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Reforming higher education in Portugal in times of uncertainty: The importance of illities, as non-functional requirements

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ABSTRACT

This article shows that higher education reforms can create opportunities for higher education institutions (HEIs) to thrive under a legal umbrella that may reinforce their legitimacy, mandate, and contribution for societal development. This requires a profound consideration of illities affecting HEIs, including but not limited to affordability, accessibility, quality, capacity, adaptability and autonomy. The analysis, based on the Portuguese reform of higher education in the period 2006–2010, allows the identification of different policy implications in distinct orthogonal dimensions. Accessibility and affordability are found to be required to broaden the social basis of the "knowledge pyramid", while capacity and quality require policies oriented to pull-up the top of that pyramid. The need to foster effective institutional autonomy and integrity of modern higher education institutions is reinforced in a context where innovation must be considered together with competence building and advanced training of people to work in increasingly globalized economies and labour markets.

1. Introduction

It is well known that emerging regions worldwide are striving to develop at an unprecedented accelerated rate their higher education systems and institutions, HEIs (Willis, 2005; Sanyal and Johnstone, 2011; Horta et al., 2015). A common feature to this process is the need to guarantee sustainable growth with adequate resources (Schwartzman, 1996). Yet, the strategic planning of this process is known to be influenced by straightforward and simple, but potentially dangerous university rankings and similar quantitative indicators (Salmi and Saroyan, 2007). Specific contexts and local conditions for growth, as well as adequate determinants of institutional capacity are often minimized, even forgotten, in the design of public policies and institutional strategies (Marginson and Considine, 2000). Rather, Institutional strategies are influenced — frequently emulated — by policies and perceived practices from mature higher education systems, placing in jeopardy higher education systems and institutions themselves in emerging regions of the world (Yang, 2003).

It is in this fast changing and uncertain context that this article argues that *Illities* should be taken into greater account as relevant factors in modernizing and reforming higher education. Illities are non-functional requirements, including but not limited to accessibility, quality, sustainability, efficiency, flexibility, and capability. They are associated with modern technical solutions and depend on the way people, institutions, and the social environment interact with knowledge (De Weck et al., 2011). The understanding of illities is associated with holistic perspectives on the increasing complexity of our daily life and related technical, cultural, social and economic relations.

From the emerging technical literature about illities, lessons for higher education policies can be learned. Neufville and Scholtes (2011) have shown that projects can be improved by flexible designs that can facilitate adaptation to uncertainty. They argue that designers of complex, long-lasting projects — such as communication networks, power plants, or hospitals — but that could well be higher education institutions and systems, must learn to abandon fixed specifications and narrow forecasts. The authors stress the need to avoid the "flaw of averages," a conceptual pitfall that traps so many designs in underperformance. This is relevant to higher education because it stresses flexibility in the design of complex higher education policies, reforms, and in creating organizational models for HEIs. It applies to planning of higher education and its links with learning societies that are expected to increasingly rely on "distributed knowledge bases" maintained across an economically and/or socially integrated set of agents and institutions (Conceição et al. 2003).

Illities also matter for higher education because of the current context of perceived and real change. De Weck et al., (2011) argue that technical change, for much of the 20th century, was mainly about artefacts and inventions. Now, it is increasingly about complex systems and their perception. For example, the charging of a plug-in hybrid vehicle

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links transportation, the electricity grid, and social behaviours. Based on many other examples, the authors argue that today's large-scale, highly complex sociotechnical systems converge, interact, and depend on each other in ways that one could have barely have imagined before. As scale, scope, and complexity increase, technical and social issues are considered together in a highly integrated approach. Concurrently, flexible, adaptable, robust systems are designed to be easily modified and reconfigured to satisfy changing social, cultural, political, technical requirements and accommodate new technological opportunities. This is relevant for higher education because flexibility, adaptability, integration, and robustness of systems refer to improving the capacity to learn and adapt.

The potential revolution for learning that the "networked world" provides is the ability to create scalable environments for learning that engages the tacit and the explicit dimensions of knowledge. The term that Brown and Douglas (2010) have used for this, borrowed from Polanyi, is "indwelling". Understanding this notion requires to connect experience, embodiment, and learning. First, the world of the 21st century is characterized by a sense of constant change, which demands rethinking the notions of interaction with new knowledge towards a deeper understanding of participation (*knowing*). Second, the notion of experience (and participation) within new media contexts has shifted from a traditional sense of experiencing content to using content as context to construct a social world with others (*making*). Third, understanding the means by which networked media supports a kind of play that allows people to navigate the complexities of a constantly shifting world (*playing*).

What may be most important to understand is that each of these dimensions of learning is in the process of evolving in response to the demands of the 21st century (Thomas and Brown, 2011). In our societies, *knowing*, *making*, and *playing* emerge as critical components of "becoming". In relation to this, the development of modern capacity in higher education to foster learning by students requires training of a competent and flexible teaching body that can be easily adapted to satisfy changing contextual and learning requirements while making use of new technological opportunities (Bellanca and Brandt, 2010). Recent literature on the concept of illities suggests that learning how to manage uncertainty is necessary; this has also become of the main challenges facing higher education reform and future development. In this sense, illities represent a movement of "rupture", emphasizing forms of thinking and action that go beyond the immediate temporal frame, apparent functionality or success, and the constraint to fundament decisions solely on what is measurable (Rouse and Serban, 2014). Sticking to what is measurable in higher education may limit choice and the potential for sustainable growth (as criticisms to university rankings and other quantitative indicators suggest; see Hazelkorn, 2011).

Inspired and conditioned by a myriad of global, national and local challenges that implicitly or explicitly rely on science and higher education for potential solutions, HEIs are required to be both increasingly adaptable and resilient (two important illities). Thus, higher education systems and institutions have to consider accommodating new configurations of knowledge production by establishing alliances with an increasingly large range of "knowledgeable" institutions (Nowotny et al., 2001). Moreover, they require to secure a sufficiently stable environment to train and supply talented people, including researchers, for that growing range of "knowledgeable" institutions (Peters et al., 2009). This leads to the need, more relevant than ever, for public policies promoting effective institutional autonomy and integrity of modern HEIs (Shapiro, 2005), that integrate higher education and science polices (Heitor and Horta, 2012). This is particularly relevant as partnerships among HEIs and scientific institutions worldwide, as well as between them and industry, gain significant prominence (Sidhu et al., 2011).

Additionally, HEIs are increasingly pressed to fulfil several societal roles. They continue to be repositories of knowledge, identity, and culture (King, 2004) and still represent beacons of creativity, where talent is assembled, and the discussion of ideas nurtured to foster the creation of new knowledge (MacLaren, 2012). In on-going processes of institutional change threatened by corporate-like reforms and neoliberal thinking, HEIs contribute decisively to democratic processes, support policy decision-making, and garner societal trust (Kwiek, 2005; Giroux, 2002). They have an unmistakably civic role strongly rooted in the public sphere and in providing public goods (Culum, 2014). A clear example of this is that HEIs continue to strive towards the socialization and education of students of diverse social, ethnic, cultural and socio-economic backgrounds to become citizens of both their nations and of the world (Denson and Bowman, 2013; Banks, 2008). As increasingly global actors, they promote knowledge flows and train national and international students (Horta, 2009), while embedded in local and community development (Lebeau and Bennion, 2014). Concurrently, they drive economic change through several initiatives, including the promotion of technological development in firms through employment of graduates, the creation of new firms and university-industry relationships (Baptista et al., 2011).

The societal roles of HEIs continue to rest — or to a large extent associated with — two basic social functions that depend on their relative institutional stability (Altbach et al., 2009), which per se is a major illity to be considered in higher education policies. Among the most essential roles of HEIs, is the supply and training of talented people. Increasingly, this is one of the most essential contributions that HEIs are expected to make (Harkavy, 2006), while remaining the most important incubator of the next generation of researchers. This requires effective "University–Science" relationships, because research-intensive environments are critical to train researchers. Another essential role of HEIs is the generation and promotion of "cultural norms" in both substantive and procedural terms (Nowotny et al., 2001; see also Walker, 2012), as it is associated to claims for the maintenance of a "culture of liberal rationality" (Nussbaum, 1997). In the 21st century, HEIs should promote the necessary institutional integrity to allow students to experience novel learning environments, evolving towards "living laboratories" to better educate youngsters towards a sustainable society (Shriberg and Harris, 2012; Conceição and Heitor, 1999). No other institutions are as well prepared as HEIs to undertake these tasks in modern societies (Barnett, 2012).

In the following sections these arguments are emphasized in terms of higher education policies in Portugal for the period 2006–2010, in a way that attempts to substantiate the reasons why the OECD considered them a success (MCTES, 2011). These sections are preceded by a section focusing on the research framework. The article concludes with a brief outline of lessons learned from Portugal with relevance to emerging regions worldwide.

2. Research framework

This article contributes to reflect on the role that higher education and science policies, if adequately integrated, may play in further democratizing and promoting social-economic development through three complementary goals in association with increasing relevant illities shaping our society (the illities are identified in the parenthesis), as follows: i) opening access to the knowledge base through higher education (Affordability; Accessibility; Quality); ii) promoting advanced qualification of skilled people and strengthening research institutions through adequate consideration of human resources in technical change (Capacity; Resilience; Systems linkages); and iii) strengthening institutions and provide adequate relevance to institutional issues in the social construction of our knowledge base (Autonomy; Adaptability; Integrity).

Overall, this framework calls for a better understanding of diversity in higher education and the effective role played by science–higher education relationships, beyond the currently dominating policies of thinking science through short-term, demand-driven economic development issues (Heitor, 2008). The rational for our approach is related

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to the need to promote stable environments to train and supply talented people, including researchers for knowledge intensive, fast-paced, and uncertain labour markets. This gains particular relevance vis a vis the growing demand of higher education by populations perceiving private and social returns of education (Altbach et al., 2009).

For the purposes of this article, the Portuguese higher education reform in the period 2006–2010 is used as a case study to illustrate our main arguments. The ultimate goal is to derive lessons that may be of relevance for emerging and developing regions worldwide. The first reason justifying this approach is that several characteristics are common between Portugal and these regions, such as low degree of institutional autonomy, internationally recognized low levels of funding, and slowness to respond to societal demands. Societal challenges are also similar, although at different levels: need to increase the formal qualifications of the population, struggle to create a more robust knowledge base, and contribute to local and national socio-economic development (see Buckner, 2011; Sirat, 2010; Horta, 2010; Shin and Harman, 2009; Svenson, 2013; Vega-Jurado et al., 2008; Balán, 2006; Seddoh, 2003; Figueiredo-Cowen, 2002). The second reason to use the Portuguese higher education reform as a case study is that it was effectively introduced through governmental action following an international assessment exercise (OCDE, 2007; MCTES, 2011). Lessons from its conceptualization and implementation can be used as a reference to inspire change elsewhere.

The reform considered significant changes in the internal system of governance of HEIs (including the management structure and the participation of external actors in governing boards), and external relations (including internationalization, research partnerships and business links, external evaluation and accountability; Heitor, 2008). The process created opportunities to strengthen important *illities* in the higher education system: it increased the levels of *autonomy*, *affordability*, *accessibility*, *quality*, *capacity*, and *adaptability*. In discussing the reforms, the dynamic relationship between society, knowledge production, and the social construction of socio-technological systems is considered (Bijker et al., 1987; Klein and Kleinman, 2002). In particular, we underline the ideas that learning processes and the implementation of reforms need to be "context-sensitive", concurring with the ideas of Conceição and Heitor (2005) that they should also be pursued towards "inclusive learning" at an institutional level.

The choice of a case study as the methodological approach to this article follows similar studies in the literature (e.g., Dao, 2014; Dakowska, 2014). As a case study representing an empirical enquiry into a complex, social phenomenon that is contemporary, situated in a real-life setting, several sources of information were sought to sustain an analytically meaningful case (Yin, 2003). Therefore, the analysis is based on documental information from ministerial reports, international organizations evaluation reports (e.g., OECD), Decree-laws and other legislation, national and international official statistics, and relevant information from HEIs websites. The official statistics data sources originate from the statistics office of the Ministry of Science, Technology and Higher Education (DGEEC), the Portuguese Science and Technology Foundation (FCT), the Higher Education Evaluation and Accreditation Agency (A3ES), Organization for Economic Co-operation and Development (OECD), and Eurostat. These data sources are aligned with those used in existing studies analysing higher education reforms (see Gornitzka et al., 2005).

3. Facts and data analysis: the process of reforming higher education in Portugal, 2006–2010

The reform process described in this article started in 2005 through an international assessment of the higher education system and its institutions, involving the Organization for Economic Co-operation and Development (OECD), the European Network for Quality Assurance (ENQA) and the European University Association (EUA). By the end of 2006 the OECD presented an overall assessment of higher education, and ENQA the results of an evaluation of the system of quality assurance and accreditation practices in higher education. These reports guided the reform for the following years (OECD, 2007; ENQA, 2006), while a voluntary programme of institutional assessment was conducted by the EUA, upon request of Portuguese HEIs to identify current and future challenges, and the strategies that they could use to meet those challenges. As these processes were concluded, the higher education reform, as framed in this article, considered three main broad set of policy instruments, which we describe in the following paragraphs according to corresponding illities (Table 1).

Table 1
Higher education reform instruments, goals and main illities for Portugal (2006–2010).

Reform instruments	Main goals	Illities addressed
Reforming degrees and promote accreditation through quality assessments	Fostering students' autonomy through access and mobility, and promoting degree accreditation based on independent quality evaluations	Affordability; accessibility; quality
Reforming the institutions legal framework	Promoting institutional autonomy and flexibility	Autonomy; adaptability; integrity;
Promoting a framework fostering public expenditure on R&D	Building capacity, strengthening knowledge institutions, stimulating internationalization and university-science-industry relationships	Capacity; resilience; systems linkages

4. Reforming degrees and promote accreditation through quality assessments

Our analysis starts with main reform elements oriented towards fostering students' autonomy through access and mobility, and promoting institutional integrity through independent evaluations. This has been implemented making use of the opportunity arisen in Europe through the Bologna process. The legal basis for its implementation in Portugal started with an Act amending the Basic Law of the Education System, and specific regulations establishing the general principles for the organization of programmes, degrees and their accreditation. These established the transition rules for the reorganization of existing programmes and creating new ones (Decree-Law 74/2006), leading to the full institutional adaptation to Bologna, achieved in the academic year 2008/09 (MCTES, 2011).

In alignment with this process, new legislation regulated post-secondary education programmes, by Decree-Law 88/2006, denominated as *Technological Specialization Courses*. These aimed at increasing the availability of technical/vocational education and widening higher education access. This process brought a new dynamism to post-secondary education, in particular at polytechnic institutes. By 2010/11, 7177 students were enrolled in these programmes compared to 2253 in 2006/07, with 80% of them in the polytechnic system, thus promoting the binary character of the higher education system and the institutional integrity of universities and polytechnics alike (Rossi, 2010; see also Teixeira et al., 2012).

Additional new legislation was passed towards opening the access of students to higher education, in particular for students aged over 23 and those meeting specific educational qualification criteria, thereby widening the recruitment pool for higher education and making it possible to reverse the decline in student numbers in higher education observed in the mid-2000s (Horta, 2010). An average of 10,000 new students per year have been enrolled in higher education through this type of mechanism since 2007/08, when in the 2005/06 academic year only 900 adults were enrolled.[1] Moreover, a new regime for access to *Medicine* degrees was created following international best-practices (Decree-

[1] See GPEARI website at: http://www.dgeec.mec.pt/np4/EstatVagasInsc/%7B$clientServletPath%7D/?newsId=120&fileName=Inscritos_Maiores23_2010_20111.xls.

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Law 40/2007). It was specifically designed to broaden access to medicine to those with a diploma in a related disciplinary field (e.g., biology). In association to increasing funding of student social support schemes and an innovative student loan scheme (see Heitor and Horta, 2013), these reforms contributed to further open higher education in Portugal. Fig. 1 show that it led to an increased participation in higher education particularly among the younger age cohorts.

The impact of public policies supporting increasing participation in higher education over twenty years is quantified in Fig. 2. It shows a strong linear relationship (fit) between expenditure on student social support and the number of students enrolled in the public higher education sector ($R^2 = 0.74$), as well as the equally strong positive correlation among them (Pearson's correlation coefficient: 0.85; $P < 0.01$). The increased participation in higher education driven by public policies is of utmost importance for the competitiveness of countries with workforce lacking formal qualifications such as Portugal, as qualified populations can better cope with the challenges of the global knowledge society (Robertson, 2005). However, the effects of these policies also decreased the rate of education early-leavers, which are known to be disruptive for the process of capacity building, while creating social and economic inequalities (Gonzalez, 2006). According to Eurostat data, the percentage of early leavers from education aged 18 to 24 years old in Portugal diminished from 39% in 2004 to 23% in 2011 (a time when that percentage was 13% in EU-27 countries; it was 16% in 2004).

The reform policies fostering student's participation and autonomy also encompassed flexible procedures for access and mobility between HEIs. The introduction of flexible procedures that promoted a wider access to higher education were done through changing an existing Law related to the basis of the educational system and funding of higher education (Law 49/2005), the introduction of a new legal regime for academic degrees (Decree-Laws 74/2006, 107/2008 and 230/2009), and the approval of a new legal regime for re-enrollment, transfer and change of courses (Ministerial Order 401/2007). These legal diplomas included the possibility for anyone interested to attend individual curricular units/courses to do it with a guarantee of certification and accreditation in the case of successful completion. Students of a given programme were granted the opportunity to attend curricular units/courses not included in their cycle of studies but provided in any national HEI. In the case of successful completion, certification and inclusion of this curricular unit in the diploma supplement was legally assured. These measures, among others, were designed to foster accessibility and flexibility, ensuring less bureaucratized procedures for student mobility, which depends on the recognition of prior learning and qualifications (Teichler, 2011).

The process also encouraged HEIs to be more adaptive and keen on student mobility. First, a new regulatory framework was introduced to facilitate the mobility of students among national HEIs, as well as with those abroad, based on the application of the European Credit Transfer and Accumulation System. Second, the implementation of the Ministerial Order 401/2007 for re-entering higher education, changing programmes, and transferring between HEIs removed the previously existing obstacles to re-entry for those who have interrupted their higher education studies at some point of their lives (an increasingly key issue for HEIs social mandate; see Hovdhaugen et al., 2013). Procedures for transfer or changing courses were also made possible to integrate students coming from both national and international HEIs. This enabled to extend admission limits and simplify admission and transferability procedures. Third, a new regime (including Decree-Laws 40/2007 and 341/2007, and Ministerial Order 29/2008) was implemented for the recognition of academic degrees awarded abroad in relation to equivalent degrees awarded by Portuguese HEIs. This new regime, based on the principle of reciprocal trust, facilitated the free circulation of diploma holders who wished to study in Portugal after obtaining their academic degree abroad. Moreover, students were granted the opportunity to attend programmes on a part-time basis (Decree-Law 107/2008).

In order to reinforce both institutional transparency and student autonomy, HEIs were asked to publish on their institutional websites the measures taken to adapt their courses to Bologna. This became a self-assessment exercise to the institutions, as demonstrated by the following quote from the report concerning the implementation of the Bologna Process of the Faculty of Law of University of Porto, "*These results show a positive evolution concerning the implementation of the Bologna Process in the Faculty of Law of the University of Porto. Despite the positive evolution, these results should not refrain us from reflecting and improving the existing education models*".[2]

Analyses on learning support services, student and faculty satisfaction, internationalization, and measures to promote student success and learning activities were carried out — in many cases for the first time — and made available publicly as a way to further open HEIs to society (e.g., GA/UBI, 2009). The relevance and continuity of these reports was reflected in several HEIs: "*This report focuses more on one of the features of the implementation of the Bologna Process, following a previous report which reflected more on the administrative facet of this implementation. In the next reports, it is hoped to further explain the ongoing implementation process and other changes of utmost importance, including the full use of the diploma supplement, the European scale of grading, and the preparation of a bilingual ETCS guide*".[3]

Finally, the Higher Education Evaluation and Accreditation Agency (A3ES) was created in 2009 as a private and independent foundation established outside the public apparel to ensure independent evaluation processes. It promoted internal systems of quality assurance throughout universities and polytechnics, completing the first cycle of the accreditation process by 2010. Among the main outcomes of this process was a significant reduction in the traditional proliferation of degree programmes.

5. Reforming the institutions legal framework

The reforms of the legal framework for higher education, and the higher education quality assessment system, were approved by Parliament in 2007. These reforms promoted institutional autonomy and flexibility. They brought about significant changes in the internal governance of HEIs, as well as in their relations with society (Magalhães and Santiago, 2012). The new legal regime of higher education institutions (Law 62/2007, known as "RJIES"), established the organizational principles of the higher education system. It redefined the autonomy and accountability of HEIs by establishing governing boards with external members, permitted the establishment of consortia recognizing research centres as part of the HEI management, and allowed for organizational diversity. An important feature of RJIES is that it gave HEIs the possibility to request an "independent legal status", keeping their public nature, but operating as "private foundations".

Granting independent legal status to HEIs is a mean of giving them greater autonomy (Hufner and Landfried, 2003). RJIES promoted this process by allowing public HEIs, on a voluntary basis, to become public foundations governed by private law (Hasan, 2007). A "university foundation" has typically four main defining features: i) it is an independent legal entity; ii) it has a mission to serve defined public interests in higher education and research; iii) it is a non-for-profit public interest legal entity, with favourable tax treatment on its incomes, assets and trading activities undertaken in the pursuit of its goals; and iv) it has the autonomy to raise funds and manage its assets in pursuit of the foundation's goals. In its more extensive form, it may grant the rights to: borrow and raise funds, own buildings, equipment and other

[2] University of Porto, Faculty of Law, Report concerning the implementation of the Bologna Process objectives, Academic year 2009–2010, (pp. 32); See University of Porto Website: file:///C:/Users/Hugo/Downloads/_Relatorio_Bolonha_2009-2010.pdf.

[3] Portalegre Polytechnic, Report concerning the implementation of the Bologna Process objectives, Academic year 2009–2010 (pp. 25), see: http://www.ipportalegre.pt/html1/1o%20polit%C3%A9cnico/9Processo%20de%20Bolonha%20no%20IPP.aspx.

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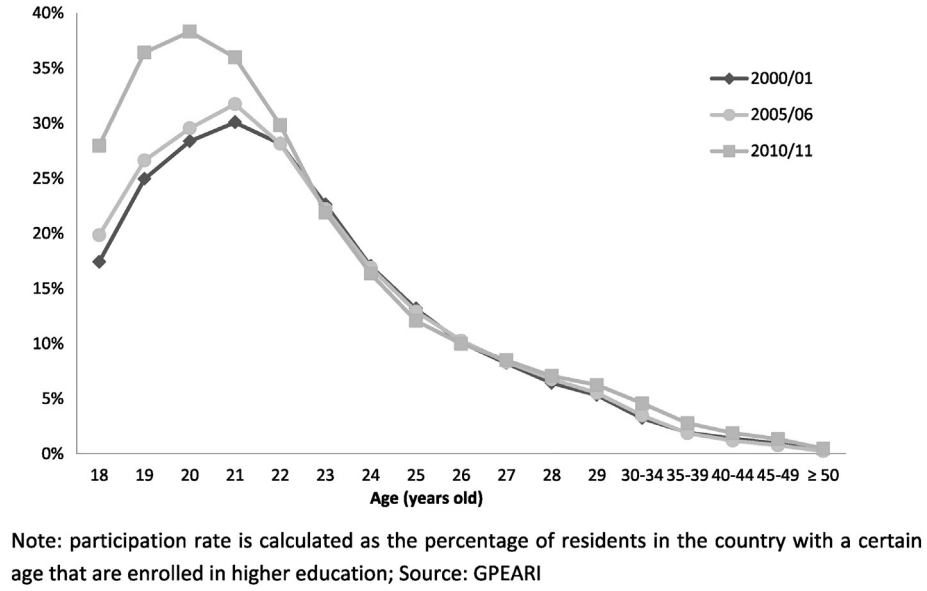

Fig. 1. Participation rate in higher education by age.

financial assets. It fully controls budgets to achieve objectives, sets internal administrative and management procedures, as well as academic courses and evaluation procedures. It consents to employ and dismiss staff, set salaries and reward systems, fix criteria and size of student enrolment and the level of tuition fees.

Foundations have a number of advantages (Walters, 2006). First, institutional leadership has the maximum autonomy to pursue strategic and operational goals with little external constraint. Second, institutional leadership can plan for the long term without being subjected to changes in the government's budgetary policies. Third, there are new opportunities for generating additional resources. Fourth, the strategic influence wielded by the curators regarding the establishment of institutional and research agendas can lead to closer collaboration with external stakeholders in the university. Finally, accountability is placed on the shoulders of those in whom responsibility rests.

Yet, there are also a number of potential shortcomings. International experiences with the development of foundations suggest a number of challenges, mainly those associated with lack of managerial skills to run them (Huisman, 2006). In addition, staff might see the transition from the status of public servant to institutional employee as fraught with uncertainties. Concern about the viability of foundations persists, such as, insufficient size to permit economies of scale to be made and explored. Still, the expectation remains that HEIs which opted to be public foundations would become more flexible, more adaptable to the demands of society and more alert to the structural problems that could affect their scholarly activities (Gonçalves, 2011). By the end of 2009, three Portuguese universities had acquired this status: i) the University of Porto, the largest Portuguese public university, with about 30,000 students; ii) the University of Aveiro, a middle-size public university, with about 13,000 students; and iii) ISCTE — Lisbon University

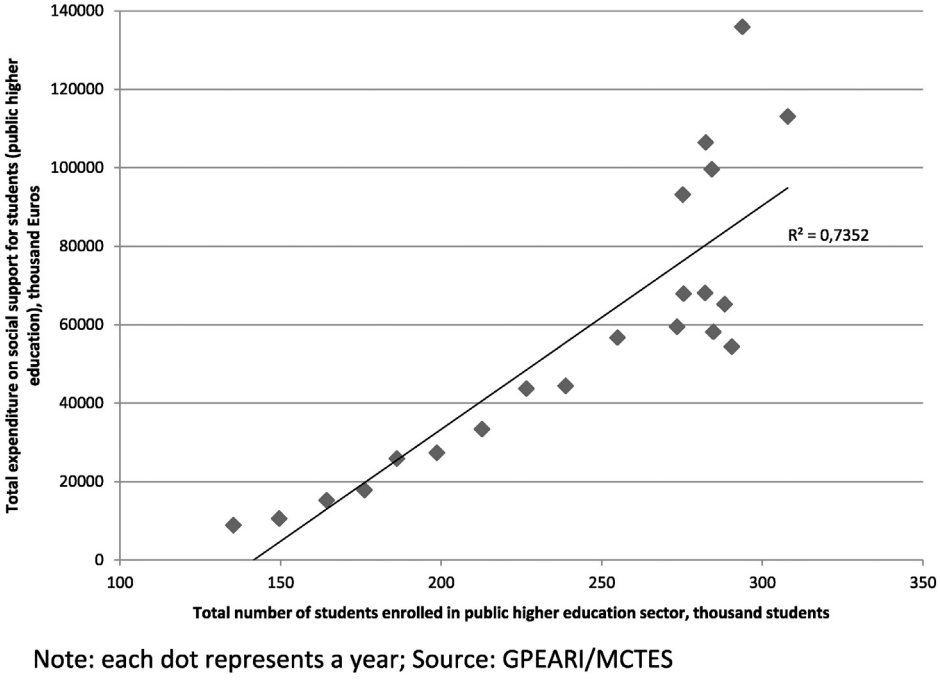

Fig. 2. Relation between expenditure on social support for students and the number of students enrolled in higher education, public higher education sector, 1991–2011.

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Institute, a small public university, with about 6000 students. Other universities have applied to get similar status since 2009. The analysis of Santos (2015) presented the case of the flexibility introduced in the system through the foundational regime and its benefits, even though the level of flexibility has been affected and reduced by other legal instruments, including the Annual State Budget Law (see Barrias, 2014).

6. Promoting a framework fostering public expenditure on R&D

The reform elements fostering capacity of higher education were based on strengthening the investment in knowledge, promoting institutional integrity and stimulating university–science–industry relationships (e.g., Rodrigues and Heitor, 2015). This has been achieved in the period considered through a large effort in public expenditure on research, supported by long-established international assessments of research and development (R&D) activities at a national level (Heitor and Horta, 2013). International research assessment exercises were upheld regularly scrutinizing the output of scientific institutions, and aimed at increasing "critical masses" by creating job openings in science and academia (Hicks, 2012). A related priority was placed on setting-up international partnerships to foster scientific networks, industry–university partnerships, and on strengthening the bonds between graduate education and research (Pfotenhauer et al., 2013; Heitor, 2014).

The systematic increase in public expenditure generated spillovers in academia and business communities. The period under analysis was characterized by two distinct, but inter-related trends: first, a remarkable increase in business expenditure on R&D, rising from 425 million Euros in 2005 to about 1300 million Euros in 2010, and university-industry collaborations (OECD, 2011). The second trend involved a marked increase in academia's knowledge-based capacity, which saw the number of PhD, and post-doctoral fellowships rise by more than twofold.[4] This analysis of public R&D expenditure can be better documented through the programmes executed by the Portuguese Science and Technology Foundation (FCT), the main R&D funding agency in Portugal. These programmes focused mainly on the advanced training of human resources and scientific employment, and institutional development of research units, their internationalization and networking.

The advanced training of human resources focused on a competitive programme of PhD fellowships, which has been considerably enlarged since 2006 to about 2000 new fellowships per year (it was about 1000/year in 2005).[5] It also includes a competitive postdoctoral fellowship programme. By the end of 2010, over 11,000 fellowships were actively funded (5000 in 2005), with an overall annual public expenditure of over 160 million Euros.[6] This programme has been the backbone base of the Portuguese science public policy for decades and continues to have a critical role in qualifying the higher education academia and promoting its internationalization (Fig. 3).

Scientific employment and the renewal of scientific and academic staff were further fostered through a new programme launched in 2007 to hire researchers on a competitive basis (five-year contracts), which involved about 1200 new contracts by Portuguese universities and research institutions by the end of 2010. More than 40% of these contracts were granted to foreigner researchers, with an overall public expenditure of over 67 million Euros, supporting further the internationalization of Portuguese academia (Patrício, 2010). This was interlinked with immigration policies fostering the entering of talented people to the country that removed obstacles to the free circulation of qualified people, independent of nationality, by avoiding bureaucratic impediments and delays that hitherto existed. According to the Ministry of Foreign Affairs, in 2010 alone, Portugal granted 648 visas for talented people of about 50 nationalities outside the European region, from only 156 when this reform was initiated in 2007.

Related to these policy instruments, funding competitive research activities has been achieved through the systematic opening of national competitions for funding R&D projects in all scientific areas. By the end of 2010, more than 4000 projects were active corresponding to an overall public expenditure of 85 million Euros, complemented by 90 million Euros to improve the scientific infrastructure from 2006 to 2010.[7] This was done in articulation with a continuous strengthening of the institutional integrity of university-based research institutions and the adoption of policy measures to foster and strengthen their international relations. These represent key elements in driving the reform of higher education in close interaction with fostering a greater academic research capacity, in the wake of a continuous process of institutional reform and building over the last fifteen years (Table 2).

In the period 1995–2005, institutional building of research organizations has been initially based on two main pillars. One refers to the research assessment exercises implemented since 1996 that strengthened the network of university research centres. The other refers to the creation of "Associate Laboratories", devised in 1999–2000 to promote critical mass and establish a network of relatively large research institutions oriented towards strategic lines of thrust and thematic networks. In 2010, 25 Associate Laboratories existed with an overall level of institutional funding of about 85 million Euros in 2010.[8]

Associate Laboratories have opened the way for advancing a culture of large scientific institutions in Portugal, grounded in institutional autonomy, sustained by the provision of incentives and stimulated by the continuous application of independent scientific evaluation (Veloso et al., 2015). They have facilitated the expansion of science-based jobs by recruiting doctorate researchers and technicians and grew more than 30% from 2005 to 2010, accounting 130 researchers on average (measure as Full Time Equivalent) per laboratory. The analysis of Veloso et al. (2015) shows that Associate Laboratories have been particularly important to foster autonomy and capacity of the research system, while suffering from a relative lack in overall coordination, and a weak relationship with the public administration, a challenge that remains to be fulfilled by the State.

Since 2005, the institutional building of research organizations and their integration in higher education was heightened by two major developments: the independent legal status in the form of "university foundations", as discussed before, and the formation of research and advanced training networks, though thematic international partnerships. The foundations have strengthened academic networks by bringing together universities, research units, associate laboratories and private, non-profit institutions. The thematic international partnerships fostered critical mass across the Portuguese research landscape in the form of relatively large consortia bringing together leading US universities, Portuguese universities, research centres, end-users, and businesses (Horta and Patrício, in press).

Strengthening the internationalization of higher education and academic research was recognized in the reform process as a way to stimulate the integration of national institutions in emerging scientific networks at an international level (Patrício, 2010). In this context, a unique set of international collaborations with leading institutions worldwide has been successfully developed in recent years based on thematic R&D networks, integrating advanced training initiatives and industrial affiliation programmes (Pfotenhauer et al., 2013).

In the scope of university-industry relations, a University Technology Enterprise Network (UTEN) was created, involving all Portuguese university-based technology transfer offices, other scientific institutions and science parks (Heitor and Bravo, 2010; Heitor, 2015). UTEN aimed at: (i) training a pool of professionals in the area of technology transfer and commercialization; (ii) promoting the institutional building of university-based offices of technology commercialization; and (iii) assisting business development and grant loft landing of university-

[4] See FCT website at: http://www.fct.pt/estatisticas/bolsas/index.phtml.pt.
[5] See FCT website at: http://www.fct.pt/images/stat/B6.gif.
[6] See FCT website at: http://www.fct.pt/images/stat/B4.gif.
[7] See FCT website at: http://www.fct.pt/estatisticas/projectos/index.phtml.pt.
[8] See FCT website at: http://www.fct.pt/estatisticas/unidades/index.phtml.pt#fet_la.

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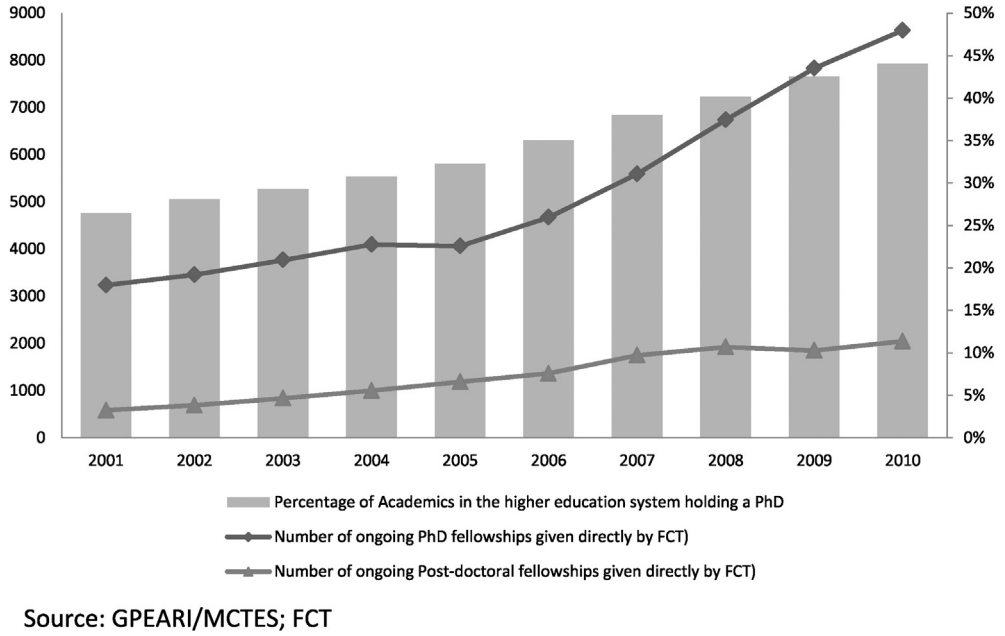

Fig. 3. On-going PhD and postdoctoral fellowships given directly by FCT and percentage of academic staff in higher education holding a PhD, 2001–2010.

based startups in international markets. It was launched in 2007 in partnership with the University of Texas at Austin, and later has extended its operations to the other strategic partnerships with the Massachusetts Institute of Technology (MIT), Carnegie Mellon University (CMU) and the Fraunhofer-Gesellschaft. The novelty of the approach in Portugal is that it focused on the process of building a system of competence building driving innovation and the diffusion of knowledge through the economic appropriation of the results and methods of science by society oriented to global markets.

7. Discussion and policy implications

This article argues that higher education reforms can create opportunities for HEIs to thrive under a legal umbrella to further reinforce their legitimacy and social contribution for societal development. This requires an exhaustive consideration of illities affecting HEIs (e.g., *autonomy*, *accessibility*, *adaptability*, *flexibility*, *capacity*). It requires policies towards the modernization of HEIs, and the expansion of the social basis for scientific and technological development (including its appropriation). The need to foster effective institutional autonomy and integrity of modern HEIs is reinforced in a context where innovation must be considered together with competence building and advanced training of people. This requires strengthening capacity at the top of the research system leading to knowledge production at the highest level. Our main argument is shown schematically by Fig. 4, which has clear policy implications. While accessibility and affordability require broadening the social basis of the "knowledge pyramid", capacity and quality require policies oriented to pull-up the top of that same pyramid.

Our argument can be discussed in terms of the most recent book of Nobel Prize-winning Edmund Phelps (2013), who argues that the modern values underlying the economy are under threat by a resurgence of traditional and corporatist values. The wellspring of what Phelps coins as "mass flourishing" are modern values such as the desire to create, explore, and meet current and future challenges (an illities viewpoint). These values fuelled the grassroots dynamism necessary for widespread, indigenous innovation. A dynamism not driven by few isolated

Table 2
Main institutional breakthroughs fostering academic flexibility and research capacity in Portugal (1995–2010).

Main institutional breakthrough	Rationale for breakthrough	Independent National Research Assessments	Independent teaching assessments
Associate Laboratories, to foster research excellence through networks of academic research centres (as created since 1999, with a few initial developments in biomedical and physical science, but reaching 25 Laboratories by 2007)	Fostering critical masses, aggregating several R&D groups and attracting new talent, under the direct support of FCT	Every 3/4 years, since 1996, through the Portuguese Science Foundation (FCT), involving international review panels: 1996/97 1999/00 2002/03 2007/08	–
Independent Legal Status for HEIs (i.e., University Foundations) (includes three leading examples in 2008: University of Porto, University of Aveiro and ISCTE-IUL in Lisbon)	Enable flexible management and organizational mechanisms; institutional autonomy and responsibility of higher education institutions; more responsive institutions		Since 2009, the Agency for Assessment and Accreditation of Higher Education (A3ES), through the assessment and accreditation of study cycles in higher education institutions, is impacting their organization (about 1200 courses were discontinued by 2010)
Research and advanced training networks, through thematic international partnerships (includes partnerships with MIT, CMU, Harvard and UT Austin in emerging themes, including ICT, energy, bioengineering, design, and clinical research)	Networks of research centres across leading Portuguese universities brought together to cooperate with leading institutions worldwide, involving business and industry and end users. These networks are reviewed on a yearly basis.		

Note: Table elaborated by the authors.

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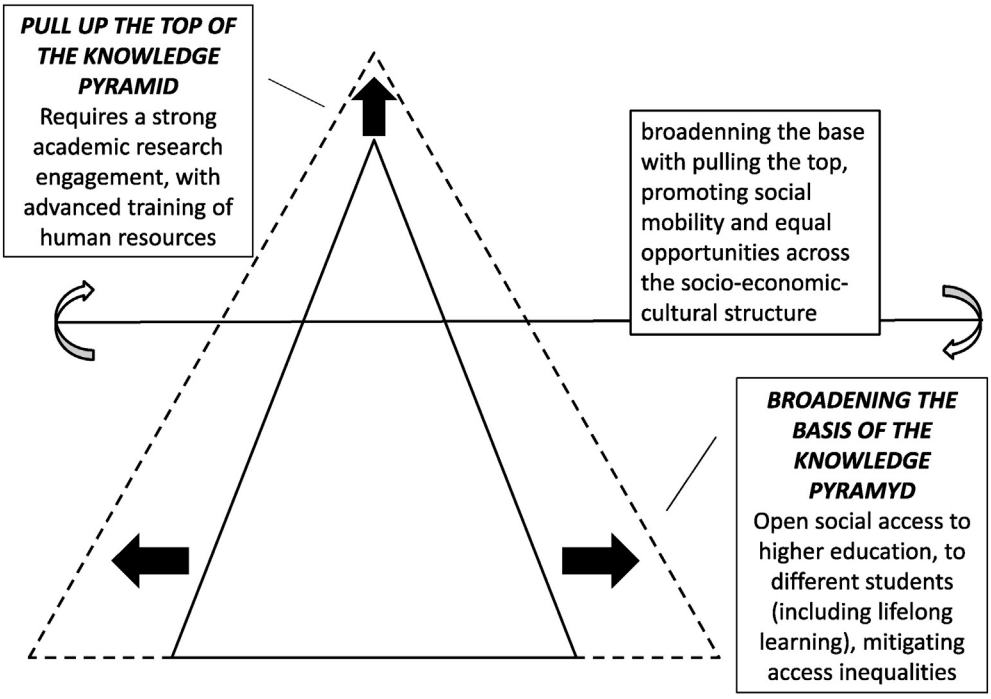

Fig. 4. Schematic representation of proposed "orthogonal" policies to foster accessibility and capacity.

visionaries (e.g., Henry Ford, Steve Jobs), but by millions of people educated and empowered to think, develop, and market new products and processes (e.g., user innovators; see Fuller et al., 2013). This refers to people trained at HEIs, supported by a research community that can make them robust social institutions.

Mass flourishing — a combination of material well-being and the "good life" — depends on the HEIs ability to supply talented people and researchers to increasingly globalized economies and risky and complex labour markets. In this context, we argue that this dynamism should not be driven — or constrained — by policies that are limited by what is solely measurable, or that bound the ability of knowledge institutions such as HEIs to develop themselves and contribute further to societal development. Rather, it requires an in-depth consideration of illities affecting HEIs (e.g., *affordability*, *accessibility*, *quality*, *capacity*).

A relevant lesson of the Portuguese reform is that the institutional integrity of HEIs, and their resilience as "social institutions", can be pursued by a combination of science and higher education policies, strongly supported by public funding. Even in a global world, expanding and maintaining critical masses and reinforcing the institutional strength of HEIs stems from the national system's internal dynamics as the funding of academic research and higher education is still a national option, and should be understood at all times as an investment rather than a cost.

Among many other funding issues, it is worth noting the harmful effect of "blind" policy instruments such as funding formulas, often based only on the number of students, which in many cases stimulated poor practices without being able to improve capacity (see Conceição and Heitor, 2005 for an in-depth analysis of the Portuguese case). Instead, policies towards building human capital need to give constant priority to people and knowledge, contributing to foster networks of institutions with the necessary critical mass to sustain the international standing of HEIs and associated scientific institutions. In this regard, three main illities inspired policy implications are highlighted in the following paragraphs.

8. Policy implications towards affordability and accessibility

The main reason for governments to increase funding for higher education is to increase participation rates and extend the recruitment base (Barr, 2004; Barr and Crawford, 2005). At the same time, new opportunities are required to give students more flexible pathways across different types and levels of educational qualification, including through recognition of prior learning and credit transfer, in order to reduce repetition of learning. This issue was addressed in two different, but related levels in the Portuguese reform of higher education: i) operationally, looking at the process of attracting and funding students; and ii) strategically, looking at society, in general, and the process of gaining societal trust through a dynamic relationship between HEIs and the remaining education system.

Students matter and, as a result, increased diversified systems are required, including at secondary and post-secondary levels of education. But the need to modernize funding mechanisms and ensure a better balance between institutional and competitive funding for higher education is paramount. It appears that more important than discussing the details of funding formulas for institutional funding mechanisms, it is to review the overall share of institutional and competitive funding sources, as well as to promote student support mechanisms (e.g., Conceição and Heitor, 2005). This includes the need to create flexible financial mechanisms to attract and keep people in academia. The key issue is how to increase and balance loans and grants for students, while developing innovative loan systems and combine them with flexible legislation to accommodate reasonable student incomes through part time work. Barr (2004) states that the goal is to provide free education to all students, by guaranteeing graduates to share the costs. The question is that the correct amount to be shared among the taxpayer and graduates, as well as other private sources, is still to be shown.

Moreover, understanding the relationship between higher education and the social contexts should consider the broad value of "collective learning". Learning systems vary considerably across the full

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spectrum of disciplines, but if the ultimate goal is to enlarge participation rates and the recruitment base of higher education, the debate will gain from current knowledge of basic and secondary education levels. Given the many changes in student populations, technology resources, and society's demands, development of innovative pedagogical approaches that are more student-centred and more culturally sensitive is necessary.

9. Policy implications towards capacity and quality

The main lesson learned through the Portuguese reform discussed in this article refers to the need to create the conditions able to strengthen institutions and to form the necessary critical masses to engage in high quality research activities (Heitor et al., 2014). Following some of the issues raised by Ziman (1968) and, later, by Ernst (2003), one critically important institutional issue refers to the training of doctoral students and young scientists. These should be provided with core competencies that help them to become successful researchers while preparing them with "transferable skills" for the job market outside academia. The issue can be further oriented in three different lines of discussion.

First, this requires the adequate public funding to train and attract skilled people and a teaching body, making use of proper research environments, at home and abroad. It must consider the concentration of funds to spur forms of international academic and scientific cooperation oriented towards the research training of young scientists and future teachers (see Heitor and Bravo, 2010).

Second, at the institutional level, attracting skilled people and teaching staff to strengthen academic research can be fostered by establishing large research centres (i.e., "Associate Laboratories" in the Portuguese context) and promoting their autonomy within HEIs. Our research shows that international academic and scientific cooperation seems to emerge as a major shaping factor for development at an unprecedented level to address these issues (Heitor, 2015). Academic institutions from industrialized countries are now operating internationally, addressing not only students individually, but increasingly developing new types of institutional arrangements that can contribute to enhance research capacity transnationally benefiting economic and social progress in developing societies (Peters et al., 2009).

Third, knowledge is a cumulative process, depending in the long-run on the widespread disclosure of new findings. David (2007) has shown that open science is properly regarded as uniquely well suited to the goal of maximizing the rate of growth of the stock of reliable knowledge. As a result, HEIs could behave as "open science" institutions and provide an alternative to the intellectual property approach to tackle difficult problems in the allocation of resources for the production and distribution of information. Consequently, the main challenge for public policies is to keep the proper balance between open science and commercially oriented R&D based upon proprietary information.

In this regard, two further aspects deserve attention. First, innovation must be considered together with competence building and advanced training through the complex interactions between formal and informal qualifications. This requires broadening the social basis for knowledge activities, including higher education enrolment, and strengthening the top of the research system. Consequently, the renovation and expansion of the social basis for knowledge-based activities is vital. This calls upon a strong conviction not only from the scientific and technical professions and of public and private research organizations, but also from students and the general population (Heitor, 2008).

Second, strengthening experimentation in knowledge networks necessarily involves flows of people (Horta and Yonezawa, 2013). It is the organized cooperation among networks of knowledge workers and institutions, together with different arrays of users that help diffuse innovation and the design of products and services. But establishing these communities requires the systematic development of routines of collaboration on the basis of formal education programmes, sophisticated research projects, and a diversified and non-structured array of informal processes of networking (Kitagawa, 2009). This requires public policies to foster "circulation" of talent and skilled people that can embody holistic perspectives of the world, institutions, ideas and paradigms, and thus contribute to meet the complex and diverse challenges of the present and the future (see also Kim, 2010).

10. Policy implications towards autonomy

HEIs require autonomy to be able to self-govern and function in pursuit of work that is deemed essential to society (see Estermann et al., 2011). Among many others, Hasan (2007) identified the relevance of strengthening the regulatory regime to facilitate more autonomous institutions in line with the requirements of public interest. This is a "context-specific" matter and should be discussed as a function of the level of state bureaucracy, which is to be avoided in managing knowledge-based institutions (e.g., Rodrigues and Heitor, 2015).

At an operational level, the attribution of independent legal status to HEIs through foundations is increasing. Hasan (2007) identified four conditions for a successful implementation. First, accepting the foundation status should be voluntary. Second, because not all HEIs are either willing or capable of taking up the foundation option, the process should be planned on a case-by-case basis. Third, the level of autonomy granted has to be meaningful and based on a carefully decided strategic research and academic agenda. Fourth, the transition to a foundation status requires many support structures and arrangements, including a professional management structure. In this context, new legal regimes of higher education seem to suggest that a package of reforms addressing various aspects of higher education autonomy is desirable, while attention needs to be paid to ensuring that higher levels of autonomy are appropriately monitored so that they are put into the service of public interest.

11. Conclusion

The building of reliable higher education systems in uncertain times is discussed in this article, based on lessons learned from the Portuguese reform of higher education in the period 2006–2010. The analysis shows that reform processes can have a major role in fostering opportunities to access knowledge and the advanced training of human resources, and that in this process illities ought to be taken into account as relevant factors when reforming higher education. While broadening the social basis for higher education promotes the qualification of the labour force, it brings a multitude of challenges, and coping with such a variety of demands and with a continuously changing environment requires that HEIs should continue to promote the necessary institutional integrity so that students experience environments of free knowledge production and diffusion. In internal organizational terms, this requires adaptable and resilient HEIs. In public policy terms, it means that governmental action on promoting training of human resources and on strengthening institutional autonomy require political actions that concentrate on critical pillars of democracy.

Our research suggests that broadening the social basis for knowledge activities and strengthening the top of the research system leading to knowledge production at the highest level should be considered. It requires a focus on the advanced qualification of skilled people and teaching staff for the entire education system and its links with society. This is a continuous process, long-term framework, while understanding the role played by science–university relationships, beyond the currently dominating policies of thinking science through short-term, demand-driven economic development issues. Our final observation is that effective institutional autonomy of HEIs and diversity of higher education systems are to be promoted in a context where building human capital is a priority.

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