision of videos, quizzes, syllabus, or discussions on forums) is also seen as affecting learning outcomes positively (Ainsworth, 1999). Through their enhanced multitasking skills (as acknowledged by Carrier *et al.*, 2009), the

---

<sup>4</sup>See also Glance *et al.* (2013) for a discussion along the same lines.

younger generations may take even more advantage of this possibility. Even if MOOCs are not yet ripe in implementing this personalization of the learning experience, the Internet provides the right conditions to move into this direction.

The third advantage concerns the implementation of evidence-based educational practices, which can be more easily implemented than in a traditional higher education environment. The main difficulty with such an approach is to distinguish between correlation and causality when considering an educational practice and the chosen learning outcome.<sup>5</sup> This difficulty follows from the existence of an endogeneity bias caused by the presence of inverse causality or by the omission of a variable that affects both the analyzed practice and the corresponding outcome. By separating the treatment and control groups in a purely random way on a large number of individuals, controlled trial experiments allow the analyst to disentangle the causal impact by looking at how the learning outcomes differ depending on the group considered. These conclusions can then give room for further improvements in terms of learning outcomes on the MOOC platforms.

There are several reasons why MOOC platforms offer a great environment for random trial experiments. Thanks to the massive amount of data concerning the learning process and the outcomes available at a very low cost, the Internet gives a perfect setting for this type of experiments (Levin, 2011). Such experiments are also technically and administratively easier to put in place than in a traditional higher education setting (where, e.g., review board might impair the randomization process based on ethical grounds). The Hawthorne effect (i.e., the learners change their behavior when they know that they are observed as subjects of an experiment) and the replication of results are also less of an issue in this context. Finally, spillovers from the treatment to the control group can be avoided by separating the two groups completely. This can be done by offering completely separate courses in parallel on the platform.

Up to now, applications of this methodology in the context of online learning have been parsimonious, Figlio *et al.* (2013) and Bowen *et al.* (2014) being two exceptions. Figlio *et al.* (2013) have analyzed how a live course fares compared with the same course taught online in an introductory class of a research university. They have observed on average a similar impact on the students' achievement. However, online classes were leading to a lower outcome for low achieving students. Bowen *et al.* (2014) have studied how students following a class in a traditional format (taught in an auditorium) and a hybrid format (taught online with face-to-face instruction time) fare. They have found that students from these two groups end up with similar learning outcomes.

---

<sup>5</sup>See Schlotter *et al.* (2011) and Bouguen and Gurgand (2012) for a discussion on this topic.

Despite these first encouraging results, MOOCs, in a stand-alone format, are far from reaching similar learning outcomes than traditional courses. Platforms are still not close to replicate online the interactions taking place in the traditional higher education sector. They also lag behind in terms of coherence between courses compared with the ones offered in a traditional higher education program. However, the difference in learning outcomes between MOOCs and traditional courses is likely to diminish. New technologies facilitating interactions with the platform and among students and the emergence of evidence-based pedagogical practices will facilitate this evolution. Moreover, this sector shows a much greater flexibility than traditional higher education sector, which should further speed up the process.

**2.4. Economic specificities.** We emphasize now two important specificities of MOOCs. On the one hand, MOOCs differ from traditional courses both on the supply- and on the demand-side, with potential effects on the market structure of higher education. On the other hand, the choice of organizational mode (for or not for profit) seems to have a larger impact on MOOC platforms than on traditional higher education institutions.

*2.4.1. Supply, demand and market structure.* On the *supply side*, MOOC platforms stand out compared to traditional higher education institutions. Their cost structure is dominated by comparatively larger fixed costs.<sup>6</sup> These costs have to be incurred even before the course starts. They concern the development of the platform, the investment in a sufficiently large bandwidth and the online adaptation of the course. The latter category can vary depending on the material used (e.g., to record the classes) and the use of external help (like a cartoonist, a video editor or teaching assistants). The (opportunity) cost of the person providing the course is also larger.<sup>7</sup> A MOOC requires more time than a normal class because the contents need to be adapted to this new format and because supervising the teaching assistants and the external technical help entails larger coordination costs.

On the other hand, variable costs are much smaller. Interactions between students and professors are now replaced by interactions with the platform (to grade quizzes) and by interactions among peers (to crowdsource the questions that students might have and to evaluate their peers). Thanks to this, if the platform is well organized and there is no issue due to congestion, variable costs are close to zero. Furthermore, there is no capacity limit as is the case for a normal course (where, e.g., teaching rooms cannot be expanded). MOOCs face the additional advantage that they could also, unless part of the contents depreciates, be reused at zero cost by the platform. Hence, MOOCs are a non-rival service in their use. Compared to their live

---

<sup>6</sup>See Hollands and Tirthali (2014) for suggestive evidences on the cost of MOOCs.

<sup>7</sup>Udacity pays professors to teach on its platform, while Coursera or edX do not, as professors are still on the payroll of their respective university (it is the choice of their host institution to provide them with incentives to teach a MOOC).

counterparts, they have an undeniable advantage in terms of economies of scale.<sup>8</sup>

On the *demand side*, MOOCs improve the accessibility of higher education: classes can be followed at any time, there is no transportation cost, no need to move in to live near a campus or to commute. They are generally free of charge. Students can also decide the courses that they want to follow without having to stick to a specific sequence. In addition, as we discuss it in Section 3.1, MOOC platforms generate indirect network effects between the professors providing content and the students following the course. Professors prefer to teach a MOOC on a platform that attracts more students and students prefer to join a platform offering more courses.<sup>9</sup>

Because economies of scale and network effects are two reinforcing forces, their combined presence may lead to a concentration of the market for MOOC platforms. This leads some observers to predict that, like Amazon, Google or eBay in their respective markets, a single platform will dominate the MOOC market.<sup>10</sup> Countervailing forces, as discussed by Evans and Schmalensee (2007), are the differentiation among platforms (e.g., from a pedagogical, linguistic or technological point of view or in terms of the objective pursued by the platform), the possibility for participants to ‘multihome’ (i.e., to participate simultaneously to several platforms) or the rise of some form of congestion in the use of the platform.<sup>11</sup>

2.4.2. *For-profit vs. not-for-profit.* Platforms active in the MOOC market tend to differ in the way they are organized. Udemy, Coursera and Udacity are organized as for-profit institutions while edX is organized as a not-for-profit institution. The main difference between these two forms of organization is that not-for-profit institutions are barred from distributing their profits to their owners.<sup>12</sup> Any budget surplus must be reinvested into the

---

<sup>8</sup>The empirical literature (see Bonaccorsi *et al.* (2006) for a review) has found no consensus on the exact level of economies of scale in traditional higher education institutions. Both increasing and decreasing returns to scale were found. Returns to scale tend to be relatively lower for undergraduate and scientific programs. Explanations for these results have to do with the level of interpersonal relation in teaching, the size of fixed assets (such as laboratories, libraries, classes or computer classrooms), and congestion problems related to large bureaucratic institutions.

<sup>9</sup>Although such demand-side economies of scale are also present in the higher education system, their role is greatly undermined by the presence of relatively important (supply-side) diseconomies of scale.

<sup>10</sup>See ‘The attack of the MOOCs’, *The Economist*, 20/07/2013.

<sup>11</sup>A high degree of market concentration could have a non-negligible impact on the professor’s wage distribution by leading to a superstar phenomenon, as observed in the entertainment industry. See Acemoglu *et al.* (2014) for a formalization of this phenomenon in a setting where less skilled professors use the digital content produced by relatively more skilled professors to complement their courses.

<sup>12</sup>The difference goes even further as they do not have any proper owner.

institution. Following the arguments of Hansman (1980), there are pro's and con's for these two modes of organization in the context of MOOCs.<sup>13</sup>

The major drawback of this legal constraint is that not-for-profit institutions may find it difficult to access additional capital as they do not have access to the equity market. In a start-up phase, their lack of collateral makes it difficult for them to raise capital via debt financing. Without large amounts of capital coming from customers (as these online businesses are not monetized yet), the lack of access to flexible capital makes it difficult to attain the critical mass needed to take advantage of the presence of indirect network effects and economies of scale. This problem could be circumvented, at least partially, by increase in capital coming from donations; yet, donations may be hard to attract and donors may impose a number of restrictions as to how funds can be used.

On the other hand, the impossibility to distribute profits plays a commitment role in the provision of an education of quality. Education is a credence good, i.e., even after its consumption students can hardly ascertain its quality. This is the source of asymmetric information between students and the providers of education. As it is also more costly to provide an education of quality, the not-for-profit status gives an incentive not to shirk on the quality of education provided to students. It can also play a similar role towards donors, who would rather see their money be invested in the causes pursued by the institution than redistributed to the owners of the for-profit firm. Hence, the not-for-profit status helps reduce the market failure created by the presence of asymmetric information. In the context of MOOC platforms, this problem can be partially alleviated by an external accreditation of the quality of the courses or, as done by several platforms, by externalizing the course development to a member of a recognized higher education institution, who would then indirectly and informally play a certification role for quality.

Currently, MOOCs were established by funds coming from venture capitalists, universities and foundations. All these contributors are looking for some form of return on their investment (in monetary terms for venture capitalists and, perhaps universities; in terms of achieving certain objectives for foundations). Such a return is only possible if platforms are able to generate enough revenues to at least cover their costs. As is usually the case for Internet start-ups, the monetization of their business is one of their main challenge. This leads us to the question of the business models that MOOC platforms can adopt.

### 3. POTENTIAL MONETIZATION STRATEGIES

A business model describes the main aspects of a firm both in terms of objectives pursued and resources needed to achieve them. Not-for-profit and

---

<sup>13</sup>See also Hansman (2012) for an application of the argument to the context of higher education.

for-profit platforms aim to offer courses to a large number of students. The resources are an adequate technology and a sufficient amount of recurring revenues, at least to cover their costs. This last element is the most critical. We examine several ways to generate revenues in a sustainable manner. Before that, we explain why MOOC platforms can be seen as multisided platforms. This perspective will allow us to understand and assess the relevance of the different business models that MOOC platforms may want to adopt.

**3.1. MOOC platforms as multisided platforms.** The main function of these platforms is to ease the interactions between several distinct groups of agents (which are the ‘sides’ of the platform). Without the intermediation of platform, interactions would take place less easily, or not at all. In addition to this, there are indirect network effects as agents on one side of the platform value the service provided on the platform in function of the importance of the participation on the other sides. As formalized by Rochet and Tirole (2003, 2006), in the context of two-sided markets, strategic pricing decisions need to be based on a careful appraisal of the interrelations among different sides (so-called “cross-side network effects”) and within each side (so-called “within-side network effects”). It is then common to see asymmetric pricing structure with one group of agents being subsidized (leading to free access, or even negative prices) and other groups being charged higher prices. In general, platforms have an incentive to charge lower prices to the group that exerts the strongest cross-side effect on the other side(s): what is lost by decreasing the price on this group is more than compensated by increasing participation on that side, as well as on the other side(s) because of the (positive) cross-side effects. By the same token, subsidizing the participation on one side allows multisided platforms to solve the so-called “chicken-and-egg” problem: as each group’s participation is conditioned on the other group’s participation, the platform strategically chooses to let one group use the platform for free so as to initiate a positive feedback loop. In the context of MOOC platforms, this logic explains how the provision of a public good by a private initiative can be sustainable, even without government subsidies.

Four groups of agents are likely to gravitate around MOOC platforms. In addition to students, professors and higher education institutions, MOOC platforms may also attract other private actors, such as advertisers or employers. To understand the functions performed by the platform (and how it can monetize them), we must first identify what each group expects from the other groups and what they can give them in exchange.

**3.1.1. *Students.*** Students participate to the platform to follow courses taught by professors. If their only motivation is to acquire new knowledge and competences, their interactions stop here. But if their learning is motivated by a will to improve their employability, students will also value the presence of universities (as they guarantee, up to now only in an informal manner, the

quality of the courses), employers (as students may signal their abilities to them) and advertisers (if their presence and their payments allow platforms to offer courses to students for free).

The role played by peer effects can also have its importance as, by observing the behavior of their peers, students might be influenced. As a result, a student's learning outcomes will depend on the interactions with his fellow students. This issue has been intensively studied in a traditional higher education context as, depending on the nature of the peer effects, different policies might prevail (see, e.g., Winston and Zimmerman (2004) for a discussion on the issue). Studies in an online environment are scarce. Bettinger *et al.* (2014) is one exception. Using data from a for-profit university active online, they observe that peer effects do exist on forum as they impact course completion and performance, and are persistent on subsequent courses. Note also that the authors observe the existence of some form of congestion as too many and too lengthy posts by other peers on the course forum can have a negative impact on these outcome variables.<sup>14</sup>

3.1.2. *Professors.* Professors seek to disseminate their teaching materials and to experiment with new pedagogies. Being involved with a MOOC allows them to reach both objectives. If dissemination is the main objective, professors clearly prefer platforms that attract large crowd of students. Professors also value the fact that universities interact with the platform. First, although professors can offer a course in their own name, they usually continue to depend on their respective university. There is often a direct link as it is the university that pays professors to develop a MOOC (considering that this task belongs to their academic missions). There are also a number of indirect links. First, professors (even if they act free-lance) benefit from the reputation of the university to which there are affiliated, as this reputation facilitates the enrollment of students. Second, developing a MOOC may help professors to improve their teaching portfolio so as to, e.g., increase their chances to get a promotion in their university. This form of reputational/career concerns is similar to the one described in Lerner and Tirole (2002) for contributors to open source software. Finally, a successful MOOC may increase the demand for complementary goods and services (such as (text)books, invited seminars, guest lecturing) for which professors can be financially compensated. Regarding the other private actors, professors value their presence indirectly if it contributes to attract more students.

3.1.3. *Universities.* As discussed by Hollands and Tirthali (2014), higher education institutions can decide to invest money and time in a MOOC platform for several reasons. First and foremost, developing MOOCs allow them to extend the reach and access of their teaching activities. Thereby, they

---

<sup>14</sup>If this congestion in the peer effects is also present in the MOOC setting, this negative impact on the benefits derived by students may potentially undermine the economies of scale of MOOC platforms.

may not only build and maintain a strong brand (by advertising themselves as innovative institutions), but also collect additional revenues. Clearly, in view of these objectives, universities tend to favor platforms that are able to attract a large and diversified crowd of students. MOOCs also help universities to improve learning outcomes thanks to new pedagogical innovations. To attain this goal, they pay professors and encourage them via other non-monetary rewards (courses buy-outs, promotions, etc.) to adapt their courses and to carry on research about new pedagogical approaches. Similarly to professors, universities only value indirectly the participation of private actors to the platform.

**3.1.4. *Private actors.*** Private actors are mainly willing to interact with students. On the one hand, employers gain access, via a MOOC platform, to a large pool of students as well as to detailed data about their skills; the larger the pool of students and the higher the quality of the data about them, the higher the chances for employers to find the desired profiles. Employers may also see MOOCs as a flexible and cheap tool to train their staff. In this respect, the presence of universities and renowned professors is highly valued. On the other hand, advertisers are ready to pay to have access to the visitors of the platform, as well as information about them. This information allows advertisers to segment the audience and to customize their commercials, so as to attract more clicks on their ads, and hopefully more sales as a consequence.

Now that we have described how MOOC platforms create value by facilitating the interaction between different groups of stakeholders, we describe five business models, which can be seen as five different ways to monetize the value that platforms create.<sup>15</sup>

**3.2. *Certification model.*** The certification model has been the model that traditional higher education institutions have been following for decades. By certifying the successful completion of an educational program, the degree signals to the job market the skills acquired by students. As long as employers value such signal (e.g., because it helps them sorting job candidates more efficiently), students value the signal as well and are thus willing to pay to acquire it. In addition, the value of the signal increases with the reputation of the institution delivering the degree. Higher education institutions therefore monetize the value that they create on the job market by reducing the information asymmetry that plagues the recruitment process.

MOOC platforms try to emulate this model but with two major differences. First, MOOCs still suffer from a reputation deficit with respect to traditional institutions. So far, the certificates that they deliver are not accredited by any external quality assurance institution; the only form of accreditation comes, indirectly from the reputation of the professors who

---

<sup>15</sup>For other analysis of the revenue models of MOOCs and of other freely available educational resources see, e.g., Downes (2007) and Dellarocas and Van Alstyne (2013).

conceive the MOOCs and of the universities that employ them. Second, and more importantly, MOOCs turn the certification model on its head in terms of pricing. In the traditional model, the institutions charge students (and/or the subsidizing public authorities) upfront for the access to a program of courses; the degree is then delivered, free of charge, when students successfully complete the program. The exact opposite applies for MOOCs: access to courses is free but students need to pay if they want to obtain a certificate that attests of their successful learning experience. Clearly, the main drawback to this approach is that revenues depend not on enrollment figures but on completion rates (and on the value that those students who complete the courses attach to a certificate). For now, this drawback is serious as graduation rates for MOOCs are particularly low (especially relative to the impressive enrollment figures).<sup>16</sup>

Facing this problem, MOOC platforms may be tempted to lower the minimum standards required for certification so as to increase revenues. They may be able to do so because these standards cannot be perfectly observed neither by students nor by employers.<sup>17</sup> However, such tactic may backfire as it may undermine the credibility of the certificates in the eyes of employers, as argued by Cantillon *et al.* (2011). The argument that underpins the certification model would then work backwards: if employers doubt on the signal conveyed by the certificates, students do not find it worthwhile to invest their time to acquire them. Indirect network effects would also play backwards: as students' participation to the MOOC platform dwindles, so does employers' participation and so on so forth.

In sum, MOOC platforms seem to have a hard time to apply the certification model. The basic difficulty comes from the fact that MOOCs are by essence open and free. As a result, platforms can only charge for the certificate itself and not, as universities do, for the bundle 'course + certificate'. Revenues then depend on completion and not on enrollment numbers. Even though MOOCs are able to enroll many more students than traditional higher education institutions, they suffer, for now, from much larger drop-out rates. All in all, the quantity of certificates that MOOC platforms can hope to deliver is likely to be small; moreover, students currently attach a much lower value to MOOC certificates than to university degrees. To turn the tide, a serious accreditation system should be put in place in order to control for the quality of the MOOC experience; any efforts to consolidate

---

<sup>16</sup>Drop-out rates of around 90% are rather common. See U.K. Department for Business Innovation & Skills (2013) for a discussion of the explanations of these high figures. The most important explanation is that MOOCs are seen by many as an educational resource rather than as a course. Another explanation is that MOOCs require a higher degree of self-discipline.

<sup>17</sup>Certification standards are more easily checked for the command of languages or for specific skills. This explains why tests like TOEFL or GMAT can be profitably administered by private organizations, whose core business is to certify (at the difference of universities or MOOCs, whose core business is to teach and not to certify).

the reputation of MOOC platforms and to improve completion rates would also certainly help.

**3.3. Freemium model.** Freemium is a contraction of the words ‘free’ and ‘premium’, the latter characterizing a privileged offer. This approach builds on the fact that some features of MOOC platforms are excludable. The idea is then to apply menu pricing (i.e., second-degree price discrimination) by proposing different versions of the service at different prices. Typically, a free version (giving basic access to MOOCs) can be offered along a number of paid versions (including various bundles of excludable services, such as personalized tutoring, privileged interactions with teachers, unlimited access to courses at any time, more flexibility in the use of the platform, etc). The freemium model goes beyond menu pricing as the free version is not just meant to identify users with a low willingness to pay, but more importantly to induce them to ‘convert’ to the paid version, whose value would be revealed by the use of the free version.

Although this model has proven to be successful for many Internet-based services (e.g., Skype or Spotify), some specificities of MOOCs cast doubt on its replicability. Competition between MOOC platforms is quite intense as platforms are not really differentiated (nor horizontally nor vertically) and users face low switching costs. Costs associated with the paid services also decrease the scalability of MOOCs (for instance, more tutors would need to be hired). These two forces inevitably reduce the margins that can be made from this revenue model. In addition, this will decrease the openness of MOOC platforms while both professors and students derive value from it. It is indeed likely that professors would invest much less in “MOCs” than in MOOCs. If professors leave the platform, students will follow, leading to further negative feedback effects.

**3.4. Advertising model.** The advertising model is one of the most preferred road to monetization in the Internet sector. The model can be summarized as follows: platforms do not sell contents to users directly but only indirectly, as contents serve to attract users, whose attention (and/or information) is then sold to advertisers. Advertisers are indeed willing to pay to attract eyeballs on their ads, and even more if they know to whom these eyes belong. In this respect, MOOC platforms are of interest to advertisers thanks to the information that they can collect about their users and the large amount of time that students spent on the platform.

This model seems promising at first glance. However, it is important to evaluate the extent to which advertisements can interfere with the learning process and, possibly, discourage students. In the language of multisided platforms, one would then say that the group of advertisers exerts a negative indirect network effect on the group of students. The implementation of such a system may also deter professors and universities from providing content for free to the platforms. To keep them on board, MOOC platforms

would then have to increase the compensation for their services, which would inevitably raise the costs of producing MOOCs.

**3.5. Job matching model.** As for the advertising model, the job matching model takes advantage of the presence of private actors around the platform and the by-product created by MOOCs, i.e., the information about its users. Asymmetric information problems are present in the labor market: an efficient pairing between the two sides of the market is difficult to achieve as employers lack reliable information about potential employees and vice versa. As we already described it above, certification can reduce this asymmetry. Other instruments are also available. Employers can indeed increasingly resort to new tools that allow applicants to demonstrate their abilities and skills in a more coherent and effective way.<sup>18</sup> It is in this context that MOOC platforms can play a creative role. By continuously monitoring the behavior of students, MOOC platforms accumulate big data that they can use to improve matching on the job market. Such service can be monetized on both sides of the market. By drawing an accurate and multidimensional profile of their students, MOOC platforms can help employers in their recruitment process. Platforms can also mine their data to better advise students and help them to present their competences in a more convincing way, thereby facilitating job placement.

Even if this model is attractive in theory, it raises many questions in its application. MOOC platforms do not appear more likely than traditional higher education institutions to offer training programs that meet the constantly changing needs of employers. Even if they may be better at identifying students' skills, the skills in question may not be the ones that employers are mainly looking for. Guiding students in their job search seems also far from their core business, namely education. Moreover, these job matching services may also impair the scalability of the platform.

**3.6. Subcontractor model.** The models discussed so far involve independent platforms connecting various stakeholders. In view of the difficulties raised by the implementation of these models, MOOC platforms may prefer to secure revenues by acting as subcontractors for either universities or private companies. To universities, MOOC platforms can sell innovative ways to deliver education, as well as cost savings. To private companies, they can sell made-to-measure training programs. Let us explore the viability of these strategies.

The first idea is to use some of the technologies of distance education to complement traditional teaching methods, leading to a hybrid approach also known as 'blended learning'. According to Deslauriers *et al.* (2011), online and live classes are complementary and, hence, their combination leads to better learning outcomes. One way to achieve this is by flipping

---

<sup>18</sup>As Staton (2014) points out, "[e]valuative information like work samples, personal representations, peer and manager reviews, shared content, and scores and badges are creating new signals of aptitude and different types of credentials."

the classroom. Students get in touch with the class material on the online platform before the class, and class hours are used to solve exercises, discuss and deepen the material using the most of the professors' skills.

In the second case, the MOOC technology is used to partially solve Baumol's cost disease (Baumol and Bowen, 1996). This phenomenon describes a rise in salaries that does not respond to any increase in labor productivity. It is typically observed in labor-intensive activities such as the education sector. It can be explained by the fact that other sectors with high productivity gains (because capital can be more easily substituted for labor) have to adjust the wages offered to their employees. To be able to keep and attract a qualified labor, higher education institutions need to imitate them, despite the lower productivity gains. As a result, the wage bill increases with no counterpart in terms of production. As discussed by Bowen *et al.* (2014), a judicious use of the MOOC technology could help improve the productivity gains for teaching activities by (partially) replacing live course materials by online counterparts. How this reduction in teaching costs can happen in practice will be discussed in more details in Section 4.1.

Note that a prerequisite for these two strategies to be successful is that universities accept not only to reform their current processes, but also to delegate part of this reform to an outside contractor. Regarding the latter point, universities may fear that MOOC platforms end up controlling an essential input, and thereby acquire a strong bargaining position. A similar situation happened in the second half of the nineties with the transition to an online market for scientific publications that resulted into a price hike (see Dewatripont *et al.*, 2006). One can therefore understand the distrust of academia to outsource the management of their own resources, educational this time.<sup>19</sup> In addition, universities must be willing to pay a sufficient price to make this model profitable (which may be problematic as financial resources are currently scarce in the education sector).

The third possibility would be to sell content to organizations and other private actors that want to provide specific training to their members. However, this raises the question of the adequacy of the MOOCs offered on the platforms (by professors driven by academic freedom) to the specific needs of these organizations.

---

<sup>19</sup>Although MOOCs operate with the same multisided platform model as publishing houses, the specificities of their respective markets make unlikely this kind of evolution. First, compared with the market for scientific publications, MOOC platforms do not play a certification role. Second, there exist potentially many substitutes for each course (online or not). Third, collaborations between professors and MOOC platforms are still bound by agreements between their higher education institution and the platform. Fourth, given the large size of higher education institutions, they have a greater bargaining power when dealing with the platform than a (or a small group of) researcher. Due to this, we can think that market power is much less concentrated in the MOOC sector, making an abuse of dominant position unlikely. These fears, however, could foster cooperation between higher education institutions and intermediaries promoting a high degree of openness of their platform as well as those with a not-for-profit status.

In *summary*, we find that existing platforms still fail to cover their costs with their own resources. This is so despite the fact that, up to now, platforms do not have to pay professors to put their resources online. Hence, platforms continue to depend on external funding sources. From this discussion, the most promising way to monetize their business seems the subcontractor model, potentially combined with elements from other models. The reason is primarily technological: distance learning technologies are evolving and become increasingly sophisticated, making it very complex to control by an isolated academic institution (as rich and prestigious it could be). Outsourcing seems the only way to keep up with this changing environment. The challenge for MOOC platforms is to profile themselves as collaborators rather than competitors to traditional higher education institutions, a theme that we further develop in the next section.

#### 4. IMPLICATIONS FOR HIGHER EDUCATION INSTITUTIONS

In this section, we build on our previous analysis to identify how MOOCs might impact the organization of the higher education system. We attempt to formulate and motivate strategies that should be implemented by the incumbent actors in the sector.

**4.1. Complement or substitute?** MOOC platforms and their technology can have a significant impact on the functioning of higher education institutions. The precise nature of this impact will depend on whether MOOC platforms appear in the eyes of their end users, namely students, as substitutes or complements to the current traditional system.

On both sides of the labor market, there seems to be an increasing demand for an unbundling of higher education, i.e., a relaxation of the time, location and content constraints imposed in the traditional system (where students have to follow a specific sequence of courses, in a single institution, during a given number of months/years). In this context, the courses offered by MOOC platforms can be seen as alternatives to those offered by traditional institutions. Such a perception would lead to an increased competition in the higher education sector, most likely to generate a positive effect on the quality of the educational programs offered, and a reduction of the tuition fees compared with the actual situation. The entry of these new players could potentially affect the institutions that have not been able to adapt their prices and programs to these changes. However, for this to happen, a condition must be met by MOOC platforms: they must offer programs that are seen, as (closely) equivalent to the ones delivered by traditional institutions.<sup>20</sup> In this regard (as we discussed above), neither their business nor their pedagogical models seem to currently allow for this. Difficulties to reproduce in a virtual environment the interactions among students and

---

<sup>20</sup>See Hoxby (2014) for an analysis of the impact of MOOC platforms on the higher education sector whenever they are seen, at least by a share of the student population, as a credible alternative to programs offered by traditional higher education institutions.

with their professors, uncertainties about how to monetize their business and a lack of pedagogical coherence are all factors that make MOOCs far from being perceived, for the time being, as a valid alternative to traditional programs.

Therefore, it seems more likely that MOOC programs and technology become supplement to those from the traditional approach. This will tend to strengthen the cooperative nature of the relationship they maintain with higher education institutions. In this context, two types of use of MOOCs are possible.

The first type highlights the possibility to diminish the capacity constraints of some establishments and to take advantage of scale economies in order to enroll more students. For instance, universities may decide to accredit some courses (or parts of courses) offered online by, or in cooperation with, a MOOC platform. This strategy seems relevant for courses taught in large auditoria where few interactions take place with the professor and where congestion effects harm the learning process. A second approach consists in offering, in cooperation with a platform, an online program taught in parallel to a live counterpart but at a lower price. The success of such a partnership, however, depends on the quality of the program and so, to a large extent, on the MOOC technology.<sup>21</sup> Depending on how successful this additional program is, this approach could bring an additional source of revenues for some universities (or help decrease some of their costs) and, eventually, be a competitive threat for some higher education institutions.

A second use puts forward what the MOOC technology can bring to higher education programs. More than a change in the higher education landscape, this approach pushes for a pedagogical paradigm change towards more hybrid forms of learning. The possibility to customize courses thanks to new technologies and to give more frequently and promptly feedback to the students throughout their learning process can contribute to the remediation or the orientation of students at the start of their higher education experience. This solution will not improve the financial state of traditional institutions. However, it can improve the quality of the programs offered, increase student's learning outcomes and increase graduation rates.<sup>22</sup>

---

<sup>21</sup>Such an offer seems particularly adequate for lifelong learning programs as the unbundling made possible with online courses is highly valued by full time workers, who tend to be less flexible and have a high opportunity cost of their time. Being more mature, these lifelong learners will tend to be more self-disciplined.

<sup>22</sup>These two types of use correspond relatively well to the problems in the European and American higher education systems. On the one hand, Europe needs to handle a capacity problem caused by the massification of its higher education system without significant additional financial help (from public or private sources). On the other hand, the U.S. are confronted with increasing tuition fees for educational programs that do not always meet the student's expectations in terms of quality.

**4.2. Which strategies to implement?** In this evolving environment, universities face several recurring issues. In order to define appropriate strategies, it is of the utmost importance to understand the whys and wherefores of MOOCs, and more generally of online education. Such a reflection should lead to a greater professionalization of teaching activities, in a similar manner to what has occurred throughout the last three decades for research activities.

A first question concerns the supply of new technologies. Is it better to produce them in-house or to buy them on the MOOC market? To answer this question, the trade-offs brought forward by the theories of the firm give us an interesting perspective. In-house production by higher education institutions allows for a complete control over the development of the educational content and a protection of students' data. The downside is that in-house development of new technologies is very expensive and risky. It is expensive because it is difficult to attract, and retain, such a specialized and highly demanded workforce in universities (which lack both flexibility and financial means, compared to the high-tech sector with whom they are competing). It is risky because Internet technologies are changing at a very fast pace, which only sufficiently large institutions are able to keep. Also, the comparatively slow decision making process inside higher education institutions make it complex to adopt a proactive stance, much needed in this quickly changing high-tech environment. Given the technological and pedagogical uncertainties in the absence of clear standards, it seems that market dependence is the best solution at the moment thanks to the incentive effects that result from market forces.<sup>23</sup>

A second issue relates to the research, development and adoption of these new teaching approaches. The institution in charge of the pedagogical support for each higher education institution will see undoubtedly its importance enhanced. At first, it will, in collaboration with the Department of Educational Science, conduct innovative research on the use of new technologies in the classical curriculum to develop new tools and promote the emergence of new educational standards. In addition to the creation, it will have the other objective, sometimes at odds with the first, to disseminate these new approaches towards professors and students. For what concerns professors, the strategies set to encourage the adoption of a new pedagogical approach should take into account some of the peculiarities of higher education institutions. Given academic freedom, their teaching approach is largely voluntary. The high cost of learning to master new technologies and developing new curricula can discourage professors given the other tasks that they have to fulfill, and which tend to be more valued. Regarding students,

---

<sup>23</sup>An intermediate solution is to develop technologies via spin-offs partially or fully funded by universities. The prominent example is Edx, which started with initial grants from the Massachusetts Institute of Technology and Harvard University. However, these institutions will still face the rude competition of other MOOC platforms.

the role of the institution in charge will be to prepare them for this new approach, as it requires from their side more initiatives and commitments.

A third important issue relates to the overall education policy at the university level, which must be adapted to this new environment. The trade-offs between research and education faced by professors is likely to be disrupted. Given the difficulty to measure teaching practices and performances, the important investment needed to be proficient with these new pedagogical approaches might lead to a greater specialization in one of these two tasks, as formalized in the multitasking model of Holmstrom and Milgrom (1991). Hence, education tasks must be revalued compared with research tasks. Pedagogical trainings in relation to these new technological developments should be provided. To influence the career concerns of professors, the completion of these trainings should be taken into consideration for promotion. This evolution should be articulated with a pragmatic improvement of the students' learning outcomes.

Conditional on these changes, traditional higher education institutions are likely to keep their leadership position in the higher education landscape for the years to come. Right now, the transformative potential of MOOCs seems more disruptive for the internal functioning of incumbent institutions than for the higher education market as such.

## 5. IMPLICATIONS FOR PUBLIC POLICIES

Given the potential benefits of MOOC platforms and their technologies, higher education policies must play a catalytic role. At the local (regional and/or national) and supranational level, governments must act to support initiatives financially and to ensure an adequate transmission of information on these issues. Several recurring questions will arise about the launch of new platforms, new pedagogical approaches and the reform of the accreditation system.

Like higher education institutions, public authorities must first focus on the creation (or funding, recurrent or not) of new platforms. The difference is that public authorities have access to more funding and can take advantage of larger economies of scale due to the higher potential number of users. However, the absence of pedagogical and technological standards and a lack of government expertise and reactivity on this subject make this type of investment very risky. Three additional arguments may explain why the development of new platforms will not or should not be a priority for public policy. First, public funds may crowd out private investments in the MOOC sector. Second, the public finance crisis may make an improvement of the funding of traditional higher education institutions more pressing than the investment in new technologies. Finally, the local nature of the public funding of higher education squares badly with the global benefits created by

MOOC platforms, leading to free-riding and suboptimal investments.<sup>24</sup> The latter argument suggests that it is supranational authorities that should invest in the development of MOOC platforms; yet, these authorities often lack the necessary funding resources and the relevant competencies in this field. In conclusion, despite the social desirability of MOOC platforms, their public provision raises a number of challenges that appear as at least as worrisome as the those faced by private providers to find a sustainable business model.

Even if they fail to provide public MOOC platforms, public authorities (at all levels) may nevertheless play an important role in fostering the adoption of innovative pedagogical approaches. Traditionally, when dealing with the higher education sector, public authorities have been much more proactive in the regulation of research than of education (and especially pedagogy). Given the important benefits that could be reaped from the use of MOOCs, this stance should be reconsidered. To design adequate policies, public authorities should bear in mind how important is the independence of both higher education institutions from governments, and professors from their employers. It is therefore crucial to set up a system that will encourage, in opposition to mandate, this pedagogical evolution. In this context, all government levels need to consider how to finance and to regulate both the creation and the dissemination of new pedagogies. In terms of innovation, the creation of a scientific research fund dedicated to this purpose seems relevant. In terms of dissemination, a framework should be established to facilitate the emergence of best practices and new pedagogical standards. This could be achieved by an institution whose goal would be to bring these new approaches outside of the small circle of innovators. Ideally, these initiatives should be taken at the supranational level in order to favor the coordination of a higher number of actors and the resulting greater economies of scale. However, once again, the lack of competencies that supranational authorities have on these matters might prevent them from implementing these policies. Despite that, a clever use of their soft power can play a key role.

A final important issue, which is directly related to the previous one, concerns accreditation. A change of view will also be needed on this subject. The lack of pedagogical coherence and standards make an accreditation of the courses offered by MOOC platforms difficult, at least for the time being. Quality assurance agencies should avoid the pitfall of a too procedural approach based on the inputs of the programs to establish a system rewarding learning outcomes. They should also fully play their intermediation role between higher education institutions and governments. Through their accreditation system, they need to encourage pedagogical innovations and

---

<sup>24</sup>As in the case where skilled workers are more mobile (Justman and Thisse, 1997), jurisdictions will free ride from investing in education as they cannot take advantage of the greater fiscal revenues derived from better paid skilled labor.

the implementation of strategies to achieve this in every higher education institution.

## 6. CONCLUSIONS

In the first part of this article, we introduced various economic and pedagogical concepts in order to understand the specificities of MOOC platforms. Using these insights, we then discussed how the private provision of a pure public good could be sustained. Five ways to monetize the MOOC business were exposed using as a common framework of analysis: the theory of multi-sided platforms. We concluded from our critical but motivated appraisal that there is no panacea but that the most sustainable approach seems to be the subcontractor model, flavored in a well-balanced way by touches of the other four models. We then claimed that these new actors of the higher education landscape could play a key transformative role in the sector by making teaching practices evolve, rather than by replacing incumbent institutions. Finally, we derived a number of directions for public policy. Governments should use their power of influence and their financial support to foster the cooperation between MOOC platforms and other higher education institutions, thereby improving the benefits that can arise from these technological innovations. A particular focus should also be given to professors in order to encourage them to innovate in their teaching practices.

By bringing together heterogeneous stakeholders, MOOC platforms are an interesting object to analyze for economists. The economic concepts used in this article have proved to be helpful to describe and to offer a tentative solution to the coordination issues observed in the context of MOOCs. They are also useful in highlighting the multiple informational problems at stake. Theoretical concepts from industrial organization and economics of education have clearly their say in this much talked about evolutions of the higher education sector. In the near future, it is mainly empirical works that will rank high on the economics research agenda. At the crossroad between education sciences and economics, learning analytics testing education policies in an online and hybrid context will flourish in the coming years. This will clearly be facilitated by the abundance of new data collected on MOOC platforms. We hope that this roadmap will inspire future research on this topic.

## REFERENCES

- [1] Acemoglu, D., Laibson, D., and List, J. (2014). Equalizing Superstars : the Internet and the Democratization of Education. *American Economic Review: Papers and Proceedings* 104, 523–527.
- [2] Ainsworth, S. (1999). The Functions of Multiple Representations. *Computers and Education* 33, 131–152.
- [3] Baumol, W. J., and Bowen, WG (1966). *Performing Arts: The Economic Dilemma*. New York, NY: Twentieth Century Fund.

- [4] Bettinger, E., Loeb, S., and Taylor, E. (2014). Remote but Influential: Peer Effects and Reflection in Online Higher Education Classrooms. Center for Education Policy Analysis working paper, Stanford University.
- [5] Bonaccorsi, A., Daraio, C., and Simar, L. (2006). Advanced Indicators of Productivity of Universities. An application of Robust Nonparametric Methods to Italian Data. *Scientometrics* 66, 389–410.
- [6] Bouguen, A., and Gurgand, M. (2012). Randomized Controlled Experiments in Education. European Expert Network on Economics of Education, EENE analytical report N. 11.
- [7] Bowen, W., Chingos, M., Lack, K., and Nygren, T. (2014). Interactive Learning Online at Public Universities: Evidence from a Six-Campus Randomized Trial. *Journal of Policy Analysis and Management* 33, 94–111.
- [8] Breneman, D. W., Pusser, B., and Turner, S. E. (2006). *Earnings from Learning: The Rise of For-Profit Universities*. Albany: State University of New York Press.
- [9] Cantillon, B., De Ridder, A., Vanhaecht, E., and Verbist, G. (2011). (Un)Desirable Effects of Output Funding for Flemish Universities. *Economics of Education Review* 30, 1059–1072.
- [10] Carrier, L. M., Cheever, N. A., Rosen, L. D., Benitez, S., and Chang, J. (2009). Multitasking across Generations: Multitasking Choices and Difficulty Ratings in Three Generations of Americans. *Computers in Human Behavior* 25, 483–489.
- [11] Dellarocas, C. and Van Alstyne, M. (2013). Money Models for MOOCs. *Communications of the ACM* 56, 25–28.
- [12] Deslauriers, L., Schelew, E., and Wieman, C. (2011). Improved Learning in a Wide-Enrollment Physics Class. *Science* 332 (6031), 862–864.
- [13] Downes, S. (2007). Models for Sustainable Open Educational Resources. *Interdisciplinary Journal of Knowledge and Learning Objects* 3, 29–44.
- [14] Evans, D. and Schmalensee, R. (2007). Industrial Organization of Markets with Two-Sided Platforms. *Competition Policy International* 3 (1).
- [15] Figlio, D., Rush, M. and Yin, L. (2013). Is it Live or is it Internet? Experimental Estimates of the Effects of Online Instruction on Student Learning. *Journal of Labor Economics* 31, 763–784.
- [16] Gaebel, M. (2013). MOOCs Massive Open Online Courses, EUA Occasional papers, European University Association: Brussels.
- [17] Glance, D., Forsey, G., and Riley, M. (2013). The Pedagogical Foundations of Massive Open Online Courses. *First Monday* 18 (5).
- [18] Hansmann, H. B. (1980). The Role of Nonprofit Enterprise. *The Yale Law Journal* 89, 835–901.
- [19] Hansmann, H. B. (2012). The Evolving Economic Structure of Higher Education. *The University of Chicago Law Review* 79, 159–183.
- [20] Hollands, F. M., and Tirthali, D. (2014). MOOCs: Expectations and Reality. Technical Report, Teachers College, Columbia University.
- [21] Holmstrom, B., and Milgrom, P. (1991). Multitask Principal-Agent Analyzes: Incentive Contracts, Asset Ownership, and Job Design. *Journal of Law, Economics and Organization* 7, 24–52.
- [22] Hoxby, C. (2014). The Economics of Online Postsecondary Education: MOOCs, Nonselective Education, and Highly Selective Education. *American Economic Review: Papers and Proceedings* 104, 528–522.
- [23] Justman, M., and Thisse, J. F. (1997). Implications of the Mobility of Skilled Labor for Local Public Funding of Higher Education. *Economics Letters* 55, 409–412.

- [24] Karpicke, J. D., and Roediger, H. L. (2008). The Critical Importance of Retrieval for Learning. *Science* 319 (5865), 966–968.
- [25] Lerner, J., and Tirole, J. (2002). Some Simple Economics of Open Source. *Journal of Industrial Economics* 50, 197–234.
- [26] OECD (2007). Giving Knowledge for Free: The Emergence of Open Educational Resources. OECD Publishing.
- [27] Pennebaker, J. W., Gosling, S. D., and Ferrell, J. D. (2013). Daily Online Testing in Large Classes: Boosting College Performance while Reducing Achievement Gaps. *PloS one*, 8(11), e79774.
- [28] Rochet, J. C., and Tirole, J. (2003). Platform Competition in Two-Sided Markets. *Journal of the European Economic Association* 1, 990–1029.
- [29] Rochet, J. C., and Tirole, J. (2006). Two-Sided Markets: a Progress Report. *RAND Journal of Economics* 37, 645–667.
- [30] Roediger, H. L., and Karpicke, J. D. (2006). Test-Enhanced Learning Taking Memory Tests Improves Long-Term Retention. *Psychological Science* 17, 249–255.
- [31] Schlotter, M., Schwerdt, G., and Woessmann, L. (2011). Econometric Methods for Causal Evaluation of Education Policies and Practices: a Non-Technical Guide. *Education Economics* 19, 109–137.
- [32] Staton, M. (2014). The Degree is Doomed. *Harvard Business Review Blog Network* (January 8). <http://blogs.hbr.org/2014/the-degree-is-doomed/>.
- [33] U.K.Department for Business Innovation & Skills (2013). The Maturing of the MOOC: Literature Review of Massive Open Online Courses and Other Forms of Online Distance Learning. BIS Research Paper n. 130.
- [34] Winston, G., and Zimmerman, D. (2004). Peer Effects in Higher Education. In C. M. Hoxby (Ed.), *College Choices: The Economics of where to Go, when to Go, and how to Pay for it* (pp. 395-424). Chicago: University of Chicago Press.

## Recent titles

### CORE Discussion Papers

- 2013/71 Alexander OSHARIN, Jacques-François THISSE, Philip USHCHEV and Valery VERBUS. Monopolistic competition and income dispersion.
- 2013/72 N. Baris VARDAR. Imperfect resource substitution and optimal transition to clean technologies.
- 2013/73 Alejandro LAMAS and Philippe CHEVALIER. Jumping the hurdles for collaboration: fairness in operations pooling in the absence of transfer payments.
- 2013/74 Mehdi MADANI and Mathieu VAN VYVE. A new formulation of the European day-ahead electricity market problem and its algorithmic consequences.
- 2014/1 Erik SCHOKKAERT and Tom TRUYTS. Preferences for redistribution and social structure.
- 2014/2 Maarten VAN DIJCK and Tom TRUYTS. The agricultural invasion and the political economy of agricultural trade policy in Belgium, 1875-1900.
- 2014/3 Ana MAULEON, Nils ROEHL and Vincent VANNETELBOSCH. Constitutions and social networks.
- 2014/4 Nicolas CARAYOL, Rémy DELILLE and Vincent VANNETELBOSCH. Allocating value among farsighted players in network formation.
- 2014/5 Yu. NESTEROV and Vladimir SHIKHMAN. Convergent subgradient methods for nonsmooth convex minimization.
- 2014/6 Yuri YATSENKO, Natali HRITONENKO and Thierry BRECHET. Modeling of environmental adaptation versus pollution mitigation.
- 2014/7 Sanjeeb DASH, Oktay GÜNLÜK and Laurence A. WOLSEY. The continuous knapsack set.
- 2014/8 Simon BUCKLE, Mirabelle MUÛLS, Joerg LEIB and Thierry BRECHET. Prospects for Paris 2015: do major emitters want the same climate.
- 2014/9 Lionel ARTIGE, Antoine DEDRY and Pierre PESTIEAU. Social security and economic integration.
- 2014/10 Mikhail ISKAKOV, Alexey ISKAKOV and Alexey ZAKHAROV. Equilibria in secure strategies in the Tullock contest.
- 2014/11 Helmuth CREMER and Pierre PESTIEAU. Means-tested long term care and family transfers.
- 2014/12 Luc BAUWENS, Lyudmila GRIGORYEVA and Juan-Pablo ORTEGA. Estimation and empirical performance of non-scalar dynamic conditional correlation models.
- 2014/13 Christian M. HAFNER and Arie PREMINGER. A note on the Tobit model in the presence of a duration variable.
- 2014/14 Jean-François CARPANTIER and Arnaud DUFAYS. Specific Markov-switching behaviour for ARMA parameters.
- 2014/15 Federico GRIGIS DE STEFANO. Strategic stability of equilibria: the missing paragraph.
- 2014/16 Claudio TELHA and Mathieu VAN VYVE. Efficient approximation algorithms for the economic lot-sizing in continuous time.
- 2014/17 Yukai YANG. Testing constancy of the error covariance matrix in vector models against parametric alternatives using a spectral decomposition.
- 2014/18 Koen DECANCO, Marc FLEURBAEY and Erik SCHOKKAERT. Inequality, income, and well-being.
- 2014/19 Paul BELLEFLAMME and Martin PEITZ. Digital piracy: an update.
- 2014/20 Eva-Maria SCHOLZ. Licensing to vertically related markets.
- 2014/21 N. Baris VARDAR. Optimal energy transition and taxation of non-renewable resources.
- 2014/22 Benoît DECERF. Income poverty measures with relative poverty lines.
- 2014/23 Antoine DEDRY, Harun ONDER and Pierre PESTIEAU. Aging, social security design and capital accumulation.
- 2014/24 Biung-Ghi JU and Juan D. MORENO-TERNERO. Fair allocation of disputed properties.
- 2014/25 Nguyen Thang DAO. From agriculture to manufacture: How does geography matter ?
- 2014/26 Xavier Y. WAUTHY. From Bertrand to Cournot via Kreps and Scheinkman: a hazardous journey.

## Recent titles

### CORE Discussion Papers - continued

- 2014/27 Gustavo BERGANTIÑOS and Juan MORENO-TERNERO. The axiomatic approach to the problem of sharing the revenue from bundled pricing.
- 2014/28 Jean HINDRIKS and Yukihiro NISHIMURA. International tax leadership among asymmetric countries.
- 2014/29 Jean HINDRIKS and Yukihiro NISHIMURA. A note on equilibrium leadership in tax competition models.
- 2014/30 Olivier BOS and Tom TRUYTS. Auctions with prestige motives.
- 2014/31 Juan D. MORENO-TERNERO and Lars P. ØSTERDAL . Normative foundations for equity-sensitive population health evaluation functions.
- 2014/32 P. Jean-Jacques HERINGS, Ana MAULEON and Vincent VANNETELBOSCH. Stability of networks under Level- $K$  farsightedness.
- 2014/33 Lionel ARTIGE, Laurent CAVENAILE and Pierre PESTIEAU. The macroeconomics of PAYG pension schemes in an aging society.
- 2014/34 Tanguy KEGELART and Mathieu VAN VYVE. A conic optimization approach for SKU rationalization.
- 2014/35 Ulrike KORNEK, Kei LESSMANN and Henry TULKENS. Transferable and non transferable utility implementations of coalitional stability in integrated assessment models.
- 2014/36 Ibrahim ABADA, Andreas EHRENMANN and Yves SMEERS. Endogenizing long-term contracts in gas market models.
- 2014/37 Julio DAVILA. Output externalities on total factor productivity.
- 2014/38 Diane PIERRET. Systemic risk and the solvency-liquidity nexus of banks.
- 2014/39 Paul BELLEFLAMME and Julien JACQMIN. An economic appraisal of MOOC platforms: business models and impacts on higher education.

### Books

- V. GINSBURGH and S. WEBER (2011), *How many languages make sense? The economics of linguistic diversity*. Princeton University Press.
- I. THOMAS, D. VANNESTE and X. QUERRIAU (2011), *Atlas de Belgique – Tome 4 Habitat*. Academia Press.
- W. GAERTNER and E. SCHOKKAERT (2012), *Empirical social choice*. Cambridge University Press.
- L. BAUWENS, Ch. HAFNER and S. LAURENT (2012), *Handbook of volatility models and their applications*. Wiley.
- J-C. PRAGER and J. THISSE (2012), *Economic geography and the unequal development of regions*. Routledge.
- M. FLEURBAEY and F. MANIQUET (2012), *Equality of opportunity: the economics of responsibility*. World Scientific.
- J. HINDRIKS (2012), *Gestion publique*. De Boeck.
- M. FUJITA and J.F. THISSE (2013), *Economics of agglomeration: cities, industrial location, and globalization*. (2<sup>nd</sup> edition). Cambridge University Press.
- J. HINDRIKS and G.D. MYLES (2013). *Intermediate public economics*. (2<sup>nd</sup> edition). MIT Press.
- J. HINDRIKS, G.D. MYLES and N. HASHIMZADE (2013). *Solutions manual to accompany intermediate public economics*. (2<sup>nd</sup> edition). MIT Press.

### CORE Lecture Series

- R. AMIR (2002), Supermodularity and complementarity in economics.
- R. WEISMANTEL (2006), Lectures on mixed nonlinear programming.
- A. SHAPIRO (2010), Stochastic programming: modeling and theory.