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FINANCING AND MODELLING TECHNOLOGY ADOPTION IN HIGHER EDUCATION INSTITUTIONS

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Contents

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Summary

This thesis is a collection of contributions on the technology adoption in Higher Education Institutions (HEIs). In particular, it focuses on how funding schemes and business models impact when a new technology is available.

With the intent of providing a picture of how technology comes in the activity HEIs, the analysis starts off with a descriptive introduction about distance education with a special focus on Massive Open Online Courses (MOOCs), then three articles will be presented.

The first paper points out a substantial heterogeneity among the funding systems: the governments reaction to the economic crisis appears to be one of the principal divisive factors. Some governments have increased funds for higher education, introducing targeted funding, allocated on a competitive basis, to meet the national targets; others have been cutting budgets; the second paper shows that the activation of MOOC platforms generates also the beginning of a new university business model with strong economic implications; the third paper finds that universities with less resources are more prone to innovate and marketization of HE will drive a depth innovation process.

Chapter 1.
INTRODUCTION

Hand in hand with the important states' disinvestments that globally have struck higher education systems in the last decade, higher education institutions (henceforth HEIs) have been obliged to re-think their business model as to find further financial resources and ensure their survivability. In the US context, HEIs have faced severe cuts. In 2015, the States were spending 20% less per student than in 2008 (Mitchell & Leachman, 2015) and, according to Forbes (2017) the Department of Education's discretionary funding will shrink by 13% in 2018. Oversea, in Europe, there have been significant changes in the funding mechanisms. Since the start of the crisis, some countries introduced budget cuts (from less than 5% in the Czech Republic, Poland, Croatia, Serbia and Macedonia. Up to 10% in Estonia, Ireland, Lithuania and Romania, while Italy expects cuts of 20%, Greece of 30% and Latvia of 48%. Estermann & Pruvot, 2011). Up to 13 higher education systems could rely on lower public funding than in 2008 (Claeys-Kulik & Estermann, 2015). In this regard, universities have increasingly competed to attract more students, both at a bachelor and master level (Cattaneo et al., 2016, Pucciarelli & Kaplan, 2016; Altbach, 2015), as to rely on more tuition fees or on states' budget distributed with a formula that considers mainly input factors (Porta et al. 2015). The competitiveness has been stressed also by a wave of reforms that started in the '90. According to File et al. (2016) these reforms had mainly three objectives: a) enhance horizontal differentiation (e.g. in 1993 the establishment of Universities of applied sciences in Austria; in 2002 the strengthening of private higher education in Poland; in 2003 the change of institutional status after the reform in Norway), b) enhance vertical differentiation (e.g. excellence initiatives: Germany 2005, France 2006, Spain 2008 and Denmark 2009) and

c) changing institutional interrelationships between higher education institutions (e.g. university mergers in UK in 2002 and in Finland in 2007).

On the other hand, distance education, which has been in the past a marginal sector, finds now greater strength and competitiveness thanks to the technologies available and even threatens to upset the traditional universities. The phenomenon of on-line learning is evolving in the framework of the changes that are currently taking place in higher education in the time of globalization of education and constraint budgets. Again, the development of increasingly interactive tools, have given rise to a new way of teaching: MOOCs (Short for Massive Open Online Courses).

This acronym defines the main characteristics of MOOCs:

Massive, stands for two main aspects. Firstly, the large number of students. Coursera, founded in 2012, counted 23 million registered users at the end of 2016 (www.coursera.com) and reached the first million of users faster than Facebook or Twitter (Lewin, 2013). Secondly, but not in order of importance, MOOCs are scalable in terms of number of users, because of taking advantage of the connection among users using web 2.0 tools.

Open, stands for the gratuity and the availability of the courses, the only requirement is to have a computer connected via internet.

Online, it's the fundamental characteristic. The difference between the traditional courses and online MOOCs is represented by the strong interaction between students, thus creating a two-way teaching representing a new method. This gives also the opportunity to generate new set of data that are used in order to improve the delivery of teaching (i.e. learning analytics).

Course, this attribute highlights the conversion of the classic teacher-student role, the teacher is no longer seen as a leader, but a guide within the

course, this new concept allows to better take out the interaction between the parties (Huan, 2015)

According to the European University Association (EUA), MOOCs are full courses offered online and free of charge to any user; they have expanded incredibly fast and are subject to rapid change in both application and use.

In the digital age, MOOCs promise to change the learning environment and to democratize knowledge, although the effectiveness of these tools is still much debated and the results on the users are not comforting (Banerjee & Duflo, 2014). HEIs all over the world are exploring MOOCs in order to understand how learning and teaching environments are changing, but there are some issues that are to be considered facing this subject.

In the first place, analysing MOOCs literature, it has to be taken into account that there is considerable speculation and anticipation about how this development may transform teaching and learning and, more generally, higher education provision (Gaebel, 2014). Secondly, their definition is not clear yet, in fact the Italian Conference of University Rectors (CRUI) highlighted that a MOOC is not a traditional university course taken by a camera and distributed online for free, it requires a different paradigm, because different is the digital environment (Paleari et al., 2015). Thirdly, the lack of published research on MOOCs leaves a significant gap in the literature (Liyanagunawardena et al., 2012). Over the past few years, MOOC phenomenon is being one of the most debated topics in the field of online education. As to confirm the three issues described, there are very different positions. While some researchers are arguing that MOOCs are a disruptive innovation able to change radically the higher education industry, especially the business model of university, conversely, opponents suggest that MOOCs are a merely marketing exercise for elite universities.

Despite these issues, scholars agree that the activation of MOOCs platforms generates also the beginning of a new university business model with strong

economic implications (Yuan, 2013) and this is the biggest reason why this thesis wants to investigate MOOCs not from a pedagogical perspective, as most of the scholars are doing, but to provide an initial framework treating them as an innovation, or a signal for the HEIs' innovation capabilities; in the framework of HEIs strategies and funding. In a difficult and uncertain economic era, it appears essential for universities to define decision-making strategies that will support choices for better dealing with change and to promote the achievement of a knowledgeable internet citizenry, which is unlikely to happen through a solely technical approach that focuses only on infrastructure without any consideration of the social and institutional process (Hargittai, 2010).

This thesis is organized as follows. Chapter 2 reports the development of distance learning that brought the birth of MOOCs. Chapter 3 surveys the literature on the funding framework and presents the main contributions and impacts of the thesis, and Chapter 4 offers suggestions for future research developments. Finally, annexes contain the final manuscript of the papers that compose the thesis.

The first describes the funding mechanisms in HEIs in five countries (France, Germany, Netherlands, United Kingdom and Spain). The focus is on the informal and latent aspects, hence how the rules are translated into behaviour in the application phase. Top and middle managers of 15 universities (3 for each country analysed) have been interviewed. The analysis highlighted the consequences of the recent reforms. The interviewees highlighted how market orientation is translated into pervasive incentive mechanisms at different levels. This is transforming the European universities, especially from the point of view of human resources' selection, which must be able to attract funds, to engage with external parties and to transfer knowledge to the market; according with the universities' three missions.

The second article aims at providing a first model of the decisional process of the activation of MOOCs' platforms. This decision generates also the beginning of a new university business model and therefore has strong economic implications. In this work, there is a first tentative model to support university managers when they have to deal with opening their courses for free on the Internet. In order to harmonize this decision with the web 2.0 DNA of MOOCs, this model includes, for the first time, the network benefits of involving more users in the knowledge network provided by HEIs.

The last paper aims at analysing the relationship between funding (main topic of the first article) and MOOCs introduction. In particular, it analyses the relationship between financial resources of a HEI and its propensity to introduce MOOCs in Europe. The analysis is performed on a sample of 482 universities listed in the ETER database (European Tertiary Education Register), considering their MOOCs activity as provided by the European MOOCs database. There is evidence that the business model of universities, defined as the average tuition fees is a significant determinant. More market oriented universities are more prone to implement a MOOC and also to increase the number of these courses in order to attract more students and, in turn, collect tuition fees. On the other side, universities with more revenues per student are found less prone in implementing MOOCs.

Chapter 2.
MOOCs' HISTORICAL EVOLUTION

To understand what gave birth to MOOCs, it is essential to analyse the trends and the players of the digital environment. After a quick historical overview, we can see how changes in the delivery of teaching happened after the introduction and the diffusion of key enabling innovations. Distance education found its roots with the introduction of uniform postage rates across England in 1840, which gave birth to the first correspondence course in 1844 delivered by Isaac Pitman (Simons et al., 2014; Tait, 2003). Pitman's system was that he corrected students' work and sent it back to them. Thus, although separated from the teacher, students received feedback directly from him or her in a direct way without any contact among students (Tait, 2003). Again, Tait in 2003 stated that the big change happened in 1858 when the University of London opened up a range of programs for external study (http://www.london.ac.uk/history.html). This broke the link of space between the students and the University. The University of London has been termed the first 'Open University' because of this move (Bell & Tight, 1993). The diffusion of the television, of the personal computer and, finally, of the world-wide web have been incremental milestones in the diffusion of distance education and multipliers of the teaching methods. According to this historical overview, to understand MOOCs, we have to investigate what is the innovation that made these courses possible.

In the last 10 years, the most important player in digital technologies have been social media that, in the digital economy, include the capacity to create and leverage both financial and social capital (McAuley et al., 2010). A MOOC is therefore nestled not only in the university, but is also permeated by the Web 2.0 capacities to connect, share, collaborate, and network that have given rise to social media platforms such as Twitter, Flickr, Facebook, LinkedIn, blogs, wikis, podcasts, and countless others. MOOCs are a huge digital

learning innovation that embodies the personal, networked, and openly collaborative practices and principles of Web 2.0 (McAuley et al., 2010).

Although the first MOOC appeared in 2008, the acronym began to become a public catchword in 2011 when Stanford University offered a freely available online course (Introduction to Artificial Intelligence) taught by Sebastian Thrun and Peter Norvig, that enrolled over 160,000 students from around 190 countries. Now the phenomenon is widespread and, according to a report published at the end of 2016 by classcentral (Shah, 2016), 58 million students attended 6.850 MOOCs offered by more than 700 HEIs in 2016. Pragmatic, economic and social reasons affect open access to learning and the digital economy is changing citizens of countries with advanced economies. Because of this and of the huge numbers of students reached, deviations from the core concept of MOOCs have begun and will continue, it is important to continue observing and analysing their development, their purposes and the opportunities they may offer for European HEIs (Gaebel, 2014).

The massive open online courses are usually categorised in two main group: cMOOCs (connectivist MOOCs), which are based on principle of connectivism, openness, and collaborative learning; and content-based xMOOCs (extended MOOCs), which follow a more behaviourist pedagogical approach with the emphasis on individual learning (Rodriguez, 2012). In the literature, unless otherwise stated, the acronym MOOC usually refers to xMOOCs. The first cMOOC is generally regarded to be the course taught by Downes and Siemens, "Connectivism and Connective Knowledge (CCK08)", which was launched in September 2008. cMOOCs are based on a connectivist pedagogical model that *"views knowledge as a networked state and learning as the process of generating those networks and adding and pruning connections. Of particular importance in cMOOCs is the view of knowledge as generative and the importance of artefact creation as a means of sharing personal knowledge for others to connect to and with"* (Siemens, 2013) this piece of literature inspired the second paper proposed in this thesis.

The objectives of cMOOC is to create a space where students can present their own view, and collaboratively create and share knowledge under the supervision of professors and tutors. The course content is defined by students during it, rather than defined by the instructors before the course (Rodriguez, 2012). In addition, in cMOOCs, instead of depending on the instructor for guidance, students are encouraged to create their own personal learning environments and networks of co-learners (Conole, 2013). The learners therefore are involved with the dual functions of students and tutor, user and developers of content. Figure 1 depicts the concepts of cMOOCs.

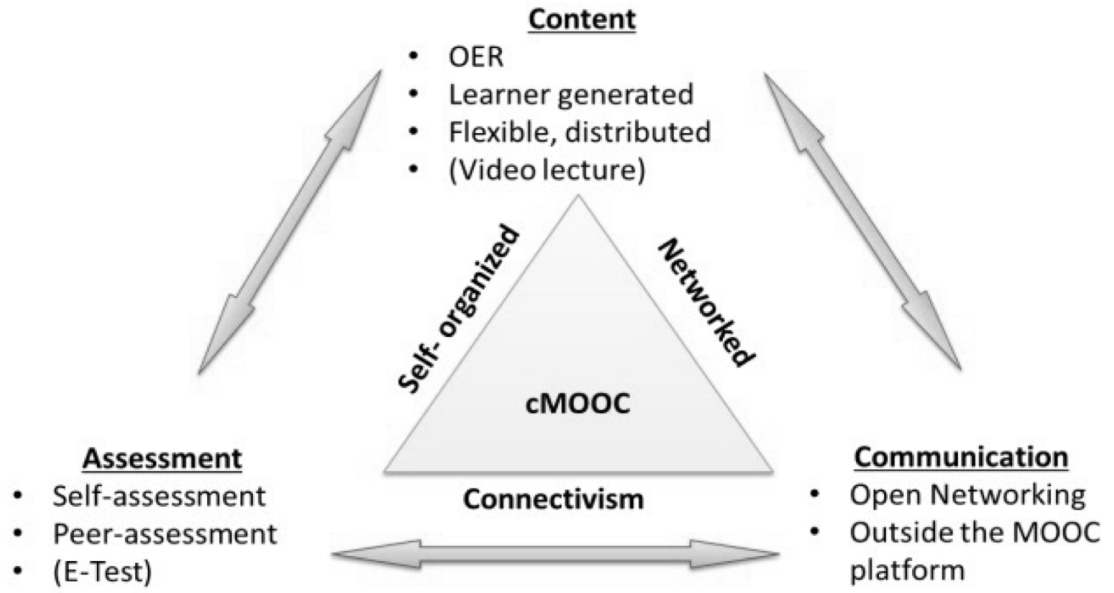

Figure 1: Features of cMOOC (Yousef et al., 2014).

On the other hand, xMOOCs follow the behaviourism, cognitivist, and constructivism learning theories (Daniel, 2012). In fact, the xMOOCs are based exclusively on the delivery of content through short video lectures and self-assessment tests. The model therefore is the classic computer-based training, and the interaction student-student and student-teacher is lower than in the cMOOCs case (Kolowich, 2013). Unlike cMOOCs, the extended

MOOC is more structured and less open, and the communication happens within the platform itself. Figure 2 depicts the concepts of xMOOCs.

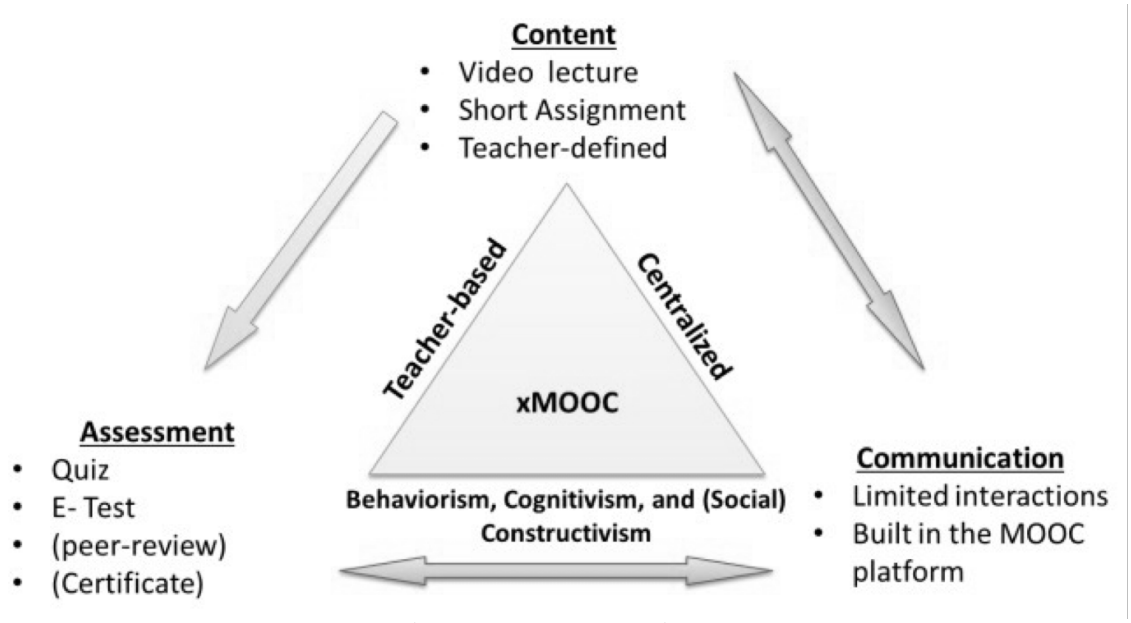

Figure 2: Features of xMOOC (Yousef et al., 2014)

Other forms of MOOCs (e.g. bMOOC and smMOOC) and taxonomies have emerged in these years. Some of these taxonomies address the same features, but with different names and in other cases, these taxonomies complement each other because highlight different features. For example, Clark (2013) proposed eight types of MOOCs based on pedagogical approach and learning functionality. Conole (2014) instead suggests that MOOCs should be measured against twelve dimensions: "the degree of openness, the scale of participation (massification), the amount of use of multimedia, the amount of communication, the extent to which collaboration is included, the type of learner pathway (from learner centred to teacher-centred and highly structured), the level of quality assurance, the extent to which reflection is encouraged, the level of assessment, how informal or formal it is, autonomy, and diversity" (Conole, 2013). However, although proposals for more detailed categorization continue to emerge as the MOOC phenomenon evolves, the two

main categories (cMOOC and xMOOC) still predominate in literature. The last and important category is: quasi-MOOCs (e.g. Web-based tutorials, such as those of the Khan Academy, the MIT's OpenCourseWare (OCW) or some video tutorials on youtube). These are technically not courses. They consist of Open Educational Resources (henceforth OER) intended to support learning-specific tasks such as an operation in algebra, or they are treated as asynchronous learning resources that do not offer the social interaction of cMOOCs or the automated grading and tutorial-driven format of xMOOCs. These resources are loosely linked and are not packaged as a course (Siemens 2013).

As pointed out in the introduction, MOOCs are not just a free multimedia version of traditional textbooks, rather to be a complete educational experience, and, the key seems to be their scalability (Suen, 2014; Paleari et al. 2015). Built-in formative assessment and feedback process are the infrastructural core and, among the various options available, peer assessment is the most widely applicable method to date. In spite of the many studies showing the efficacy of peer assessment in promoting learning (e.g. Bouzidi & Jaillet, 2009), scepticism remains as to whether peer assessment results can be trusted; also because students do not trust the results offered by their peers (e.g., Furman & Robinson, 2003).

Peer interaction and peer assessment play an important role as a way to reach scale economies, as can be seen in figure 3.

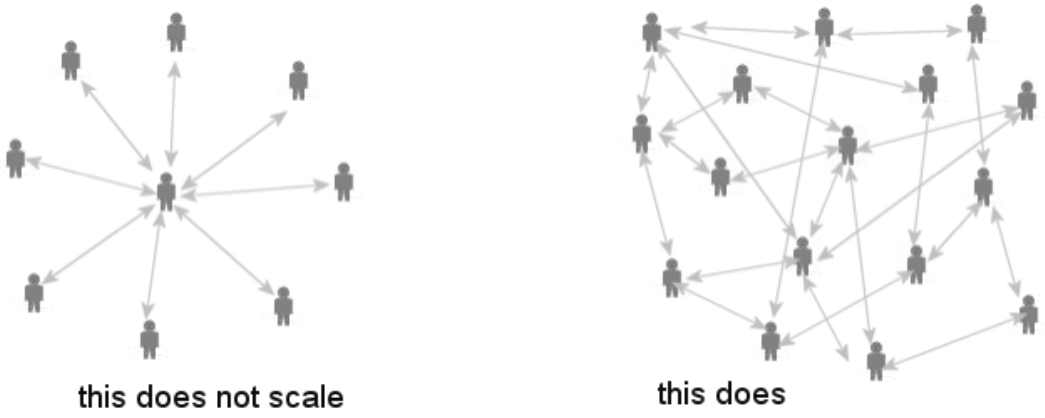

Figure 3: Scalability of MOOCs (Downes, 2013)

MOOCs as a whole will innovate teaching with data and learning analytics (Siemens & Long, 2011). This area is a relatively new field of interest and focuses upon new ways of gathering data and using it to inform design and learning experiences (Buckingham Shum et al., 2012). In the e-learning area, scholars have been looking at mass data through accessing web log analysis data for some time (e.g. Dunwell et al., 2012), primarily as a way to chart social interactions, improve usability and enhance learning experience. In MOOCs this possibility is considered to be exponentially bigger. This opportunity is at an early stage of development, future research may yield significant advances in terms of feedback modelling in online courses and real time monitoring and support extracted from activity and interactions (De Freitas, 2013).

Chapter 3.
RESEARCH QUESTIONS AND MAIN CONTRIBUTION

In recent decades, university sector research funding has changed in many countries. New Public Management (NPM) is gradually been adopted and the share of direct government funding has gradually decreased, while the share of external and industrial funding has increased (Auranen & Nieminen, 2010). At the same time, public funding has faced important transformations, as government core funds are increasingly allocated on performance basis, and funding agencies have adopted mission-oriented and contract-based strategic allocation procedures (e.g. OECD, 1998, OECD, 2004, Skoie, 1996 and Slaughter & Leslie, 1997). Many studies have pointed out country-specific differences in universities' public funding and, in the case of federal countries, also heterogeneity within the country itself (e.g. Germany and Spain).

The mechanisms for public funding contain important incentives to achieve higher education's objectives and is also a mechanism to steer academic decisions. Funding models not only serve to allocate resources for given ends, they are increasingly being used as governance or management tools.

HEIs generally receive block grants, which means that they have a greater autonomy to decide on the spending of their public resources in their internal resource allocation. Over time, in more and more countries the way the size of this block grant is determined has changed, with most countries heavily relying on formula funding these days. Scholars observe an increased reliance on market-type co-ordination mechanisms, moved away from bureaucratic planning and negotiations-based approaches and today make use of more market-based approaches.

Traditionally, the funding of higher education and research was driven mostly by input measures like student enrolments or staff positions, in recent years, we are witnessing the introduction of competition and the stressing of performance-based funding (Jongbloed & Vossensteyn, 2001).

The funding framework adopted in the first paper of this thesis was used firstly by the German higher education research centre HIS (Leszczensky & Orr, 2004). This classification divides funding methods in three categories: Formula-based approach on 1) input or 2) output indicators and project-based funding. Most funding formulae comprise a mix of input/output. Project based funding can be divided into projects awarded on a competitive base and projects awarded on a non-competitive base. In the latter case, funds are distributed equally across institutions or negotiated between the government and (a selected number of) HEIs if the proposals meet the project criteria.

The main objective of this thesis is to understand the economic conditions that drive universities to enhance the innovation capacity of their teaching activities. In doing so, the work firstly addresses to the case of European universities with the first paper. It investigates funding mechanisms and their future direction. Namely, how practitioners actually take actions and decision in a given framework of rules and reforms, and how funding schemes become systems of incentives that pervasively steer academic decisions.

Through the analysis of the conducted interviews, it examines the main strengths and weaknesses inherent in the different funding mechanisms. In particular, respondents were requested about the distribution systems in historical share, in formula, in projects, and moreover, regarding the student contribution, the ability to attract external funding and collaboration with the local territory.

Firstly, if the funding allocations based on historical spending guarantee a basic funding, therefore greater stability, greater autonomy and the opportunity to plan for subsequent periods with less uncertainty, it must also

be pointed out that the exclusive use of this typology tends, in the long run, to reward universities that have chosen to downsize its numbers or to punish those that grow.

The distribution mechanisms through a formula instead are very useful in order to promote the understanding and the achievement of specific objectives, and they also allow universities to align to the criteria of internal funding allocation with the national ones simply equating the formula. Although the most commonly used formulas continue to take into account mostly input variables (such as the number of students, lecturers, staff, etc.), the currently observable trend in Europe shows a growing weight given to indicators and benchmarks that measure the performance of universities and their output. It should be emphasized that the exclusive use of only on input-based funding mechanisms can result counter-productive in the course of time, particularly when the monitored parameters are few. These, in fact, can become incentives in the hands of the universities that, in order to attract more funding, activate aggressive policies to increase the number of students. Conversely, some respondents, faced with a hypothesis of financing mainly related to the outputs, have expressed many uncertainties, particularly with regard to a potential qualitative decline in teaching and research, which could arise from the excess of competitiveness that, in their opinion, this method of financing could trigger. In this particular case, the observed trend that sees a shifting toward output related parameters, could let to an abuse of technology in order to "produce" more graduates with a lower cost per graduate.

Project funding has been appreciated by respondents because it encourages interdisciplinarity and the achievement of specific objectives (steering at a distance), nevertheless funds must be allocated with the awareness that it may lead to the so-called Matthew effect.

Tuition fees payable by students in the analysed countries are always centrally regulated. In some countries, they are established directly by

governments, in others they are delegated to the universities, but within a range decided by the government. According to some respondents, the demand for Higher Education is quite rigid to the price, that might be the cause a lack of innovation; the third paper addresses empirically also this point, universities that rely more on student fees are more prone to introduce MOOCs.

Within the funding framework provided, the thesis aims at offering, with the second paper, a possible decision making strategy to understand if a university should harmonize its teaching offer with the world of web 2.0: namely, introducing MOOCs. In particular, it divides the student population into two categories: "support-oriented" and "support-independent", in the first category there are typically young university students, in the latter life-long learners. Studying the phenomenon of MOOCs from the perspective of university management, and, although the model should not be intended as a comprehensive decisional algorithm, it firstly states the importance of network externalities, secondly its main output are three possible scenarios. The first is defined as protectionism, that mainly targets traditional consumers (support-oriented), they are high school students who are in need for support services that can be obtained only with the university enrolment. When both the aging society and the need for life-long learning set the increase of support-independent consumers, according to the model presented, universities tend to invest in MOOCs. This strategy aims at enlarging the network of know-how in order to increase the value of support services and, consequently, the willingness of traditional consumers to pay. The final scenario sees an ulterior rise of the category of support-independent consumers, so that university management may be interested in designing pricing strategies tailored to their availability, in order to get them registered. The economic crisis and the historical circumstances have led to a downward trend in registrations forcing universities to also pay attention to the other category of consumers, in the model called "support-independent"; the growing need of life-long learning and the aging population will cause the rise

of support-independent consumers. It will force universities to rethink their strategies. This is a futuristic scenario, the result of assumptions and simplifications of real contexts but that allows understanding how the phenomenon of MOOCs could be only a transition period, a necessary step to give new impetus to the university system fully integrated with these possibilities.

Once the funding mechanisms and decisional variables to introduce MOOCs are set, the third article aims at analysing how financial resources play a role in addressing the MOOCs' strategy, hence in the capacity to innovate of HEIs. Specifically, there is evidence that the business model of universities, defined as the ratio between the total amount of tuition fees on the core budget, is a significant determinant, especially for the universities. More market oriented universities are more prone to implement a MOOC and also to increase the number of these courses in order to attract more students and, in turn, collect tuition fees. Also all the HEIs that are more dependant from the tuition fees paid by the students are more prone to implement MOOCs. On the other hand, universities with more financial resources have adopted a more conservative approach, this meets also the literature that looks at MOOCs at a mean to improve the cost effectiveness of HEI (Anderson & McGreal 2012).

Chapter 4.
IMPLICATIONS AND AVENUES FOR FURTHER RESEARCH

This thesis is a collection of contributions on the technology adoption in HEIs. In particular, it focuses on the impact of funding schemes and business models when a new technology is available. The analysis is introduced by a brief discussion on distance education with a special focus on Massive Open Online Courses (MOOCs), then is followed by the discussion of three articles. The first paper (Annex 1) is based on semi-structured interviews and points out a substantial heterogeneity among the funding systems: the government's reaction to the economic crisis appears to be one of the main conflict-ridden factors; the second paper (Annex 2) shows that the activation of MOOC platforms generates also the beginning of a new university business model with strong economic implications and it aims at providing a first decisional model for universities to determine whether to offer MOOCs; the third and last paper (Annex 3) is a bridge between the first and the second, it explores the financial determinants why universities are entering in the MOOCs market.

The open movement has demonstrated, also in the field of education, that peer interaction often solves scalability issues and allows greater numbers and low costs per user. There might be problems with the reliability of educational materials and tendency to abandon the textbook as a reference tool for the basics of the discipline and fundamental concepts, hence potential problem of viral propagation of errors not easily recognizable. The first data demonstrates how MOOCs are reaching those who already have Higher Education degrees (Emanuel, 2013; Lue, 2014) and have very high dropout rate (Dacey, 2014). The business model, or at least return on investment, it is not entirely clear, as also reported by the Department for Business Innovation of the UK: "The Burning Issue in the MOOCsphere is the search for business

models". There are consortia for MOOCs alliances with private partners large, as done by the Khan Academy with the Bank of America on particular fields of training, in order to raise financial resources for the development of the courses, as well as skills. And again, there is lack of direct and physical contact between students and faculty. Lack of informal communication that takes place during the lesson, thanks to the multiple communication channels that are activated, even unconscious. Lack of "life training" of the university campus or city.

MOOCs are a new phenomenon, born in the United States of America. Their impact on a global scale back in some way to autumn 2011 when Stanford University has provided a free post-graduate course of artificial intelligence which enrolled about 160,000 students from 190 countries. MOOCs users have exceeded one million after only four months: an amazing start, faster than Facebook or Twitter (Blake & Scanlon, 2014). Because of their rapid growth and, in part, because of the speculation about their role in changing future higher education, MOOCs have captured attention not only of students, faculty and university administrators, but also of journalists, politicians and public influencers (Fischer, 2016). Many scholars have underlined the potential disruptiveness of MOOCs in HEIs (e.g. Christensen & Weise, 2014) or in democratising education, but pointing out the potential risk to create a dual system where MOOCs may be a second-class education, augmenting inequalities in accessing learning (e.g. Carver & Harrison, 2013). However, research has pointed out how difficult it is for those who do not have attained previous higher education programs to attend with positive results a course based exclusively online and how MOOCs are completed by the so-called "educated few" (Emanuel, 2013). This has led me to a question that may be addressed with future research: spending money in order to develop MOOCs, that are mainly addressed for those who already have a college degree, isn't it an expense designated to augment inequalities?

The discussion that MOOCs have risen among scholars has brought awareness about innovation in teaching activities, even the loudest critics of MOOCs do not expect them to fade away, rather as a part of an expanded infrastructure in which MOOCs are complemented not only by residential universities, but by all of the other components contributing to rich landscapes of learning (e.g. blended learning or flipped classroom).

MOOCs are also driven by market orientation, which is growing in Europe thanks to the development of NPM mechanisms in universities, by the scarcity of resources and for future studies could be important to understand if universities that are funded mainly with output based criteria are more prone to implement MOOCs compared to those who are funded by input based formula. In fact, respondents in the paper 1 highline the possible danger of a quality drop applying formulae more balanced on output criteria rather than input.

MOOCs could herald opportunities not only from the teaching point of view, but also on the research side. MOOCs providers, thanks to the large number of subscribers and the intensive use of information technology, will generate important data that could change the understanding of the dynamics of learning. MOOCs can also be an opportunity for what concerns classroom activities, for instance playing a complementary role. Online courses could indeed prepare the classroom activities, allowing professors to focus more in discussing what has been learned online.

The most important field where MOOCs and traditional universities meet is teaching. Understanding the opportunities that can come from this novelty might be useful to understand what is the added value of a traditional university that online courses cannot provide. It would be naive to imagine a model in which universities, in their teaching mission, are only "filling" the mind of the students. The writer Michel Eyquem de Montaigne said *"mieux vaut une tête bien faite qu'une tête bien pleine"* (i.e. being able to think is better than having a head stuffed full of information). We are moving toward

a society constantly changing faster and education needs to provide exceptional tools in this "liquid" society, to put it as the sociologist Zygmunt Bauman. Notwithstanding the opportunities described, so far there is not a technology that could fully substitute traditional universities. An example comes from the so-called "campus life"; i.e. the set of life experiences that prepare students not only for their professional career, but helps them to achieve of a broader view of knowledge, which makes education a value in itself.

Reading through the chapters of this work, the reader might find some gaps. As it appeared that most empirical studies on MOOCs rely on surveys with low response rates and with unclear indications of their representativeness, more research is needed in order to make valid generalizations (van de Oudeweetering & Agirdag, 2017). On the other hand, literature reviews (e.g. van de Oudeweetering & Agirdag, 2017) demonstrated a lack of empirical studies on MOOCs on smaller or non-Western based platforms and underlined their relevance; for instance, in determining the barriers to complete a MOOC, for instance separating the effect of having a previous education with the language barrier. Some scholars state that the barriers to complete a MOOC for those who have a lower level of education might be also due to the English language; therefore, it is essential to examine whether multilingual platforms can reduce existing inequalities in participation and completion rates (see also Van Laere, Agirdag, & van Braak, 2016).

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Annex 1.
FUNDING MECHANISMS IN FIVE HIGHER EDUCATION SYSTEMS IN EUROPE: A COMPARATIVE STUDY[1]

1. Introduction

The funding mechanisms for HEIs have undergone important reforms in several European countries in recent years and many empirical studies have been conducted to verify their efficiency and analyse their formal change (Hicks, 2011; Auranen e Nieminen, 2010; EUA Define Projects). However, only a few studies evaluate the adoption of the implemented reforms focusing on their informal and latent aspects, hence how the rules are translated into behaviour in the application phase. The purpose of this paper is to identify similarities and differences among the different funding schemes for HEIs in European countries and analyse their trends and try to find discrepancies between the formal and informal procedures deriving from their implementation.

This analysis turns out to be crucial, being funding methodologies not only an indicator for the forms of public capital allocation, but also for education and research policy (Sexton et al., 2012). This paper describes the funding mechanisms for tertiary education in five European countries, using the

[1] A version of this chapter co-authored with Mattia Cattaneo, Davide Donina and Michele Meoli has been published on Scuola Democratica (2015), 6(1), 103-122, with the title "Il finanziamento dei sistemi universitari in cinque paesi europei: uno studio comparativo". In the published version, sections "Funding Mechanisms for Universities", and "Changing trends, strengths and weaknesses of resource" are fully my contribution; "Introduction", "Territorial Analysis: differences in the financing System" and "Conclusions" are written jointly with the co-authors. Instead, I am responsible for all the changes in this chapter with respect to the published version.

results of a study coordinated by UNIRES[2] and consisting of over 90 interviews conducted in 14 universities of the five different countries (see table1.1).

A first evidence is the substantial heterogeneity among the different funding systems: The governments reaction to the economic crisis appears to be one of the principal discordant factors. Some governments have increased funds for higher education, introducing targeted funding, allocated on a competitive basis, to meet the national targets; others have been cutting budgets (Paleari et al., 2014). Then, the paper illustrates the principal allocation methods of public funds to universities and the main sources of private funding, with a special focus on student contribution. The allocation criteria within the university itself, adopted by each of the five selected countries, will be as well examined, before moving to an analysis of the principal strengths and weaknesses of the funding methods.

2. Funding Mechanisms for Universities

Tertiary education has been affected by a slowdown in investments growth since the 1970s. Student enrolment has been following the opposite trend, increasing as rapidly as the pressure put on the University system to enhance its educational capacity (Reale & Seeber, 2013). In many countries, the *New Public Management* (NPM) has been the inspiring paradigm for reforms aiming at transforming the traditional funding mechanisms. Nevertheless, the mere funding mechanism does not *per se* reveal the perspective which has

[2] UNIRES (Italian Centre for Research on Universities & HE Systems) is an interuniversity Research Centre based at the Scuola Normale Superiore. It aims to study higher education systems and their changes in a comparative and multi-disciplinary way, in order to provide comparative data and analyses to policy-makers, as well as being a partner in international networks on higher education systems and policies.

been embraced (Braun, 2006); rather, it is important to examine the way this has been implemented (Reale & Seeber, 2013). Tertiary education institutions can be financed in multiple ways. The interviewed pointed out a significant increase and diversification of the funding mechanisms, resulting from the progressive adoption of the NPM principles. The funding mechanisms will be hereafter defined in accordance with the criteria introduced by the EUA Public Funding Observatory[3].

Most governments finance Universities through a fund, distributed according to specific criteria. The overall amount can be determined in different ways: through negotiation, on historical basis, through a financing formula, on competitive basis, or through a synthesis of all these elements. As highlighted by Estermann et al. (2013), the combination of different allocation methods results to be the mainly used approach, and within this mix a principal role is played by a formula-based funding. Over time, the percentage of government funds allocated on competitive basis, in particular the ones related to research products, has been increasing. In some cases, these are earmarked for specific purposes, as it will be discussed in the following chapters. Nevertheless, there are as well examples of direct allocations to some institutions, which do not relate to any competitive factor.

3. Research design

The interviews were conducted in three universities per country (Spain, Germany, Netherlands, United Kingdom and France). Universities within each country have been chosen in order to be different among themselves in terms of size, subjects, ranking and characteristics of the territory. The main objective was to investigate not only formal aspects of higher education reforms, but also latent aspects and unintended consequences of the different

[3] http://www.eua.be/publicfundingobservatory.

approaches in funding mechanisms. For each university have been interviewed 2 head of departments or deans (middle managers), the Rector and 2 pro/vice Rectors (top managers).

University	Country	Students x 1000	Location
Manchester	United Kingdom	40	City
University College London (UCL)	United Kingdom	25	Metropolis
Leicester	United Kingdom	18	City
Amsterdam (UvA)	Netherlands	30	Metropolis
Leiden	Netherlands	20	Small city
Maastricht	Netherlands	16	Small city
Heidelberg	Germany	30	Small city
Freiburg	Germany	21	City
Lüneburg (Leuphana)	Germany	7	Small city
Strasbourg	France	42	City
Paris Sud	France	27	Metropolis
Tours	France	21	Small city
Barcelona (UB)	Spain	81	Metropolis
Valencia	Spain	55	City
Zaragoza	Spain	37	City

Table 1.1. Universities interviewed in this study.

4. Differences in the financing System across EU countries

This paragraph analyses the financing system in the five countries on which the study is focused. It will examine the principal allocation methods of public funds to universities; the main sources of private funding with a special focus on student contribution and the allocation criteria adopted within the university itself.

As mentioned before, European HEIs have undergone important transformations in the last decades, pursuing, in most cases, a greater autonomy. Financial autonomy is crucial for a university to achieve its targets; if this were missing, all other dimensions of autonomy would exist

only in theory (Estermann e Nokkala, 2009). A more autonomous University should be better able to compete by diversifying its financing sources, attracting competitive funds, contracts with private companies and donations from the non-profit sector. This could make the university less dependent on individual revenue items, and enable it to adapt to a constantly changing environment. Within a public organization funding allocation happens to be a crucial aspect (Wildavsky, 2002), affecting significantly the behaviour of its members. These have to be engaged in a concerted effort, so that individual actions could align to the criteria according to which the State distributes the funds.

Table 1.2 shows tertiary education funding as a share of GDP and the variation in nominal terms between 2008 and 2014 in the five European countries under study. The data reveal how the economic crisis has led the countries to follow divergent strategies. In particular, the crisis divides the Mediterranean from Central and Northern European countries, substantially delineating a two speeds scenario. An exception is represented by England, which has reformed its tertiary education system. This country has experienced a reduction in the funding, getting at the same time more decision-making autonomy, which has made it even more market oriented.

In most European States Universities are funded through block-grants. However, there are still some cases in which funding is tied to specific balance sheet items, leaving no chance to change its use (Estermann and Nokkala, 2009).

	Total Public Funding 2014 (Mil €)	Total public funding as percentage of GDP 2014	Inflation-Adjusted Change (2008 - 2014)
France	23,900	1.12%	+5.2%
Germany	27,900	0.96%	+27%
Netherlands	3,295	0.53%	+3.2%
United Kingdom	8,690	0.44%	-26%
Spain	7,405	0.71%	-15%

Table 1.2. Tertiary education public funding. Source: EUA funding observatory.

4.1. Spain

Spanish Universities received 7,405 million Euro public funding in 2014, equal to 0.71% of GDP. They experienced a funding decrease of 15%, net of inflation, between 2008 and 2014 (EUA Public Funding Observatory).

Before the LRU (Ley de Reforma Universitaria) in 1983 Spanish Universities were exclusively financed by the central government. The Reform has led to a profound change. Regional governments currently provide funds to public universities, which are then free to allocate and redistribute them internally. Other sources of funding come from tuition fees, from research contributions related to European or national funds and from contracts with companies and sponsors. The core funding, allocated from the regions, constitutes a significant proportion compared to the total funding, but the percentages may vary greatly from university to university (60-70% in the University of Zaragoza; 85% in the University of Valencia). Each Spanish region has, in fact, its own financing system, which is still centred on allocation methodologies mainly based on inputs (number of students enrolled, number of professors, etc.) rather than on outputs (research innovativeness and other performance indicators). In other cases, financing depends on the achievement of a set of goals, established through a contract. The criteria are

freely defined by the autonomous communities. Regional funds are used by the University to finance educational activities and basic research.

As reported by one of our respondent, this system creates a certain dependence on the number of students. a greater number of enrolments gives rise to increased transfers, encouraging the University to increase the overall number of students.

In Spain, there are various ways to attract external funds, for example from businesses, especially through conventions and agreements. One method consists in the creation of *Cátedras institucionales y de empresa* (business-sponsored chairs), managed by an external body, such as an institution or a company. This provides funds, usually approximately 20,000 Euros, for research project, organization of events or conferences. Such a strategic long-term agreement benefits both parties, for example a large numner of Spanish law firms use this possibility. The University of Zaragoza is the second Spanish university in number of corporate professorships. At present, it counts 58 business-sponsored chairs in various areas, each one headed by a joint committee, responsible for approving the annual program.

Another option, to give a second example in the legal field, is to sign an agreement with law firms or organizations, write opinions on particularly complex issues and receive a sum of money in return, 20% of which is retained by the University itself.

An alternative form of cooperation between the University and external institutions, aiming at attracting additional funding for technology transfer, is represented by the OTRI (Oficina de Transferencia e Innovación Tecnológica). This office provides support to the research groups of the University and to external bodies, which wish to cooperate with it for research, innovation and technological development.

Furthermore, the National Plan for Scientific and Technical Research and Innovation 2013-2016 has been approved. By granting deductions, the tax law

supports the expenses incurred by companies for research and development in collaboration with Spanish universities. Tuition fees are regulated by the regional governments: They establish a range within which the University can determine the actual extent. Due to the recent (and significant) reduction in public resources, regional governments have allowed universities to raise the tuition fees above the limit established by the law. The University of Valencia has increased its fees by 50% in the last two years, but not indiscriminately. The most significant increase has involved those, who can be defined as "failing students", students who have not passed the examinations within the stipulated time (*primera convocatória*). For these students, tuition fees have increased by 85%. On the contrary, students which are not falling behind in their studies have experienced an increase of 15%.

Since the tertiary education system is strongly regulated at government level (even though from the regional governments), there are no significant differences in the level of taxation between faculties, except small variations due to different needs for funds. At the University of Valencia this differentiated tax increase was indeed applied indiscriminately.

All funds received are managed by the rector, who has the responsibility and the decision-making power to proceed to the distribution. The lack of differentiation between faculties can be here noticed once again: The distribution of funds always depends on the number of students and on the discipline; no performance indicators are taken into account.

4.2. Germany

German Universities received 27,900 million Euro public funding in 2014, equal to 0.96% of GDP, and the funding increased by 27% in real terms, between 2008 and 2014 (EUA Public Funding Observatory).

Most of German universities are public. In line with the federal structure of the country, the organization, administration and funding of the higher education system fall within the responsibility of the sixteen *Länder*. These establish autonomously the distribution criteria.

Projects of national importance, such as the Excellence Initiative and the financial support for students are matters of federal competence.

The interviews were carried out at the Universities of Heidelberg and Freiburg, in Baden-Württemberg and at the Leuphana University in Lüneburg, Niedersachsen (Lower Saxony). Respondents from both universities in Baden Württemberg confirmed that the allocation of core funding is built on traditional criteria, such as historical expenditures or the number of students and do not take performance indicators into consideration.

However, the German public core funding represents a smaller percentage of the University budget, in comparison to other European countries. For example, it accounted for 61% of the incomes of the University of Heidelberg in 2012. The remainder comprises public and private funds, distributed on competitive basis through research foundations. The interviews with top managers did in fact reveal that the German system is heading in the direction of the NPM, empowering individual professors for their own funding.

According to one respondent, the German Research Foundation[4] (DFG) provides the most substantial proportion of the funding: in 2012, it represented 40% of the funds obtained on competitive basis by the University of Heidelberg, followed by donations and sponsors (23%), industrial funding (15%), grants from the Federal Government (14%) and European Union funds (7%)[5]. The Excellence Initiative is instead run at federal level, and the central government distributes funds to be allocated on competitive basis in order to strengthen certain Universities and increase their international visibility.

More than 30 universities have received this funding, in terms of scholarships, PhD and research grants, and through the creation of clusters of excellence linking the University system, research institutes and the business community. 11 Universities of Excellence were selected among these and are currently being funded to promote high-level University research.

As regards student contribution, tuition fees were prohibited by the federal law until 2005, when the German Federal Constitutional Court declared this was against the Grundgesetz[6].

After the Court's decision, seven of the sixteen German states introduced tuition fees of around 500 Euro per semester (Bruckmeier and Wigger, 2014).

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[4] The *Deutsche Forschungsgemeinschaft* (DFG) supports research through grants programs, awards and financing infrastructure. The organization is independent, has its headquarters in Bonn and is funded by the German federal States and by the federal government. All the main German research University are members of the DFG.

[5] Other funds: 1%

[6]. *Grundgesetz* is the German Constitution (Basic Law). In 2006 it underwent a review process, which recognized the Länder the power to derogate from the federal legislation for Higher Education.

However, a gradual abolition of student contribution has been effected in recent years, restoring the previous situation.

With the elimination of tuition fees in the last state (Lower Saxony) in 2014, German University *de facto* became free for all students.

In the two Länder, in which the interviews were conducted, no student is required to pay any fee to finance the expenses of the University, with some exceptions for the lifelong learning programs and for students coming from non-EU countries.

One of the many reasons why German University are currently pushing towards internationalization is, therefore, of economic nature: immigrant students contribute to the University budget with their taxes. One of the respondents belonging to Heidelberg top management reports that no substantial increases in core funding (Grundmittel) has been observed since 1998; allocations on competitive basis have therefore been gaining importance. Furthermore, this absence of guarantees leads the University to strongly seek external sources of funding.

A respondent from the University of Lüneburg, with great international leadership experience stated that it is much easier to attract external funding in Germany because the teachers are free to create their projects, and thus have an incentive to seek funding. The academic staff shows therefore a good predisposition to attracting external funding.

Finally, respondents from the universities under study reported the creation of special offices to support the faculties in the management of the call for proposals. In Freiburg, this is a centralized service, but the staff is organized, so that each faculty can count on specialized personnel.

4.3. Netherlands

The Dutch public funding amounted to 3.295 million Euro in 2014, equal to 0.53% of GDP and increased by 3.2% in real terms from 2008 to 2014 (EUA Public Funding Observatory). Approximately 70% of the funding to Dutch universities comes from public funding, while the remaining 30% is represented by student contribution and third party funding. These funds, allocated on a competitive basis and used to finance research, are becoming a source of great competition among universities. As mentioned, the main funder is the central government, which establishes the criteria for resources allocation.

The indicators used are the number of registrations and the number of European citizens graduated in bachelor, master and doctoral degrees. The Dutch universities also sign a performance based contract with the Ministry of Education and a strategic plan for the mission of the University.

The total amount of the funding is established by the Ministry and the universities compete for their share on the basis of their performance. Resources are allocated in different proportions: 60% for teaching and 40% for research.

A second flow of financial resources comes from the regional governments. This is often tied to specific needs. For example, the Province of Limburg provides additional funding to the University of Maastricht, in order to encourage young students to study chemistry and natural sciences, two disciplines which are functional to the economy of the region, which is strongly focused on the chemical industry and currently showing factors of crisis. The remaining part of public funding comes from grants awarded by the European Commission or by private companies.

University fees are handled by the University with a high level of discretion: the Dutch government sets a fixed rate, but the universities can increase it according to their own financial policies. Student contribution differs between

European and non-European, amounting to about 1,700 Euro for the former and being generally higher for the latter.

The system through which the Netherlands aims at attracting external funds is similar to the German one. Each professor pertains to a research institute. These institutes are research coordination structures (most of the members have their own office in the respective department), designed to organize and conduct group research projects, which should be able to attract external funding both from the public and private sector. The research institutes obtaining the most external financial resources (from privates) must leave to the university a percentage varying from 10 to 25%. Professors are responsible for their funding and it is in their direct interest to attract it in a greater extent. In particular, respondents emphasized the growing importance of the Dutch Research Council, which has important funds available, and the ability to attract these sums is crucial for Dutch Universities.

As mentioned above, the University of Maastricht maintains close ties with the regional territory and economy, in order to attract more external resources. For example, one of the main partners of the University is the Academic Hospital Maastricht (azM). The hospital cooperates with the Faculty of Health, Medicine and Life Sciences through the formal partnership established with the Maastricht University Medical Centre. However, this is not their main goal. As argued by one respondent, the external financing sources are to be seen only as an additional value, preventing their attraction from becoming the mission of the University.

The collected funds are invested by the Dutch Universities with full autonomy, but observing the principles of accountability and transparency.

The internal distribution criteria are established independently by each university, generally following the state criteria of allocation, in order to be in line with the parameters and get more resources. Incentives are often given

to those, who manage to attract resources on a competitive basis, who in turn have to allocate part of these grants to the university structure.

In the University of Amsterdam, for example, the resources are allocated to the faculties following the proportions of national allocation, that is to say 60% for didactic activities and 40% for research.

Education funds are defined on the basis of the credits achieved per student, while research funding is awarded on the basis of more complex indicators (equipment cost, number of doctoral students, etc.).

Each faculty distributes its funding according to own variable mechanisms, although some faculties allocate funding to educational and scientific facilities following the same criteria adopted at University level.

4.4. United Kingdom

In 2014, the UK university system has been funded with 7.048 billion pounds (approximately 8.69 billion euro and to 0.44% of GDP), and has declined by 26% between the years 2008 and 2014 in real terms (EUAs Public Funding Observatory). In England, the total amount of funding is allocated annually by the government and distributed through a variety of agencies (*quangos*). The lead agency for the allocation of public resources is the Higher Education Funding Council for England (HEFCE). The funding distributed by the HEFCE does not fully cover the costs of the universities. It is just a contribution to teaching, research, knowledge exchange and related activities. The share of entry coming from the HEFCE is related to some factors such as the fees that the University applies to its students, its activities and the money raised from other sources. Universities also have a range of other funding or income sources, such as endowments, businesses, other public sector organizations and the student contribution, which is a substantial part of the University budget in England. Most of the public funding is allocated through a formula linked mainly to inputs, including the number and type of students, the teaching subjects and the quantity and

quality of the undertaken research. As mentioned above, the student contribution has become an increasingly an important part of the University budget, especially from 2012 (Donina, 2014), when the limit imposed by law on student fees increased from about 3,000 to the current 9,000 pounds. In addition, the legislative limits to taxation of students who have already obtained a bachelor degree and for students with non-European citizenship are much less restrictive: about a third of the fees is paid by non-European students, even though they are about 12% (HESA, 2015). This suggests that the student contribution is a significant source of income and that British universities are acting strategically in increasing the degree of internationalization of their own in order to have students paying higher fees than the 9,000 pounds' limit per year.

4.5. France

In 2014 France funded its universities with 23.9 million euro, approximately 1.12% of GDP. In addition to Germany it is the only country, among the analysed ones, where the funds have increased of 5.2% in real terms between the years 2008-2014 (EUA Public Funding Observatory). The state public funding is the most substantial part of the resources received from the University. This comes from two distinct channels: the first one is an allocation related to personnel costs, accounting for about 90% of the funding; the second is related to the algorithm SYMPA and is about 10% of the financing. The personnel costs are paid on the basis of historical expenditure and include automatic annual adjustments. The SYMPA algorithm relates the transfer of government resources to a number of parameters such as the number of students, number of graduates, number and characteristics of the research staff, research activities (taking into account the evaluation of the AERES) and square meters of the structures. The University of Strasbourg has a budget of around 481 million euro, in which the main entry item is the

state funding of around 330 million euro, representing 69% of revenue. Government funding related to the *Investiment d'avenir* program provides another 26 million euro, equal to 5% of revenue. The third type of income is represented by other public subsidies amounting to 31 million of euro, or 6% of revenue. Their resources have a weight percentage of 19%, amounted to € 55 million and include research contracts and university fees. These, on average, amounted to 265 euro per student and have a total weight of the total revenue slightly higher than 1%. Other revenue (depreciation and internal billing) amounted to 36 million euro. As for the expenses, 68% of the total resources of 330 million Euros, is the cost for the staff. The costs for the operation amounted to 119 million, or 25% of total expenditure. Finally, the cost of investment amounted to 34 million euro, equivalent to 7% of total revenue. In France, the tuition fees are set by the central government and not by the institutions, which have a limited ability to impose additional charges for certain services. The law is very strict mainly because many institutions want to increase their funding level from student contributions, with annual fees in 2013/14 amounted to 183 euro for the bachelor degree, 254 euro for Master and 388 euro for Ph.D. (JORF n. 0195 du 23 août 2013 texte n. 16). Given the difficulty of the French government in securing financing, the legislation is going in the direction of granting greater autonomy to universities and with high probability this will lead to an increase in student contributions.

5. Changing trends, strengths and weaknesses of resource allocation methodologies

Through the analysis of the conducted interviews we can examine the main strengths and weaknesses inherent in the different funding mechanisms. In particular, respondents were requested opinions about the distribution systems in historical share, in formula, in projects, and moreover, regarding the student contribution, the ability to attract external funding and collaboration with the local territory. Based on the findings from the interviews it is possible to make some observations.

Firstly, if the funding allocations based on historical spending guarantee a basic funding, therefore greater stability, greater autonomy and the opportunity to plan for subsequent periods with less uncertainty, it must also be pointed out that the exclusive use of this typology tends, in the long run, to reward universities that have chosen to downsize its numbers or to punish those that grow. The distribution mechanisms through a formula instead are very useful in order to promote the understanding and the achievement of specific objectives, and they also allow universities to align to the criteria of internal funding allocation with the national ones simply equating the formula.

Although the most commonly used formulas continue to take account of input variables (such as the number of students or matriculated, lecturers, staff, etc.), the currently observable trend in Europe shows a growing weight given to indicators and benchmarks that measure the performance of universities and their output. It should be emphasized that the exclusive use of only on input-based funding mechanisms can result counter-productive in the course of time, particularly when the monitored parameters are few.

These, in fact, can become incentives in the hands of the universities that, in order to attract more funding, activate policies to increase the number of students. Conversely, some respondents, faced with a hypothesis of financing

mainly related to the outputs, have expressed many uncertainties, particularly with regard to a potential qualitative decline in teaching and research, which could arise from the excess of competitiveness that, in their opinion, this method of financing could trigger. However, the exclusive use of this type of formula does not apply in any of the analysed universities.

Despite what mentioned above, a second result emerged from the comparative analysis is the growth of funds allocated on a competitive basis, in particular through the use of project financing. All respondents agree in highlighting the results obtained thanks to the use of this method, whose main merit is to increase competition in the research field and direct it to the achievement of specific objectives (steering at a distance), encouraging interdisciplinarity at the same time.

Some respondents, however, pointed out that when the resources generated by the projects represent a significant part of the funding mix, this could limit the autonomy of the universities, in both academic and financial terms. From the academic point of view, the researchers see their academic freedom as limited, since they have to follow the predetermined tracks prepared by the project, even after any potential unexpected results that deserve greater flexibility of the project. From the financial point of view, instead, in relation to the use of the funds obtained. For example, respondents from the University of Heidelberg have underlined they have been able to attract a many funds, not having, in aggregate terms, economic resources problems. Funds received for research projects are however bound, that does not preclude the fact that there is some difficulty in having to administer the university facilities with core funding, in spite of the abundance of total funds.

European universities are increasing their skills in attracting external funding distributed according to competitive modes by the competent bodies. Respondents, in fact, have remarked the importance that a part of the research should be market oriented and have implemented strategies to be competitive and better placed in the territorial fabric, emphasizing the

importance of knowledge and technology transfer. In Spain, for example, the Technology Transfer Offices (TTOs) are called OTRIs (*Oficina de Transferencia de Resultados de Investigación*), and are involved in promoting collaboration and technology transfer with the companies. At the University of Zaragoza, as illustrated above, the *Cátedras institucionales y de empresa* (institutional and enterprise chairs) have assumed an important role as a collaboration tool and method to attract funds with a long-term collaborative perspective. Some Spanish respondents stated that these relations however are not enough and that they should further increase the share of funding from companies. Some respondents answered that the problem is attributed to a lack of entrepreneurial culture, others argue that the country's severe economic crisis has had a negative impact not only on public transfers, but also on the assets of the companies, which are seen to reduce the production and credit. The economic situation, in fact, brought on as a consequence that in the last two years many collaborations with private companies for consultancy or specific research contracts have been suspended, because of the decline of the disposable income of the companies (and in some cases their closure).

An interviewee from the University of Lüneburg, with a strong international management experience, said that in Germany it is much easier to attract external funding because professors are free to create and manage their own projects. They are so encouraged to seek funding and, being able to manage them with greater autonomy, to be empowered to use. According to all respondents, in fact, the decision-making autonomy of the professor, inserted into a structure that provides a well-functioning set of enabling services in order to support teachers in the research and preparation of paperwork to obtain financing, is the best way to attract private and competitive funds.

Tuition fees payable by students in the analysed countries are always centrally regulated. In some countries, they are established directly by governments, in others they are delegated to the universities, but within a

range decided by the government. Moreover, as we have seen, in many countries there are mechanisms of differentiation which mainly are applicable only to foreign students and students not belonging to the European Community.

According to some respondents in Spain, the tax increase, at the origin of which there is only a problem of public funds reduction, was a tool to enhance the teaching efficiency. Others do however note that, despite the tax increase was quite substantial, especially for the so-called "failing students", and during a period of severe economic crisis, surprisingly there has not been a reduction in enrolments.

Looking at the internal allocation of resources, the typology of university governance is the key point from which two different methods of consensus management originate. Some doubts have emerged about the overly representative and very centralized systems of governance, which seem to represent a brake on the introduction of merit-based sorting systems. The fact that the leading positions are accountable to the academic community creates a process by which any unpopular decisions can then be discounted. The elected leaders are accountable to their electorate, not being able to act strategically by focusing resources on strategic research areas (Paleari et al., 2014). The same pattern applies within the faculty, if applied to the various departments that make it up: even in this case the principal would pay the consequences of unpopular choices to the next election.

6. Conclusions

This contribution has placed under review the trends related to the financing systems and the allocation rules in five European university systems, with the ultimate aim to examine the similarities and differences. The analysis of interviews with the top and middle management of the surveyed universities aimed at shedding light on some informal practices associated with the implementing of these mechanisms.

The first interpretation offered by the contribution concerns the trend related to the public funding of university systems. It is possible to identify a clear dualism between Southern European countries characterized by a strong contraction of resource (in this analysis Spain), and the rest of the continent, where resources were maintained at a constant level in recent years (France and Holland), when not increasing (Germany). This duality is the key that explains many of the differences that emerged in the analysis of the funding system in the various contexts. United Kingdom must be considered apart, given that the contraction in public funding was compensated by a substantial increase in autonomy which let UK institutions charge more on tuition fees, especially for non-EU students.

Looking at individual countries, differences emerge with regard to various aspects: financing channels (core budget and direct funding to specific projects), modalities for the transfer the budget (block grant, or directed to the financing of specific inputs), allocation criteria (historical quota or allocation based on funding formulas), determining the mix of resources (public, private, student fees). However, it is possible to identify general trends. In all the countries considered in the analysis, we observed a gradual overcoming of the core budget, of block grants and historical quota, in favour of models based on funding specific projects, directed to specific inputs or allocated on the basis of funding formulas. For example, some countries use the historical expenditure or a formula that includes input variables, but in all countries of the output measures begin to be included, as well as growing

use of funds allocated on a competitive basis to increase competition among universities in research and to achieve specific national objectives. This transformation is in line with the general process of renovation of the university system and the implementation of the principles of New Public Management, accompanied by greater autonomy and accountability of institutions, although they are some exceptions (Donina et al., 2014). This transformation process appears more mature in Central Europe than in southern Europe. United Kingdom stands out the analysed contexts, where the autonomy and empowerment not only is applied in the context of research funding, but they are also strongly linked to the ability of universities to attract students, considered as a source of resources.

Even the respondents do not identify a predominant system or a system which is better than the other. In their opinions always emerge strengths and weaknesses, often influenced by the context of application. Pondering the right mix of financing, declining it according to the culture and the territory in which it will be applied, thus it appears to be crucial to the good financial functioning of the university systems.

For this reason, the German model has an advantage, being among the contexts considered to be able to take greater account of the specific needs of the territories, as the governance and the distribution of funding is up to the individual states. Second in this country has been adopting a mix of financing that covers various needs related to research; while the financing of historical basis encourages the long-term planning skills. The decision-making autonomy is empowered by the individual professors in an environment that is able to support them in winning projects and attract competitive funds. In it, they enhance the peaks of excellence through the *Exzellenzinitiative*.

Market orientation, that has been translated into pervasive incentive mechanisms at different levels, is transforming European universities, especially in relation to human resources involved in the field, and in particular the selection criteria and the access to the institutions. They shall

be required to be able to attract funds, to relate with external parties and to transfer knowledge to the market. Idea of academic professionalism that more needs to align then with the principles of New Public Management, and with an idea of universities, perhaps, more able to attract resources and sustainable from a financial point of view. But what are the consequences on the capacity of universities to carry out their missions, especially the most traditional, in a capable and independent manner, is yet to be assessed.

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Appendix

A. Interview outline with the university top leadership (set of questions for Rectors and Vice-Rectors, Senior officers, Board members, Senate members)

1. Background information

a) How long have you been in your current position?

b) Did the governance of your university undergo major reforms in the last 15 years? When and how? (only one respondent per University)

2. Roles and responsibilities

a) How are the Rector and the top academic leaders elected or nominated in your university? (only one respondent per University)

b) The Rector and the top academic leaders are expected to be accountable to whom? E.g. to the executive board, to the senate, to the external stakeholders, to the Ministry?

c) What is the relationship between the top academic leaders and the top administrative managers in decision-making?

d) Let's now talk of the collegial bodies (Board and Senate, or equivalent bodies): how are they composed and elected or nominated, and what are their respective powers? (only one respondent per University)

e) Have the middle managers (deans and department chairs) in your university gained more authority, formally or informally, in recent years? Were they strengthened strategically?

f) The middle managers are expected to be accountable to whom? E.g. to the Rector, to the academic community?

g) Who takes the formal decisions with regard to recruitment? Can you briefly describe the way recruitment to new professorships and post-doc positions usually takes place?

3. Curricula design and teaching activities

a) Who takes the formal decisions with regard to the design/revision of curricula and to the teaching activities in your university? Can you briefly describe the actors and procedures involved?

b) To what extent do actual decisions on these matters conform to formal procedures? Are there discrepancies between formal roles and procedures on the one hand, and actual decision-making on the other?

c) How do you try to steer the development of curricula and the teaching activities? And how do you try to guarantee high-quality teaching?

d) Is there a focus to attract any particular group of students (e.g. best-talented students, non-EU students)? And if so, what strategies do you use (e.g. scholarships, student's loans, lower fees, courses taught in English, support for accommodation, etc.)?

e) Is the mix between first- and second-level education, PhD training, vocationally-oriented degrees, etc. roughly the same in all of your university's departments and schools? Or is the focus different in different schools, and if so why?

4. Research activities and performance

a) Who takes the formal decisions with regard to research activities in your university? Can you briefly describe the actors and procedures involved?

b) To what extent do actual decisions on these matters conform to formal procedures? Are there discrepancies between formal roles and procedures on the one hand, and actual decision-making on the other?

c) How do you try to steer the research activities? E.g. by setting the research pro les/priorities, by selective recruitment, by funding the research centres, or what? d) Suppose one of your departments or research centres shows a

worse performance in research than the average department at your university, or than the department you consider as benchmark in another university: what actions are the university leadership likely to take? E.g. closely monitoring the department's performance; give it more resources to catch up with the others; force it to specialize in vocationally-oriented degree programs or in third-mission activities; other actions.

e) Are there any rewards for better performing Faculties or Departments? E.g. increase in the number of PhD students, increasing funding allocations, etc.?

5. Third mission

a) How do you try to steer third mission activities?

b) Do you have one or more technology transfer offices at the university central level? Or at the faculty/department level? Which services do they offer? (only one respondent per University)

c) Which type of experience in academic entrepreneurship (e.g. spin-o s, patenting, etc.) has your university developed? In which fields? (only one respondent per University)

d) Which role does your university play in regional development and community engagement? How do you try to foster this role?

e) Are third mission activities such as knowledge transfer, life-long learning, support to local economy more developed in the departments with top research performance or in the ones with lower levels of scientific performance?

6. Resource allocation to and within the university

a) Is there a performance-based component in the funding mechanism used by the national or regional government? Is this component the same for the

whole system, or is it agreed with each university? (only one respondent per University)

b) Which share of university income is provided by competitive sources? (one respondent per University)

c) And which share of public funding is provided as block-grants (untargeted)? (one respondent per University)

d) Can your university keep a surplus with respect to the public funding? Can it borrow money on the financial market? Does it own real estate and is it allowed to buy, sell and build autonomously? (one respondent per University)

e) Are student fees set autonomously or are they subject to any limitation? Is there any differentiation on fees for different type of students (e.g.: non-EU, degree level, failing students) (one respondent per University)

f) How are resources for teaching and research internally allocated? Are there performance-based agreements for resource allocation within the university? More specifically, to what extent are the outcomes of external or internal assessment, the position in rankings, the students' evaluations, or any other measures of performance, actually used to allocate human and financial resources among the different departments or units?

7. Financial and human resources attraction

a) Does your university rely on particular types of revenue? (one respondent per University)

b) Are there any policies and incentives, at the university or at the department level, to attract external financial resources?

c) How does your university try to attract top professors and researchers? (e.g. with higher salaries, research funds, facilities, agreements on private activities and patenting, etc.)?

d) Who decides on academic salaries and promotion? Is your university free to set them, and are there performance-based contracts with academics? (one respondent per University)

8. Evaluation

a) Are research assessment exercises conducted regularly? If so: are they internal or external? Who is assessed and who is evaluating? (one respondent per University)

b) Are teaching assessment exercises conducted regularly? How? (one respondent per University)

c) What are the consequences of assessment for the organizational units (Departments, Faculties)?

d) Do you reward specific forms or outcomes of research or teaching?

B. Interview outline with the university middle management (set of questions for deans, vice-deans, department chairs, in two different organizational units: one in the hard sciences, the other in the SSH)

1. Background information

a) What is your position in the organizational unit (Faculty/School/Department/Institute) and what are your main responsibilities? For how many years have you been in this position?

b) Who appointed/elected you to this position? Please briefly describe the process by which you have been nominated/elected.

c) Please describe the structure of your organizational unit (number of staff, budget, major fields of research and teaching) and the major institutional changes undergone by it in the last 10-15 years. (only one respondent per organizational unit)

d) How do you see the position of your organizational unit within your university in terms of reputation, human and financial resources, centrality in the institutional mission?

2. Decision-making processes

a) Who is formally in charge of decisions in your organizational unit? Please name the body and its composition, or the person/role.

b) How did the decision-making process and the distribution of power change as a consequence of recent reforms or reorganizations (new bodies, new actors, new procedures, etc.)?

c) Could you summarize the changes in the relationship between the middle management and the top leadership in your university in the last decade (more/ less centralization, management of conflicts, etc.)?

d) In your experience, are there any discrepancies between the formal processes of decision-making and the informal ones? If so, can you mention the major ones?

3. Teaching activities

a) How are teaching activities formally organized within your organizational unit? (one respondent per organizational unit)

b) Who is in charge of designing/revising curricula, of allocating teaching duties and of supervising teaching activities?

c) Are there differences between those who teach in bachelor vs master vs PhD programs? (E.g. do full professors concentrate on master and PhD courses?)

d) Can you/your department decide on the subjects to teach (especially at the time of designing/redesigning curricula)?

e) Are there conflicts with the Faculty leadership regarding that?

4. Research activities

a) How are research activities formally organized within your organizational unit? (one respondent per organizational unit)

b) Who is responsible for allocating research grants, research support, etc.?

c) Could you briefly describe the typical decision-making process – from the selection of research topics, to funding, to assessment of results?

d) How does your organizational unit try to balance teaching loads and research activities?

e) Are there teaching-only and/or research-only positions?

5. Allocation of funds and performance measurement

a) In which ways are human and financial resources allocated to your organizational unit? Are they allocated on a performance basis? Are there performance-based agreements/contracts with the dean? With the university top leadership? (one respondent per organizational unit)

b) Could you please describe how the performance-based system works? Which are the criteria and how have they been selected? Is it managed at the local level or at the centre? (one respondent per organizational unit)

c) Does your organizational unit try to increase third party funds?

d) What about research and teaching assessment? Is your work assessed regularly? If so, by internal or external evaluations? Who is assessed and who is evaluating?

e) Are assessment results discussed collectively, published in the university website, etc.? And what are the consequences of assessment?

6. Recruitment/promotion

a) Could you briefly describe the process of recruitment to a full professor position? Who is going to decide about the position to fill? And about the candidate to select?

b) What are the respective powers of department chairs, deans, university leadership? And what is the role of collegial bodies?

c) Could you briefly describe the process of internal promotion to a full professor position? Who is going to decide about this?

d) What are the respective powers of department chairs, deans, university leadership? And what is the role of collegial bodies?

7. The decision-making process in action. Two examples

a) When a degree program must be designed or revised, how does the decision-making process actually take place? Which are the various steps that lead to the final outcome? Which are the actors involved (individuals, collegial bodies, most relevant actors)?

b) Are there differences between the way the process should be and how it is in practice?

c) When a post-doc position can be opened, how does the decision-making process actually take place? Which are the various steps that lead to the final outcome? Which are the actors involved (individuals, collegial bodies, most relevant actors)?

b) Are there differences between the way the process should be and how it is in practice?

Annex 2. TO MOOC OR NOT TO MOOC: DECISION-MAKING STRATEGIES IN CONTEMPORARY UNIVERSITIES[1]

1. Introduction

The continuous evolution of digital technologies and the development of increasingly interactive tools, have given rise to a new way of teaching: MOOCs (Short for Massive Open Online Courses). In the digital age, MOOCs promise to change the learning environment and to democratize knowledge, although the effectiveness of these tools is still much debated and the results on the users are not comforting (Banerjee & Duflo, 2014). HEIs all over the world are exploring MOOCs in order to understand how learning and teaching environments are changing. The activation of MOOC platforms generates also the beginning of a new university business model with strong economic implications (Yuan, 2013). In a difficult and uncertain economic era, it appears essential for universities to define decision-making strategies that will support choices for better dealing with change. In the last 5 years, the most important player in digital technologies have been social media that, in the digital economy, include the capacity to create and leverage both financial and social capital (McAuley et al., 2010). The MOOC model might play a critical role in developing competitive advantage, indeed they could be fundamental to understand and create network effects. The phenomenon of on-line learning is evolving in the framework of changes that are currently

[1] An extended abstract of this chapter co-authored with Matteo Kalchschmidt has been presented at the conference "Eu-SPRI ECC (Early Career Researcher) Conference Sowing the seeds of the future: The financing of tomorrow's innovations" in Bergamo (Italy) the 25th June 2015. However, I am responsible for all the changes in this chapter with respect to extended abstract presented.

taking place in higher education also in Europe, like globalization and marketization (Porta et al., 2015).

Pragmatic, economic and social reasons affect open access to learning; therefore, it is important to investigate it. The digital economy is changing citizens of countries with advanced economies, Hargittai (2010) highlighted the importance to achieve a knowledgeable Internet citizenry, which is unlikely to happen through a solely technical approach that focuses only on infrastructure without any consideration of the social processes and institutions in which people's Internet uses are embedded. In this paper, we aim at providing a first decisional model for universities to determine whether or not to offer MOOCs. This aims at 1) stimulating a discussion in this direction and 2) understanding the variables that influence this decision and the role they play.

2. Theoretical framework

Hollands et al. (2014) reported possible reasons why an institution should decide to invest in a MOOC: 1) extend the reach of the institution and access of their teaching activities; 2) build and maintain a strong brand; 3) increase revenues and/or reduce costs; 4) improve learning outcomes; 5) experiment new model of teaching and learning and 6) improve research on teaching and learning. Therefore, the emergence of MOOCs is not only a source of pressure on traditional HEIs, but also offers opportunities for those universities able to change and develop new strategies. For example institutions can set up new departments with different resources and processes to explore new educational approaches, or can open their target market to students who are not able to go universities (Yuan & Powell, 2013). MOOCs providers, such as Coursera and edX, are new entrants to the higher education market. Further they offer an attractive substitute product that is easier to access than the existing higher education model (especially than USA university model given the high level of tuition fees). However, despite the high rivalry within the

higher education market, many institutions have joined together to establish MOOC initiatives. This indicates a certain degree of collaborations (Marshall, 2013). In the modern HEI business model, the students are "consumers" and "suppliers" have meaningful bargaining power. Supplier groups include the academic publishing consortia, technology companies such as Google and Blackboard, and other companies that providing specialist functions. These organizations are essential to the operation of many universities (Marshall, 2013), and their interest in MOOCs is clear. For instance, in late 2012, Pearson has established a partnership with edX and Udacity to support the assessment process of MOOCs (Guthrie et al., 2013). Belleflamme & Jacqmin (2014) based on the theory of multisided platforms, describe five ways to monetize the MOOC business: certification model; freemium model (second-degree price discrimination, i.e. proposing different services at different prices); advertising model; job matching model and subcontractor model. They argue that "there is no panacea but that the most sustainable approach seems to be the subcontractor model, favoured in a well-balanced way by touches of the other four models." In this paper, we argue that there are two possible ways to acquire know-how according to the so-called freemium model: 1) the free MOOCs and 2) the traditional university. What differentiates these two methods is a set of support services that will be divided into *N* and *nonN*, hence those that are influenced by the volume of the network of users and those that are independent.

Under this theme, this paper aims to model the social and economic mechanisms that the university has to face when deciding whether or not use MOOCs within its curricula.

3. Modelling why university choose to enter the MOOCs market

MOOCs main function is to widen the dissemination of know-how to external subjects which are not enrolled at the university. For this reason, MOOCs courses can also be defined as know-how distributors, in fact they are able to create a network of industry knowledge among participants in the courses and professionals in the university faculty (McGreal et al., 2013).

MOOCs are part of the information market, which is defined as a network market; its main features are that a) information and knowledge are public goods whose consumption by one agent does not preclude the use of other agents (Stiglitz, 1999); b) knowledge is replicable, it can't be excluded nor divisible (Rullani, 2004) and therefore can spread uncontrollably (Boisot, 1998; Grant, 1996; Rullani, 2004); c) MOOCs are part of network markets because the owner of the know-how can copy it cheaply and distribute it to other consumers; d) the reproduction of the know-how, under certain conditions, can be a phenomenon that allows an extension of the network and consequently a widening of the profitable market with the network factor (i.e. the value of the service increases with the number of users). For instance, the piracy of a content or free samples might represent an alternative channel by which consumers experience the quality of the product and the willingness to pay a higher price for the original because consumers see in it a higher value.

When should a university hinder or promote the free distribution of the know-how, enabling or signing an agreement with a MOOCs platform?

Consumers of this model are seeking the know-how that in this model means the set of basic skills needed to understand and communicate in a particular work environment. (e.g. a language or a model). The more people possess these skills, the greater the value of the skills learned (network factor). This does not include the value of diversity in knowledge, nevertheless the more

people are involved in the knowledge network (q), the more they benefit from it.

We can consider a heterogeneous population where there are two types of consumers: a) Support-oriented (n): Consumers interested in having support services (e.g. high school students, undergraduates); b) support-independent (m): consumers indifferent to support services (e.g. graduates, professionals who want to improve and / or update their knowledge).

The hypotheses on which this model has been built on are that a) costs that university faces for an additional registration are balanced by economies of scale related mainly to the saturation of the classrooms and other organizational optimizations; b) support-independent consumers have differential benefits from the opportunity to take courses at a distance as they do not lose hours of work; c) support-oriented consumers do not benefit from the differential ability to take courses at a distance because they do not work; d) the university structure provides learning support services that can only be achieved through the registration.

The students' fee (p) is a payment that is required only to those who enrol in a traditional course, on the other hand, those students who have a benefit not attending a traditional course (e.g. already employed) are having a benefit (b) when the course is available online and can be taken at any time in any place. There are also costs in order to open a MOOC (Yuan et al., 2013) that are considered in the model (C).

Support services in relationship with the volume of the network (N) (e.g. traditional lectures, formative experiences, project work in team, alumni association). Refer to a set of services that have a greater value, the bigger is the network of users. For example, the value of an online gaming service provided by Sony or Microsoft, in addition to the console, has a much higher value as more users access it. Similarly, a university lecture will have more value the greater the spread of know-how that allows you to capture and you can use in the work context. Support services independent from the volume

of the network (*non*N) (e.g. career service, channels for finding a job), refers to a set of additional services provided by the university, which does not have a directly proportional relationship with the dimension of the network.

In this study, we have provided examples of the contents of these variables, but these topics are still much debated in the specialized literature. The model will only take account of existence and contribution of "N" and "nonN" variables without going into the detail of their content.

Therefore, this model is based on a set of variables described in the following table:

Name	Description
q	the network factor, the number of consumers who access the network of know-how (universities or MOOC).
n_i	support-oriented consumers
m_i	support-independent consumers
p	university fee
N	Support services influenced by the volume of the network
nonN	Support services independent from the volume of the network
b	differential benefits arising from the ability to take courses at distance
C	costs for MOOCs platform activation

Table 2.1. List of variables.

3.1. Structure

The potential student has therefore 3 options: a) university enrolment; b) take a MOOCs based course and c) give up.

The utility function for the two different kind of consumers differs therefore by the benefits of support services for the first category and the benefit of breaking time and space barriers for the latter:

Support-oriented consumers:

$$Uo \begin{cases} q(1+N)+nonN-p & \text{if } n_i \text{ enrols in a university} \quad (1) \\ q & \textit{if } n_i \textit{ takes MOOCs} \quad (2) \\ 0 & \textit{if } n_i \textit{ gives up} \quad (3) \end{cases}$$

In case of *university enrolment*, the utility is made of: a)the value of the network that they attribute to the asset (the know-how) that is equal, by convention, to the number of holders of the asset (q); b) the utility deriving from the network support services to and non-network support services (qN+nonN); c) decreased by university fee (p).

In case of *MOOCs*, the utility is made of the only value of the network (q), because the support services are only achievable by university enrolment.

If the consumer *gives up*, the utility is equal to zero.

Support-independent consumers:

$$UI \begin{cases} q - p & \text{if } m_i \text{ enrols in a university} \quad (4) \\ q + b & \textit{if } m_i \textit{ takes MOOCs} \quad (5) \\ 0 & \text{if } m_i \text{ gives up} \quad (6) \end{cases}$$

In case of *university enrolment*, the utility is made of: a) the value of the network that they attribute to the asset (the know-how) that is equal, by convention, to the number of holders of the asset (q); b) decreased by university fee (p).

In case of *MOOCs*, the utility is made of the value of the network (q) and the benefits from logistics optimizations (b).

If the consumer *gives up* the utility is nothing.

3.2. Scenarios

University has three possible choices. The first is *Protectionism (P)*, the university doesn't build a MOOCs platform, and sets the price of registration according to the possibilities of support-oriented consumers; the second is *MOOCs (M):* the university builds a MOOCs platform trusting in the network effects and in the value of its additional support services; the last is the *Inclusive policy (IP),* the university sets the price of registration according to the possibilities of support-oriented consumers. In this way, it involves both categories of consumers.

4. Modelling

For each scenario, we calculated equilibrium price and expected profits. Comparing the profits, we will define numerical thresholds designed to assist, with appropriate qualitative assessments, strategic decisions.

4.1. First scenario: protectionism

The university does not build a MOOCs platform, and sets the price of registration according to the possibilities of support-oriented consumers. Because of this strategy, the only way that consumers have to access to the know-how is the university enrolment.

In this strategy, the equilibrium price is the one that makes support-oriented consumers indifferent between to enrol and to give up:

$$Uo_{enroled}=Uo_{give\ up} \quad (7)$$

$$q(1+N)+nonN-p=0 \quad (8)$$

$$p=q(1+N)+nonN \quad (9)$$

In this case, only support-oriented consumers access the know-how. Support independent consumers don't access because they are not willing to pay such a high price for entry. Consequently, the network factor is equal to:

$$q=n \quad (10)$$

Replacing q in the formula, we can find the equilibrium price:

$$p=n(1+N)+nonN \quad (11)$$

Thanks to these data, we can determine the expected profits. We have to be careful with the number of buyers, i.e. it is limited to oriented-support consumers:

$$\pi_P = np \quad (12)$$

$$\pi_P = n[n(1+N) + nonN] \quad (13)$$

$$\pi_P = n^2(1+N) + nnonN \quad (14)$$

4.2. Second scenario: MOOCs

The university builds a MOOCs platform trusting in the network effects and in the value of its additional support services.

In this scenario, support-independent consumers have access to the know-how using free MOOC courses. Support-independent consumers do not enrol ever, because, at any price proposed, they would have a negative utility. For this reason, the university strategies will be focused to attract only support-oriented consumers.

Therefore, the equilibrium price is when the support-oriented consumers are indifferent between enrol and attend MOOCs:

$$U_{O_{enroled}} = U_{O_{mooc}} \quad (15)$$

$$q(1+N) + nonN - p = q \quad (16)$$

$$q + qN + nonN - p = q \quad (17)$$

$$p = qN + nonN \quad (18)$$

Remarks:

The university will set a price much higher:

a) when it increases the value of its additional services;
b) when it increases the number of consumers involved in the network of know-how.

In this case, both support-oriented and support-independent consumers access the network, therefore the network factor is:

$$q = n + m \qquad (19)$$

Replacing q in the formula, we can find the equilibrium price:

$$p = (n + m)N + nonN \qquad (20)$$

Thanks to these data, we can determine the expected profits. We have to be careful with the number of buyers, i.e. it is limited to support-oriented consumers:

$$\pi_M = pn - C \qquad (21)$$

$$\pi_M = n[(n + m)N + nonN] - C \qquad (22)$$

4.3. Third scenario: inclusive policy

The university sets the price of registration according to the motivations of support-independent consumers. In this way, university involves both categories of consumers. In this scenario, we will obtain an optimal price lower than the protectionism case because of the support-independent consumer has a lower propensity to spend money than the support-oriented one. The decrease of price will be balanced by an increase in total number of consumers involved that will produce positive effects both on the network factor and on the number of buyers.

The equilibrium price is when the support-independent consumers are indifferent between enrol and give up:

$$UI_{enroled}=UI_{give\ up} \quad (23)$$

$$q - p = 0 \quad (24)$$

$$p = q \quad (25)$$

In this case, accessing to the network both support-oriented and support-independent consumers, therefore the network factor is:

$$q = n + m \quad (26)$$

Replacing q in the formula, we can find the equilibrium price:

$$p = n + m \quad (27)$$

Thanks to these data, we can determine the expected profits. In this scenario, the cluster of buyers gathers both support-oriented and support-independent consumers:

$$\pi_{IP} = (n + m)p \qquad (28)$$

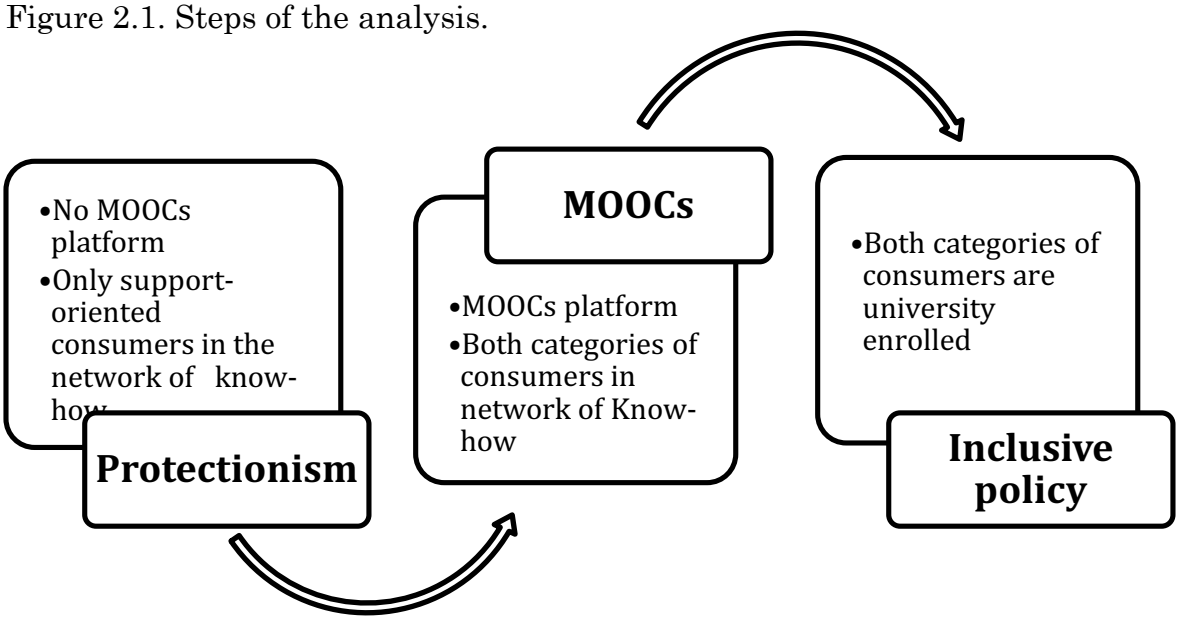
$$\pi_{IP} = (n + m)^2 \qquad (29)$$

The logical order of the comparison is designed for a progressive involvement of support-independent consumers in the network of know:

1. Protectionism vs MOOCs
2. MOOCs vs Inclusive policy

The diagram below summarizes the steps of the analysis:

Figure 2.1. Steps of the analysis.



STEP 1: Protectionism vs MOOCs

We begin to show when it is convenient to turn to a MOOCs platform rather than a protectionist policy:

$$\pi_M > \pi_P \quad (30)$$

$$[(n+m)N + nonN]n - C > n^2(1+N) + nonN\ n \quad (31)$$

$$n^2R + N\ m\ n\ nonN\ n - C > n^2 + n^2R + nonN\ n \quad (32)$$

$$n^2 - N\ n\ m\ + C < 0 \quad (33)$$

$$1 - \frac{m}{n}N - \frac{C}{n^2} < 0 \quad (34)$$

$k = \frac{m}{n}$

$$1 - kN - \frac{C}{n^2} < 0 \quad (35)$$

$$kN > 1 - \frac{C}{n^2} \quad (36)$$

$$k > \frac{1}{N} - \frac{C}{N\ n^2} \quad (37)$$

$$Hp\text{: N}n^2 \gg C \quad therefore \quad \frac{C}{Nn^2} \to 0 \quad (38)$$

$$k > \frac{1}{N} \quad (39)$$

$$m > \frac{n}{N} \quad (40)$$

Analysing the threshold obtained, we can understand that, with the increase of the value of the support services, the threshold is lower; therefore, it increases the convenience to engage support-independent consumers in the network of know-how, even without getting any differential income because support-independent consumers would attend the MOOCs for free. To understand this result is useful the special study of the "N" and "*non*N" variables. The involvement of support-independent consumers in the network

of know-how increases the value of higher education services, in fact these services will support a more common good. For this reason, support-oriented consumers are willing to pay more for these services, generating additional profits.

It can be concluded that, when the number of support-independent consumers become high, the university management can no longer ignore them, indeed university managers are interested in involving support independent users in the know-how network.

Remarks:

The threshold just obtained can also be read as:

$$\frac{m}{n} > \frac{1}{R} \quad \rightarrow \quad mN > n \qquad (41)$$

This means that, to be profitable to implement a MOOC platform, the differential value of the support services, produced by the involvement of support-independent consumers, needs to be higher than the network effect produced by the involvement of only the support-oriented consumers.

STEP 2: Inclusive policy vs MOOCs

Now we will try to understand when university have to switch from MOOCs to an inclusive policy with lower fees designed specifically to involve support-independent consumers in traditional courses:

$$\pi_{IP} > \pi_M \qquad (42)$$

$$(n+m)^2 > n[(n+m)N + nonN)] - C \qquad (43)$$

$$n^2 + m^2 + 2\,n\,m > n^2N + n\,m\,N + nonN\,n - C \qquad (44)$$

$$m^2 + nm(2-N) + (n^2 - n^2N - nonN\ n + C) > 0 \quad (45)$$

$$\frac{m^2}{n^2} + \frac{m}{n}(2-N) + \frac{n^2 - n^2N - nonN\ n + C}{n^2} > 0 \quad (46)$$

$$k^2 + k(2-N) + \left(1 - R - \frac{nonN}{n} + \frac{C}{n^2}\right) > 0 \quad (47)$$

$$Hp: n \gg nonN \quad therefore \quad \frac{nonN}{n} \to 0 \quad (48)$$

$$Hp: n^2 \gg C \quad therefore \quad \frac{C}{n^2} \to 0 \quad (49)$$

$$k^2 + k(2-N) + (1-N) > 0 \quad (50)$$

$$k_{1,2} = \frac{N - 2 \pm \sqrt{4 + N^2 - 4N - 4 + 4N}}{2} = \frac{N - 2 \pm N}{2} \quad (51)$$

$$k < -1 \quad \vee \quad k > N - 1 \quad (52)$$

Given that k is the ratio between two positive quantities:

$$k > 0 \quad (53)$$

$$k > N - 1 \quad (54)$$

$$m > nN - n \quad (55)$$

In this scenario, support-independent consumers grow further, thanks also to the MOOCs platform that involves them in the network of know-how without paying. However, when support-independent consumers exceed the differential value provided by network support services [$m > N\ n\ n$], it is time to change strategy. In this situation, support-independent consumers become so relevant that university management have to set a price tailored to their availability, in order to get them registered.

In this decision, support services play a reverse role than before, in fact, the enlargement of the network thanks to the MOOCs platform, increased the willingness to pay of support-oriented consumers for support services. Therefore, if "N" grows, also the willingness to pay of support-oriented

consumers will grow. For this reason, there will be a change in strategy only if the number of support-independent consumers will become as great as to force a switch from a margins-based price policy to quantity-based one.

4.4. Decision pattern

Thanks to the thresholds just obtained, we can compose a complete pattern of alternatives that support the decisions of the executive. The university management will have a tool that allows them to quickly assess the value of a strategy in relation of the involved variables.

Below are summarized the thresholds obtained in the previous chapter:

$$For \qquad m > \frac{n}{N} \qquad \pi_M > \pi_P \qquad (56)$$

$$For \qquad m > n\,N - n \qquad \pi_{IP} > \pi_M \qquad (57)$$

In order provide an overall view; the data are synthesized into the table below:

Threshold	Decision
$m < \frac{n}{N}$	Protectionism
$\frac{n}{N} < m < N\,n - n$	MOOCs
$m > N\,n - n$	Inclusive policy

Table 2.1. Decision matrix

5. Conclusions and limitations

Educational resources distributed via the Internet are proliferating rapidly. These new resources include lecture videos, online teaching notes, Internet chat groups, online interactive problem sets with instantaneous feedback/grading, educational games, and many other developing technologies. Numerous institutions have created fully autonomous software that grades student essays. In the press, MOOCs (massive open online courses) have received the most rumours (Acemoglu et al., 2014). MOOCs are characterized by open enrolment, online assessments, forums in which students interact, and students assessing one another's work through crowd-sourcing, but the social value of these courses is yet unproven and the high dropout rates (in excess of 90 percent) have been fodder for much debate (Hoxby, 2014). Observing the data collected by an economical study on 4,600 students attending a MOOC course, there is over 50 percent male participants, coming from 194 countries. There is an approximately equal proportion of men and women. The mean age was 30 years old. The students came from a relatively advantaged background: 99 percent had computers at home (this reflects the fact that the classes are mainly taken at home, not in a college or school environment or computer labs) and 87 percent had more than 25 books. Ninety-eight percent of students had a high school degree or higher, 82 percent had a bachelor's degree or higher, and over 75 percent had parents who have completed at least some college (Banerjee & Duflo, 2014). The characteristics of these data led us to divide the consumers of know-how in two categories: "support-oriented" and "support-independent". Using these categories, we have modelled the dynamics that drive consumers to the acquisition of know-how (in the sense of basic skills to interact in the workplace). We have studied the phenomenon of MOOCs from the perspective of university management and we have observed that the introduction of MOOCs in the university system is part of a coherent strategy to the context in which it is applied. The model just described aims at providing a first

tentative framework to describe dynamics still in progress and predict possible developments, consequently it faces contexts not completely defined yet. For these reasons, it has some limitations that are listed below:

1. Support services

The “N” and “nonN” variables represent the additional services offered by the university to every enrolled member. During the discussion, we have tried to describe the contents of these variables with appropriate examples but, for a more detailed characterization, they deserve a separate discussion because they involve other factors that would divert from the primary objectives of the model.

2. Kinds of knowledge

In this model, firms are interpreted as *Knowledge Company* (Mintzberg, 1983; Peteraf, 1993; Schön, 1993), i.e. as a "system that knows" (Spender, 1996).

Consumers of this model aim for a knowledge of basic skills. They seek the knowledge to aspire and fit in a particular workplace. The model does not take into account all factors such as inventiveness, adaptability and reading of situations. These factors are unique to the individual, and the less common they are, the more their value increases.

Furthermore, the presented model should not be intended as a comprehensive decisional algorithm. Several variables are missing and should be considered when a HEI decides to start up a MOOC (e.g. spill over effects).

The university can choose between three different ways of approaching the market of know-how. The first approach is a protectionist strategy that mainly targets traditional consumers (support-oriented), they are high school students who are in need for support services that can be obtained only with the university enrolment. The second approach sets a first opening to the category of consumers indifferent to the support services provided by the university (support-independent). In order to reach support-independent

consumers, university builds a MOOCs platform. This strategy aims at enlarging the network of know-how in order to increase the value of the support services and, consequently, the willingness to pay of traditional consumers to obtain them. The final approach brings up the category of support-independent consumers. These consumers became so relevant that university management may be interested in designing pricing tailored to their availability, in order to get them registered. The willingness to pay of these support-independent consumers is certainly less than the traditional ones, therefore the price charged will be lower but turned to a much broader market. In this way, university shifts from a margins-based price policy to quantity-based one.

The economic crisis and the historical circumstances have led to a downward trend in registrations forcing universities to also pay attention to the other category of consumers, in the model called "support-independent". This category includes non-graduates and professionals who, for economic or logistic reasons, cannot attend classes but still want to improve their knowledge. To meet these needs, in recent years many Italian universities have begun to enter MOOC courses within their curriculum.

Looking further afield, we can hypothesize that, in a few years MOOCs will become commodities. Meanwhile, MOOCs have distributed knowledge to many people, increasing the whole number of support-independent consumers. The rise of support-independent consumers will force universities to rethink its strategies. At this time, support-independent consumers are so many (also because of the aging society) that it might be appropriate to set a price tailored to their availability, in order to get them registered. This is a futuristic scenario, the result of assumptions and simplifications of real contexts but that allows understanding how the phenomenon of MOOCs could be only a transition period, a necessary step to give new impetus to the university system fully integrated with these possibilities.

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Appendix

Inclusive policy vs protectionism

It is calculated below the threshold of support-independent consumers needed to switch to an inclusive strategy without the extra step of MOOCs platform.

$$\pi_{IP} > \pi_P \tag{58}$$

$$(n+m)^2 > n^2(1+N) + nonN\ n \tag{59}$$

$$n^2 + m^2 + 2nm > n^2 + n^2N + nonN\ n \tag{60}$$

$$m^2 + 2mn - n^2R - nonN\ n > 0 \tag{61}$$

$$\frac{m^2}{n^2} + 2\frac{m}{n} - N - \frac{nonN}{n} > 0 \tag{62}$$

$$k^2 + 2k - \left(N + \frac{nonN}{n}\right) > 0 \tag{63}$$

$$k_{1,2} = \frac{-2 \pm \sqrt{4 + 4(\frac{nonN}{n} + N)}}{2} = \frac{-2 \pm \sqrt{4(1 + \frac{nonN}{n} + N)}}{2} = \frac{-2 \pm 2\sqrt{1 + \frac{nonN}{n} + N}}{2} \tag{64}$$

$$= -1 \pm \sqrt{1 + \frac{nonN}{n} + N} \tag{65}$$

$$Hp: n \gg N \quad therefore \quad \frac{nonN}{n} \to 0 \tag{66}$$

$$= -1 \pm \sqrt{1+N} \tag{67}$$

$$k < -1 - \sqrt{1+N} \ \vee \ k > -1 + \sqrt{1+N} \tag{68}$$

k is a relationship between two positive quantities, therefore:

$$k > 0 \tag{69}$$

$$k > -1 + \sqrt{1 + N} \tag{70}$$

$$m > n(-1 + \sqrt{1 + N}) \tag{71}$$

This result is consistent, in fact, to change from a scenario of protection to one of inclusion, without the intermediate step of MOOCs, it is necessary that the independent population exceed a higher threshold than the one that must be overcome to move from MOOCs to inclusion.

Annex 3.
THE FINANCIAL DETERMINANTS OF INNOVATION IN EUROPEAN HIGHER EDUCATION INSTITUTIONS AND UNIVERSITIES[1]

1. Introduction

Together with the important states' disinvestments that globally have struck higher education systems in the last decade, HEIs have been obliged to re-think their business model as to find further financial resources and ensure their survivability. In the US context, HEIs have faced severe cuts. In 2015 the States were spending 20% less per student than in 2008 (Mitchell & Leachman, 2015). Oversea, in Europe, there have been significant changes in the funding mechanisms. Since the start of the crisis, some countries introduced budget cuts (from less than 5% in the Czech Republic, Poland, Croatia, Serbia and Macedonia. Up to 10% in Estonia, Ireland, Lithuania and Romania, while Italy expects cuts of 20%, Greece of 30% and Latvia of 48%. Estermann & Pruvot, 2011). Up to 13 higher education systems could rely on lower public funding than in 2008 (Claeys-Kulik & Estermann, 2015). In this regard, universities have increasingly competed to attract more students, both at a bachelor and master level (Cattaneo et al., 2016, Pucciarelli & Kaplan, 2016; Altbach, 2015), as to rely on more tuition fees.

In the wake of this structural transformation of the HE sector, universities have started to innovate and reinvent their service to students by introducing

[1] An extended abstract of this chapter co-authored with Stefano Paleari has been presented at the conference "CHER 2016, 29th Annual Conference, The University as a Critical Institution?" at Queens' College (University of Cambridge, UK) the 6th September 2016. I am responsible for all the changes in this chapter with respect to extended abstract presented.

(since 2008 at the University of Manitoba) massive open online courses (MOOCs), which have been also implemented for an economic purpose (Hollands & Tirthali, 2014). Indeed, along with the opportunity to attract more students and increase the institutional reputation in the eyes of competitors, MOOCs also provide but also collect additional revenues and also help universities to improve learning outcomes thanks to new pedagogical innovations (Belleflamme & Jacqmin, 2015).

Notwithstanding MOOCs have become highly popular in the last years (Economist, 2015; Pappano, 2012) up to involved an increasingly mass of students at a global level: more than 35 million people have enrolled in online courses since 2012, and 2015 enrolments doubled from 2014 (Bersin, 2016), an investigation of which type of universities have relied on this practise is still missing in the literature. In the difficult and uncertain economic era of today, it appears highly essential to understand the determinants for universities to open a MOOC as the crucial trigger to improve their degree of innovation as a whole in the medium term, and in particular to understand whether underfinanced universities are more prone to rely on this innovative tool to deliver education. An empirical investigation of which HEIs implemented this practice is largely missing in the scientific literature.

For this purpose, we focus on the population of European universities in 2012 to investigate whether more market-oriented universities, defined as those relying more on tuition fees relative to their budget, have a higher propensity to introduce MOOCs. Europe is an interesting framework where to investigate the impact of universities' business model on the opening of new MOOCs as there is an ecosystem of different HEIs which are relying on different legislative frameworks, especially regarding their funding mechanisms, depending on the state and in some cases on the region where these institutions are based. Our findings document that financial resources play a role in the HEIs capacity to innovate. Universities are more prone to introduce MOOCs when they are more dependent on tuition fees and when

their business model is more market oriented, especially for those universities that are ranked in the ARWU. Also HEIs that have less financial resources are more prone in introducing MOOCs, confirming the perception of cost efficiency that accompanies the MOOCs literature.

This paper is organized as follow. In the following section, we are presenting the conceptual background, section 3 is dedicated to the development of the testable hypotheses. Section 4 describes the research design. 5 shows the results. Section 6 concludes.

2. Conceptual background

Researchers began investigating innovation in the services sector in the mid-1990s. Johne and Storey (1997) define innovation in services as the variations occurring in the distribution of the product or add-on services improving the service experience for the customer. In this sense, according to Browne et al. (1998) who see the students as customers of HEIs, innovation in HEIs lies in the development of new activities carried out for the improvement of the students' experience in teaching activities.

The lack of previous research is due in part to the collection of data that come from the absence of appropriate available indicators for measuring innovation activities in teaching. However, we found evidence on how several environmental factors influence the adoption of innovation (Kuznets, 1962; Utterback, 1994). The degree of competition matters because of the need to transform new ideas into new products more effectively than competitors. Second, financial resources influence innovation because capital availability allows an HEI to adopt an innovation, investing for the development of the new course before the release. In this sense, the activation of MOOC platforms has been recognized as the beginning of a new university business model with strong economic implications (Yuan et al., 2013).

The emergence of MOOCs is not only a source of pressure on traditional HEIs, but it also offers opportunities for those universities able to change and develop new strategies, as setting up new departments to explore new educational approaches or explore new student's markets (Yuan et al., 2013). According to Gaebel (2014), making a MOOC can be quite expensive, as it usually requires a large production team. Their primary income sources come from the certifications. Another income source would be to sell courses to other HEIs, in order to lower costs or to make their study programmes more attractive.

In the interviews conducted by Hollands & Tirthali (2014) emerged the institutional goals for developing and delivering or using MOOCs in HEIs: 1) extending reach and access, 2) building and maintaining brand, 3) improving economics, 4) improving educational outcomes, 5) innovation, 6) research on teaching and learning. Universities only value indirectly from developing MOOCs (Belleflamme & Jacqmin 2015).

MOOCs have the clear purpose not only to provide more learning opportunities, but also to improve learning experiences (Gaebel, 2013). HEIs all over the world are mostly exploring MOOCs to understand how learning and teaching environments are changing. MOOCs are an improvement on non-interactive courses (Hoxby, 2014). However, despite their aim to change the learning environment and overall democratize knowledge, their effectiveness in students' learning is still much debated and results on the users are not comforting (Banerjee & Duflo, 2014).

A large consensus nowadays exists on the fact that MOOCs are a mean to innovate tertiary teaching (Kop et al., 2011; Kop & Carroll, 2011; McAuley et al., 2010; Rodriguez, 2012; Vihavainen et al., 2012) also from the financial point of view (Anderson & McGreal, 2012). Understanding the financial determinants for HEIs to open a MOOC can also explain how funding mechanism can be the financial trigger to improve the degree of innovation of HEIs in general. In the literature, there are no empirical assessments

analysing the determinants of university innovation, especially about the introduction of MOOCs or blended learning.

3. Testable hypotheses

This paper investigates what are the financial determinants of introducing MOOCs in European universities, analysing whether the probability of a HEI to implement MOOCs is significantly influenced by 1) higher level of student fees, (2a) higher market orientation, (2b) higher market orientation for reputable universities, (3) and higher cost efficiency.

3.1 Level of student fees

Everything being equal, universities with higher fees are supposed to be more prone to implement MOOC activities. Higher level of students' fees would indeed mean additional financial resources that can be used to increase the visibility of the university at a national and international level by implementing innovative tools. Additionally, the implementation of such a strategy is less influenced by the level of autonomy that governments leave to single institutions. Indeed, set a MOOC is not a decision that involves the Ministry, but it is taken a university level.

Hypothesis 1: Higher levels of student fees increases the probability to produce MOOCs.

3.2 Market orientation

Universities relying more on students' fees on their budget are supposed to be more active on the market by implementing innovative activities as to attract new financial resources (i.e., paying students). In this regard, MOOCs represent an important tool to increase universities' visibility as thus easy their access to the market arena. Not implementing an innovative tool like a

MOOC would signal a scarce ability in the eyes of external stakeholders, and mainly towards students and their families.

Along with the recent financial crisis families have experienced significant financial difficulties that inevitably impacted their ability to afford and willingness to pay for students' post-secondary education (Long, 2013). Reduced income has gradually decreased households' ability to provide youths with a higher level of education, primarily because of the impossibility to support the costs of education or the expectation of future unemployment (e.g., Riphahn, 2002). As a consequence, the choice of a university is more selective due to the greater financial constraints they face and the external employment conditions of the market, with the primary aim of increasing the relative advantage their children will enjoy in the future. Being equipped, also from a technological point of view, is therefore positively valued on the market. This condition might find greater strength for those universities that have higher reputation in terms of ranking, indeed many authors point out the effect of marketing and branding when implementing a MOOC, especially for elite universities (Yuan & Powell, 2013; Gaebel, 2014; Zemsky, 2014)

Hypothesis 2a: More market-oriented universities are more likely to set MOOCs.

Hypothesis 2b: More market-oriented universities are more likely to set MOOCs, especially if they are ranked.

3.3 Revenues

It is well established that MOOCs are cheaper due to economies of scale (Anderson & McGreal, 2012). But it must be taken into account also the fact that the few extraordinary charismatic MOOC "stars" will ultimately need to be paid like stars (Hoxby, 2014). This last economical treatment appears to be more likely in the American HES, while in non Anglo-Saxon countries the bargain power of professor is fewer or inexistent. Because of this, in the European system, allegedly MOOCs are seen as an efficient way to deliver

lectures. We expect that universities with less economical resources are more prone to introduce MOOCs in their educational offer.

Hypothesis 3: Universities with lower overall budget are more prone to introduce MOOCs.

4. Research design

4.1 Sample and data

To test our set of hypotheses, we consider a unique dataset of European HEIs listed in the ETER (European Tertiary Education Register) database, considering their MOOCs activity as provided by the European MOOCs database.

The rationale for using a European dataset is the ecosystem of different HEIs which are relying on different legislative frameworks, especially regarding their funding mechanism, depending on the state and in some cases on the region where these institutions are based.

ETER is a database of HEIs in Europe, currently including 36 countries and 2,673 HEIs. These institutions are mainly divided in three categories: universities, universities of applied sciences (UAS) and other institutions, those observations referring to the latter have been dropped because they are non-active in the MOOCs market and are not our object of analysis. Since we are investigating the financial determinants we dropped also those HEIs that are not providing data on their core budget, tuition fees and total revenues. Among these 498 HEIs we have performed a series of tests in order to verify the presence of sample selection issues. For the variables used in the model there is no difference between these two samples.

We rely on the European MOOCs database[8] to collect data on HEIs MOOCs activity. We collect a total number of 58 HEIs involved in MOOCs in our final sample of 498 HEIs providing financial data.

We considered the year 2012 as a topic point in time, it was indeed considered by the New York Times in an article written by Laura Pappano "the year of MOOCs", when the MOOCs awareness burst out and universities started to decide whether to implement a MOOCs strategy or not. Given the time that it takes to plan, to find the resources, to produce and to deliver a MOOC, the 2012 data on university were matched with the MOOCs activity from 2012 to 2016 according to the European MOOCs database.

Table 3.1 describes the sample by the variables used to perform the analysis. Since 2012 to 2016, 11.6% (58) HEIs implemented MOOCs. Private institutions are 21.3% (106), and 47.8% (238) are universities of applied sciences. Among these 498 HEIs, the 15.7% (78) appear in the Academic Ranking of World Universities (ARWU) and the highest position is the 23rd of the Federal Institute of Technology Zurich. The average size is 11,049 students, the smallest Institution is the Theological University Apeldoorn (88 students), the biggest is the University of Hagen (76,827students). The oldest university is the university of Heidelberg University founded in 1386.

Table 3.2 reports the statistics of the 15 HEIs most involved in MOOCs among the sample. The most active are public universities: Federal Institute of Technology Lausanne, Delft University of Technology, University of Copenhagen, Leiden University and the University of Geneva. The Federal Institute of Technology Lausanne is offering 72 MOOCs, and 6 more are planned to be produced; 33 are delivered in English language and they are more focused on science and technology.

[8] http://www.openeducationeuropa.eu/

4.2 Methodology

This work investigates at institutional level whether the (1) dependence on student fees, (2) market oriented business model (also for those ranked in the ARWU ranking), (3) revenues have a positive impact on the probability of developing MOOCs.

We performed a probit regression (see equation 01) where the dependent variable is a dummy variable that indicates if the institution has introduced MOOCs, for the whole HEIs sample and only for the universities. We controlled for ownership (public/private), age, ranking, faculty students ratio and PhD intensity of the institutions. In order to do so, we identified a set of control variables listed in tab 3.3.

$$\text{MOOCs} = \alpha * \text{country effect} + \beta * \text{size} + \delta * \text{legal status} + \phi \text{ age} + \gamma \text{ ARWU} + \varphi * \text{faculty student ratio} + \kappa * \text{Ph.D. intensity} + \lambda * \text{student fees} \quad (1)$$

The core explanatory variables are defined as follows:

- **Student fees:** it represents the level of dependence of the HEI from the tuition fees paid by the students;
- **Total revenues:** it states the overall level of funding of a HEI and also its availability of resources to be invested, also in the innovation of the institution itself;
- **Market orientation** it represents the business model of the HEI, high values for those more market oriented.

According to the study of the literature we expect all these variables to influence positively the implementation of MOOCs.

5. Results

Regarding the set of hypotheses, the findings document that financial resources play a role in addressing the MOOCs' strategy, hence in the capacity to innovate of HEIs. Dependence from the tuition fees paid by the students is positive and significant in determining MOOCs activity. There is also evidence that the business model of HEIs, defined as the ratio between the total amount of tuition fees on the core budget, is a significant determinant. Moreover, market orientation is more influent in determining MOOCs activity for those universities who are ranked. More market oriented universities are more prone to implement a MOOC and also to increase the number of these courses in order to attract more students and, in turn, collect tuition fees. On the other hand, universities with more financial resources have adopted a more conservative approach, this meets also the literature that looks at MOOCs at a mean to improve the cost effectiveness of HEI (Anderson & McGreal 2012).

The model confirms that bigger universities that can take advantage of scale economies are more likely to be able to overcome technological entry barriers to set up a MOOC. Also those HEIs that have a higher faculty students ratio are more likely to innovate their teaching activities. Daniel (2012) points out how often is confused the university brand achieved in climbing rankings and its capacity to deliver effective teaching. Indeed, we found no evidence that ranking effects the MOOCs production.

6. Conclusions

MOOCs are seen as an innovative approach to teaching, for both quality and cost efficiency reasons. Understanding the financial determinants of MOOCs can explain also the financial determinants of innovative HEIs. Our findings document that financial resources play a role in the capacity to innovate of HEIs. The model performs better in the subsample composed by only universities, which innovate in order to pursue quality when their business model is more market oriented.

HEIs with higher fees and those with a more market oriented business model are more prone to implement a MOOC, the reason is to attract more students, especially international students to increase their revenues and reputation. MOOCs are indeed a mean to globally advertise teaching activities of the University.

Also resource scarcity plays a role in the process in innovation, universities with less financial disposal seek innovation in order to increase cost effectiveness. HE in Europe is going through a marketization process that sees also the reduction of the funds in both terms of state funding (Estermann et al. 2013) and fees, mostly due to demographic reasons (Nazaré 2012).

This will drive a process of innovation of HEI, especially for universities, who will have to face scarcity of resources and marketization. Their capacity to break barriers of space and time will be fundamental for their survival and so the shape of universities and HEIs in general will deeply change in the next years.

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Tables

Table 3.1	Obs.	Mean	Std. Deviation	Min	NOME	Max	NOME
MOOCs	498	11.6%	0.321	0		1	
Legal Status (Private=1)	498	21.3%	0.410	0		1	
ARWU (%)	498	15.7%	0.364	0		1	
ARWU	78	230.75	132.48	23	Federal Institute of Technology Zurich	451	
Size	498	11067	11049	88	Theological University Apeldoorn	76,827	University of Hagen
Type (UAS=1)	498	47.8%	0.500	0		1	
Age (in 2015)	498	82	124.59	2	Brandenburg University of Technology Cottbus-Senftenberg*	629	Heidelberg University
Faculty-students ratio	498	8.3%	0.065	0.007	University of Hagen	0.658	Hannover Medical School (MHH)
Ph.D. intensity	498	4.0%	0.081	0		0.773	Hannover Medical School (MHH)
Student fees	498	1319	3274	0		56,634	European School of Management and Technology, Berlin
Total revenues	498	13947	19219	1161	University of Hagen	265,447	Hannover Medical School (MHH)
Market orientation	498	53.8%	1.903	0		17.51	Vilnius University

*Brandenburg University of Technology Cottbus-Senftenberg was born in 2013 out of a merger of the former BTU Cottbus and the Lausitz University of Applied Sciences

Table 3.2 Top 15 Universities in the sample for number of MOOCs	country	legal status	ARWU 2012	Number of MOOCs				Subject							
				Total	place	planned	in English	Applied sciences	Arts	Business	Humanities	Mathematics and statistics	Natural sciences	Science and technology	Social sciences
Federal Institute of Technology Lausanne	CH	public	101-150	78	72	6	33	13	2	1	2	12	2	46	0
Delft University of Technology	NL	public	201-300	39	32	7	39	13	0	5	0	4	15	2	0
University of Copenhagen	DK	public	44	28	26	2	26	3	5	0	14	0	3	0	3
Leiden University	NL	public	73	24	21	3	24	3	0	1	11	0	3	0	6
University of Geneva	CH	public	69	14	14	0	6	1	0	4	2	0	4	0	3
University of Amsterdam	NL	public	101-150	11	9	2	11	0	0	1	1	3	0	1	5
Federal Institute of Technology Zurich	CH	public	23	10	10	0	10	2	0	0	0	0	1	7	0
University of Groningen	NL	public	101-150	10	10	0	10	0	0	3	5	0	2	0	0
Pantheon-Assas University	FR	public	non ranked	8	8	0	0	0	0	1	1	0	0	0	6
Technical University of Denmark	DK	public	151-200	6	6	0	6	3	0	0	0	0	2	0	1
University of Zurich	CH	public	59	6	6	0	4	0	1	1	1	0	0	0	3
Copenhagen Business School	DK	public	non ranked	6	6	0	6	0	0	6	0	0	0	0	0
Pierre and Marie Curie University	FR	public	42	5	5	0	0	2	0	0	0	0	0	3	0
Eindhoven University of Technology	NL	public	301-400	5	4	1	4	5	0	0	0	0	0	0	0
University of Burgundy	FR	public	non ranked	4	4	0	0	1	0	0	0	0	0	3	0

Table 3.3 VARIABLES	Note
MOOCs	The variable is equal to 1 if the institution has activated a MOOC, 0 otherwise
Student fees	Logarithm of 1 plus the ratio of total income in student fees and number of students
Total revenues	Logarithm of the ratio between total revenues and the number of students
Market orientation	Logarithm of 1 plus the ratio between total income in student fees and total budget
Country fixed effects	A set of dummies for each country
Size	Logarithm of the total number of students (Ph.D. Excluded)
Type	0 stands for university, 1 for University of Applied Sciences
Legal status	0 if public, 1 if private institution
Age	Logarithm of 2015 minus the foundation year
ARWU	The variable is equal to 1 if the institution is ranked in ARWU, 0 if not ranked
Faculty-students ratio	The ratio of the Professors FTE over the number of students
Ph.D. intensity	The ratio of PhD graduates over undergraduate students

Table 3.4 VARIABLES	(1) MOOCs HEIs	(2) MOOCs HEIs	(3) MOOCs HEIs	(4) MOOCs Universities	(5) MOOCs Universities	(6) MOOCs Universities	(7) MOOCs Universities
Size	0.535*** (0.138)	0.535*** (0.142)	0.569*** (0.149)	0.752*** (0.266)	0.892*** (0.289)	0.980*** (0.299)	0.953*** (0.297)
Legal Status (Private=1)	-0.0889 (0.474)	-0.195 (0.487)	-0.539 (0.551)	0.331 (0.764)	0.237 (0.783)	0.195 (0.799)	0.236 (0.795)
Age	0.0306 (0.113)	0.0259 (0.115)	-0.00535 (0.117)	-0.0436 (0.159)	-0.0559 (0.163)	-0.0764 (0.171)	-0.0802 (0.170)
ARWU (Ranked=1)	0.199 (0.267)	0.106 (0.278)	0.0324 (0.278)	-0.0306 (0.344)	-0.206 (0.344)	-0.211 (0.348)	-0.354 (0.360)
Faculty student ratio	8.172*** (2.803)	12.22*** (4.370)	11.83*** (3.940)	9.597*** (3.489)	15.14*** (5.061)	16.22*** (5.113)	16.39*** (5.054)
Ph.D. intensity	-5.431* (2.870)	-3.921 (3.389)	-3.310 (3.011)	-5.909* (3.370)	-3.002 (4.359)	-3.285 (4.104)	-3.105 (4.137)
Student fees	54.43** (25.33)	90.23** (39.98)	71.66** (32.54)	51.19* (28.33)	101.5** (43.38)	89.19** (40.74)	88.24** (38.44)
Total revenues		-0.0223 (0.0150)	-0.0188* (0.0113)		-0.0275** (0.0136)	-0.0279** (0.0125)	-0.0285** (0.0119)
Market orientation			0.640** (0.326)			0.958** (0.475)	0.774 (0.535)
Market orientation * ARWU							1.625** (0.729)
Constant	-7.021*** (1.384)	-6.937*** (1.430)	-7.127*** (1.489)	-8.836*** (2.429)	-10.15*** (2.683)	-10.98*** (2.766)	-10.65*** (2.758)
Observations	380	380	380	161	161	161	161

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1