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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rimp20

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To cite this article: Anders Broström , Guido Buenstorf & Maureen McKelvey (2020): The knowledge economy, innovation and the new challenges to universities: introduction to the special issue, Innovation, DOI: 10.1080/14479338.2020.1825090

To link to this article: https://doi.org/10.1080/14479338.2020.1825090

INNOVATION
https://doi.org/10.1080/14479338.2020.1825090

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ARTICLE

The knowledge economy, innovation and the new challenges to universities: introduction to the special issue

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ABSTRACT

Universities face new challenges in the knowledge economy, due to two underlying transformations. One is that universities have increasingly developed from bodies of professorial self-governance bodies towards a status as 'complete' organisational actors, able to develop and deploy organisation-level strategies. A second is that by becoming key players in the knowledge economy and responding to stakeholder expectations, universities also have taken on new missions in addition to teaching and research. We propose that a series of new challenges arise from interrelations between universities' internal organisational dynamics and changes in their external relationships. Moreover, we outline the contributions to this special issue, each of which address a specific question through their respective conceptual discussion and/or in-depth examination of these challenges. We conclude with recommendations for future research on the roles of universities in the knowledge economy and for innovation. Specifically, we propose that future research should simultaneously tackle vital issues about governance of universities and their activities, while also further developing extant empirical work on the microfoundations of academic knowledge production and career dynamics.

ARTICLE HISTORY
Received 4 September 2020
Accepted 15 September 2020

KEYWORDS
Universities; knowledge economy; higher education institutions

Universities are currently experiencing two fundamental and inter-related transformations. How they respond to the challenges invoked by these transformations is likely to determine their future role for innovation in economy and society. First, while traditionally having been loosely coupled organisations characterised by a high degree of professorial self-governance, universities increasingly develop characteristics of more complete organisations. Organisation-level strategies take more concrete forms than they have typically done in the past (Krücken & Meier, 2006). Internal professional management and the systematic use of performance indicators have gained importance, sometimes shrinking the room for professorial self-governance (Musselin, 2013) and thus inducing new tensions into academic everyday life. Second, as important players in the knowledge economy universities have taken on, or been forced to accept, new missions and objectives beyond their traditional tasks of teaching and research.

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Notably, this includes expectations to contribute to technological innovation, regional development, and solutions to societal problems (Geuna & Muscio, 2009).

The new challenges and their effects on universities, in particular as regards innovation in terms of universities' activities and strategies, are in the focus of this special issue. In addition, although both transformations can be distinguished conceptually, from the university perspective they are closely related and interdependent. Changing relationships to external stakeholders, in particular to policymakers, have led to organisational change within universities. At the same time, organisational change in universities not only affects their internal relationships but also their roles in the knowledge economy. In this introductory essay, we review some of the discussion on the challenges that universities confront in the knowledge economy, highlighting the interrelations between both transformations. The essay also introduces the individual contributions to the special issue, which extend the conceptual discussion and offer an in-depth examination of the challenges facing contemporary universities.

Changes in the funding and governance of universities

Different time periods and national institutional contexts have imposed varying mixes of societal demands and governance modes on universities. David (2005) argues that during an extended period of reorganisation of scientific activities, universities replaced earlier institutional setups such as Royal Societies (Purver, 1967) or Science Museums as places of experimental knowledge production. Norms shifted from secrecy to open science, and the associated institutions, incentives and organisational structures for rapid disclosure of research results evolved. Throughout the 20th century, new societal demands led to extensive growth of the university system and large-scale state funding of university research. As empirical studies have shown, wide variation across universities developed – where examples of important variation may be found in their national institutional contexts; their financing; their specialisation in terms of disciplines; their breadth and depth of education missions and research groups; their missions, and their organisational forms such as public or private (Bonaccorsi & Daraio, 2007).

World War 2 vividly demonstrated how direct and profound the societal impact of scientific research may be. Unprecedented amounts of public funds were expended to support war-related research projects in fields such as nuclear physics or materials science, and the success of these efforts proved to be decisive for how the war ended. After the war, Vannevar Bush (1945) drew upon the war experience to argue that the U.S. government should continue to support science, through independent self-governed foundations, and that the government would benefit technological progress, industry, and society best by focusing upon basic science and renewal of scientific talent. In the post-war period, large-scale public funding for a highly autonomous and self-governing public research system remained the dominant governance model in the Western world (Stokes, 1997). Policymakers continued to rely on basic research to deal with diverse societal challenges ranging from cold-war antagonism with the Soviet bloc to (nuclear) energy supply and the exploration of outer space. In doing so, while public universities were formally organised as part of the public service, policymakers and the broader public generally acknowledged the self-governing capacity of the research system, and

a high level of autonomy for individual researchers and universities was institutionalised in many countries (Altbach, 2001).

This remarkable trust in the self-governing capacity of science has been challenged in recent decades. In dealing with the fundamental information asymmetry between those who conduct research and those who fund it (David, 2005), policymakers have been less content than before to rely on self-governing mechanisms such as peer review and competition for priority and reputation (Merton, 1973). Two broad types of rationales for the ensuing changes in science policy can be identified (Bleiklie et al., 2011): process-oriented concerns about the cost-efficiency of knowledge production at universities, and substance-oriented concerns about the allocation of resources across disciplines, fields, and research questions.

To safeguard the cost-efficient use of resources, policymakers targeted the governance of universities' knowledge production processes. Reforms such as the introduction of external bodies for project proposal evaluation can be seen as a response to widespread suspicion that if left to their own, universities would – due, e.g.,, to mechanisms of nepotism and discrimination – distribute the research funding allocated to them among people and projects in a manner which is not satisfying in terms of 'the best of science for the money' (Geuna & Piolatto, 2016).

Policy changes addressing the efficiency of knowledge production processes were more visible in Europe, where most universities are public, than in the United States. Principles and instruments of 'new public management' found increasing application in various European countries (cf. Whitley & Glaeser, 2014, for a critical discussion). State control over the university system increasingly relied on output indicators, which promised to provide transparency about university performance and make universities more accountable to the public. At the same time, these indicators made universities comparable in their performance, allowing policymakers to introduce competitive elements in their funding decisions (Hicks, 2012). Specific forms in which this happened differed across countries, ranging from formula-based funding employing institutionalised nation-wide assessments, such as the Research Assessment Exercise/Research Excellence Framework in the United Kingdom, to allocating performance-based extra funding to 'excellent' universities, e.g., in the German Exzellenzinitiative. At the level of individual researchers, project-based funding has become more important even in countries like Germany and Japan where block grants used to dominate (Wang et al., 2018; Winterhager, 2014). What the various initiatives have in common, however, is that science policy defines output criteria to guide the allocation of future funding, where these criteria are mostly based on judgements (in peer review) and activities (e.g., in citing) internal to the research system.

Adding to these concerns about the cost-efficient use of resources, policy initiatives have also taken an active role in shaping the substance and thematic composition of university research. Retreating from the post-World War 2 position that technological and societal innovation may be best served by autonomous basic research (Stokes, 1997), policymakers have become increasingly reluctant to leave decisions about the allocation of funds across research fields to autonomous actors in the university system, particularly in contexts where the funding of research is perceived as a means to more or less well-defined aims. Policy initiatives to prioritise specific fields and types of research reflect ambitions to address pressing societal problems such as climate change, to increase

science-based innovation (c.f. Jones, 2011), or to engage in science diplomacy (Lord & Turekian, 2007).

Such policy initiatives to prioritise specific fields and types of research are often designed to guide the research efforts of scientists towards more or less well-defined problem areas, and to ensure that research is conducted in forms that are seen as appropriate. For example, funding may be organised to stimulate direct interaction between academic researchers and industry (Broström, 2012), as, e.g., practised in the EU's framework programmes. Policy-makers may also try to stimulate science-based innovation by channelling funding towards problem areas seen as particularly promising for innovation, as identified, e.g., in dialogue with industry representatives (Mazzucato, 2018). Mazzucato (2016) proposes that through mission-oriented innovation policy, public agencies can 'de-risk' innovation and also pave the way for new technological opportunities through market creation. Going further, Schot and Steinmueller (2018) argue that transformative innovation policy requires broader socio-technical system changes to address the Sustainable Development Goals, in contrast to earlier innovation policy framing on R&D or national systems of innovation. Such priority-setting schemes of research funding may be established by 'traditional' bodies of public research funding, but also by individual ministries and government agencies (such as the Department of Energy or NASA in the United States) that aim to advance their missions. The latter group's engagement with university research reflects a development where science policy has been increasingly interwoven with other areas of public policy. It is typically manifested in the introduction of mission-oriented project-based funding schemes. These policy initiatives can be designed in different ways – either to increase total funding to science through such additional policy or to shift more of the existing funding for science away from scientists internal governance and towards policy goals.

From the perspective of researchers and the university system, the medium-term implications of this development are complex, with overall effects being heterogeneous across initiatives. On the one hand, thematic project-based funding schemes enhance the capacity of science policy to shape the research agenda, which shifts the control over what researchers are to engage in away from the university system (Musselin, 2013). On the other hand, when such schemes entail increases in the overall amount of public funding for university research, then they provide new opportunities for universities and their researchers, and lower autonomy is counterbalanced by increased funding. In other contexts, notably in periods of crisis, no such compensation will be feasible, and a new balance between autonomy and financing must be decided upon.

Concerns about the efficient use of resources in the university system and about the substance of university research come together in debates about the commercialisation of research findings. In various contexts, these debates have been framed by alleged 'paradoxes', where countries or world regions were perceived to not generate as much product and process innovation as one might expect to emerge from their basic research accomplishments (Dosi et al., 2006; Edquist & McKelvey, 1998). This concern about the insufficient application of university research spurred policy initiatives around the globe, and the success of biotechnology companies based upon early research results in genetic engineering served as a model of commercialisation of science (McKelvey, 1996; Pisano, 2006). Probably the most consequential of these initiatives was the U.S. Bayh-Dole Act of 1980, which granted universities intellectual property rights in technologies

based on federally funded research and thus legitimised universities' commercialisation activities. Even though the apparent success of the Bayh-Dole Act may reflect that it coincided with changes in patent legislation and the ascent of biotechnology (Mowery et al., 2001), similar legislation was enacted in many other countries (Thursby & Thursby, 2011; Von Proff et al., 2012).[1] Today, taking an active stance in commercialising research outputs, as well as engaging with societal actors through a wide range of formal and informal mechanisms at the individual and organisational level (Perkmann et al., 2021, 2013) can be seen as universities' 'third mission' (Etzkowitz & Leydesdorff, 2000), in addition to research and teaching. Instead of emphasising additional organisational structures such as technology transfer offices run by the university, the academic engagement literature focuses upon the activities of individual university scientists and their groups, as the impetus for interactions with society (Perkmann et al., 2021, 2013).

More recently, the policy prerogative that university research should also provide direct benefits to society has fed back into the assessment of research performance, which in turn leads to further demands on universities and their researchers. Reacting to criticism that traditional bibliometric indicators of research output are too one-sided, science policymakers in the U.K. and elsewhere have searched for new approaches to measuring research output such that societal 'impact' is captured (Watermeyer, 2016). In parallel developments likewise motivated by perceived shortcomings of traditional output indicators, alternative metrics based on attention that university research gets in online media have been developed (Bornmann, 2014).

In summary, a series of shifts in the funding and governance of science has contributed to shifting responsibility for academic performance assessment away from academic self-governing processes within universities (Musselin, 2013). While decision processes within universities are still important in shaping, e.g., recruitment and promotion decisions, the power over what agendas to prioritise is now shared with different layers of decision-makers in governments, government agencies, international organisations (such as the European Union), and public, private, as well as non-profit bodies of research funding (Laudel, 2006). Increasing sensitivity to the cost-efficient use of resources enforces universities' accountability vis-à-vis society. At the same time, universities and researchers have to deal with the expectations that university research should be 'useful' and provide the foundations of technological and societal change. Thus, universities have to demonstrate their responsiveness not only to the demands of science policy, but also to other stakeholders that increasingly perceive university as service-providing organisations. These changes in the external relationships of universities also have repercussions on the internal structure and interaction within universities. In the next section, we will propose that the introduction of new forms of funding and governance has affected the distribution within universities of decision-making power, while it contributed to the increasing organisational nature of universities.

Changing external relationships as triggers of organisational change within universities

The two current transformations of the university systems are inter-related in various ways. The first link to discuss is that changing external relationships trigger internal

organisational change within universities. These changes within the university have led to new balances of power, and new patterns of decision-making.

The previous section argued that public policy as well as other stakeholders have new expectations, and ways of measuring, how the university performs. The proliferation of criteria and indicators to measure, assess and compare university performance, and efficiency-oriented reforms seeking to increase performance along one or several dimensions, have induced a variety of organisational responses. Similarly, universities have responded by trying to take on an expanding role within the knowledge economy. Organisational responses relate both to how the university addresses the challenges stemming from new demands in its interactions with external stakeholders and in its internal relationships, notably how these new demands are transferred to university researchers and staff.

Organisational sociologists have observed that recent changes in science policy enhanced the capacity, but also the need, of universities to act as organisations, i.e., to pursue organisational objectives and develop organisation-level strategies to reach them. At least in continental Europe, universities have traditionally been weak as organisational actors. They have thus been characterised as loosely coupled expert organisations or even organised anarchies (cf. the article by Krücken (forthcoming) in this volume and the references provided therein).

Scholars working within innovation studies and evolutionary economics have developed an evolutionary explanation of how and why universities compete (Deiaco et al., 2010, 2012; Martin, 2012; McKelvey & Holmén, 2010). Competition has been sparked by external changes in the national institutional contexts, leading to not only trajectories of specialisation, but also adaptability as an organisational form. In response to new financing forms and large investments in interdisciplinary research, specific universities are then forced to adapt and develop new types of intermediary organisational structures (Bourelos et al., 2012; Dodgson & Staggs, 2012; Martin, 2012; Mosey et al., 2012). Thus, conceptually, one can say that universities, particularly public universities in Europe, have had to 'learn to compete' due to the transformation of universities and higher education institutes to become knowledge businesses, instead of societal institutions providing public services (McKelvey & Holmén, 2010).

As a consequence, present-day universities are more capable and more inclined to position themselves in competitive processes for resources, reputation and talent, and to formulate organisational strategies to defend and improve their competitive position (Bleiklie et al., 2017). Widespread organisation-level attempts to sharpen universities' profiles by horizontal and vertical differentiation can be understood as responses to stronger competitive pressure. Horizontal differentiation strategies try to make universities more recognisable without introducing new differences in their overall quality and reputation, for instance, through endeavours to specialise in specific fields of research and teaching and/or address societal challenges such as sustainable development or digital transformation. In contrast, vertical differentiation strategies aim to enhance (perceived) quality differences across universities. They mostly focus on universities' capacity to conduct research at the global frontier and to be perceived as top-tier research institutions. Vertical differentiation finds its expression in university rankings (Espeland & Sauder, 2007), in the competition for 'excellence' funding, but also when universities

sort themselves into various leagues such as the Russell Group in the U.K. or the 'German U15' (see also the discussion in Paradeise & Thoenig, 2013).

Current output-oriented reforms have strengthened the positions of university (and departmental) leaders; hierarchical authority has become more important at the expense of collegial self-governance among professors and quality assurance within the peer groups of disciplinary communities (Enders et al., 2013). With the increasing centralisation of decision-making within the university, the number and influence of managerial and administrative staff have increased in many countries. This is perhaps most visible in the commercialisation of results, where technology transfer offices (TTOs) have been established by most universities to handle patenting and licencing issues. Similarly, support of entrepreneurial endeavours by researchers and students (Åstebro et al., 2012) has been institutionalised by the establishment of university incubators, accelerator facilities and collaborative research centres (cf. the article by Knudsen et al., forthcoming, in this volume). TTOs and incubators are only specific instances of a broader trend, however, as many of the functions that universities fulfil have been put into the hands of professional experts (Krücken & Meier, 2006). For instance, communication with the general public is managed by public relations professionals, and relationships with external parties are scrutinised by legal experts to minimise the university's exposure to lawsuits (Furuta & Ramirez, 2019). The educational mission of the university is likewise supported by various professional specialists, and many universities require that their teachers take formal training in pedagogics.

Regarding internal relationships between universities and their researchers, recent changes reflect many of the developments that universities as organisations have been subject to. Specifically, as part of 'academic controlling' activities emulating the private sector, universities' attempts to measure, assess and compare individual research performance are often similar to those that policymakers enacted in the governance of universities, and new dimensions and objects of competition have been introduced at the individual level. Again, details differ across universities and countries. Extreme cases where individual researchers receive indirect and direct cash bonuses for successful publication activities have gained in popularity (Franzoni et al., 2011). But even in countries like Germany where changes in the employment relations of university researchers were relatively modest, new remuneration schemes were introduced that shifted away from rewarding seniority and paid more attention to individual performance and the labour market environment (Ytsma, 2015).

Beyond remuneration, many universities have established internal funding contests in which researchers compete for funding, often with the expectation that university funds are used as seed funding to win larger-scale grants from external funders, for example, national and supra-national funding agencies (Musselin, 2018). Acquiring prestigious large-scale projects is a key element in the strategic positioning of universities. However, for securing external funding university leaders cannot only rely on competition among researchers, but also depend on their collaboration. While grant applications may be initiated 'top-down', success is dependent on the collaboration of researchers, whose participation in applications is therefore incentivised by many universities. That the university depends on its researchers to attain its organisational objectives also implies that the recruitment of researchers is of utmost strategic importance. It is therefore not surprising to see an increasing focus of universities on

attracting star scientists in an increasingly global market for human capital. And since the academic labour market offers limited opportunities for advancing careers and increasing incomes within a single university, while major career steps tend to be linked to researcher mobility across universities, increasingly strategic and star-oriented recruitment by universities exerts further competitive pressure on individual researchers.

From the perspective of individual researchers, repercussions of these changes are again complex. On the one hand, their standing in the university may be dependent on their willingness to contribute to the 'top-down' activities initiated by the university leadership, which may force them to adjust their research agenda to make it fit into university-level objectives. In this way, university leaders gain more salient roles as enablers of coordinated action to maximise the outcome of their institutions (Enders et al., 2013), possibly at the expense of the mid-level leadership within the university organisations.[2] On the other hand, individual professors (principal investigators) who engage in successful university-level initiatives not only get some control over the use of the obtained funding, but may also enhance their influence on future university strategies. Moreover, the availability of funding from alternative external sources (and independent of university-level initiatives) provides outside options that help safeguard the autonomy of university researchers. How relevant these outside options are varies across countries, which have different balances of how much research funding is available internal to the universities, or via external sources such as research councils and foundations.

Organisational changes as triggers of change in external relationships

A second link between the two transformations of the university system is how and why the organisational changes discussed above in turn trigger changes in external relationships. Current developments suggest as a general tendency that universities increasingly interact with their environment as organisations, rather than as collectives of researchers. External stakeholders can therefore expect universities to act more professionally and consistent than before, but also in a more formalised and less flexible fashion (Bodas Freitas et al., 2013; Valentin & Jensen, 2007). External relationships are also more strategic, as universities make more systematic efforts to shape the way they are perceived by policymakers, students and their prospective employers, and the general public (Broström et al., 2019). Present-day universities are branding their services much in the way that corporations do (Drori et al., 2016). Doing so appears indispensable for universities in the current environment, not least in their endeavours to build stronger relationships to external stakeholders, harness the potential for research commercialisation and secure their long-term funding base (Guerrero et al., 2016). At the same time, universities have to balance their strategic external relationships and the quest to be as attractive as possible to stakeholders with the fundamental requirements stemming from their mission to generate reliable knowledge, which requires them to uphold their independence from the interests of their stakeholders.

In their actual interactions with universities, stakeholders are more likely to deal with experts who are specialised in the respective type of external relationship, e.g., a technology transfer officer, a professional fundraiser or a public relations expert. This

professionalisation of external relationships entails a higher level of codification of processes, and also increasing homogeneity of how individual types of relationships are managed by different universities. Such homogenisation can be expected to arise not least by the professionalisation of activities itself (DiMaggio & Powell, 1983). Among its drivers are professional associations for specific types of management positions in universities (such as AUTM, the Association of University Technology Managers in the United States) as well as the establishment of study programs for university management (Krücken & Meier, 2006).

Professionalisation of external relationships may also mean that relationships that individual researchers are willing to support may be terminated if they are not sufficiently attractive for the university from the perspective of, e.g., centrally employed lawyers. This may affect small-scale research collaborations with other universities or firms, for which organisational requirements for contracting, reporting and payment may not be practicable or worthwhile. In the context of commercialisation, anecdotal evidence suggests that newly established technology transfer offices were sometimes unwilling to continue ongoing relationships with the private sector because they considered the contributions made by the private-sector partner as insufficient and expected to find more attractive alternative partners.

Professionalisation of processes also affects other type of relationships between researchers employed at universities and external stakeholders. In writing grant proposals, and in many other tasks related to research, teaching, as well as commercialisation and engagement, the proliferation of management and administrative positions in universities provides them with the help of professional support staff. At the same time, professionalisation and formalisation of processes may compromise researchers' ability to interact informally with external partners. The university's enhanced capacity to act strategically and coherently as an organisation may thus come at a cost to the capacity of its researchers to act autonomously and entrepreneurially. It may also affect individual research agendas. Organisational demands to contribute to organisation-level objectives and strategies, notably to participate in large-scale collaborative grant applications, may crowd out other research activities that would have been initiated in their absence. At the system level, this trend towards larger-scale research endeavours may lead to a loss in diversity of research topics and methodologies.

The articles in this special issue

The five articles included in this special issue contribute to our understanding of the interplay between organisational change and the development of their external relationships.

A conceptual essay by Georg Krücken highlights a largely overlooked aspect of the recent developments in higher education (Krücken, forthcoming). As outlined above, 'learning to compete' (McKelvey & Holmén, 2010) is one of the main challenges that universities, particularly in continental Europe, are confronted with. Krücken argues that universities do not only face intensified competition. The number of competitive arenas has also increased, as new entities have turned into competitive agents, and competition expanded to activities that traditionally were subject to other modes of governance. At the centre of the essay is the proposition that present-day universities are entangled in

multiple competitions, derived from the tradition of competition as a central dimension of governance in research and in advanced education. According to Krücken, multiple competitions in the university system have the potential to adversely affect creativity and innovation in knowledge production. They moreover add further complexity to the interrelations of internal organisational change and external relationships discussed above.

Rake (forthcoming) empirically studies university-industry collaboration in pharmaceutical cancer research, as captured through co-publication of research papers. Rake's results indicate that papers originating from universities with an intermediate level of engagement in alliances with pharmaceutical companies tend to be published in more highly reputable journals. That universities without such alliances tend to publish in less prestigious journals seems well in line with the general association between academic performance and collaboration (Laursen et al., 2011), and with academic research benefitting from industrial alliances in terms of in-flows of knowledge and resources (D'Este & Perkmann, 2011). However, also the universities that are most heavily engaged in alliances with pharmaceutical firms tend to have a greater share of their publications published in less reputable journals. This latter finding points to the presence of important trade-offs (c.f. Hottenrott & Lawson, 2014). These may involve e.g., adherence to industrial stakeholders' interests leading to prioritisations other than those that would maximise the academic contributions (Banal-Estañol et al., 2015), or to restrictions in timely communication of research results (Thursby & Thursby, 2002). In the context of this special issue, these results speak to a central theme in contemporary debates about universities' external relationships.

Three articles in the special issue investigate different types of collaborative practices in case studies of contemporary European universities.

In their contribution, Hermanson et al. (forthcoming) analyse how researchers and the university as an organisation acted to initiate academic engagement and commercialisation, in an area with previously low levels of collaboration, namely engineering and equestrian sports. Previous literature tends to study existing academic engagement, and also has demonstrated the importance of individual researchers with specific characteristics (Perkmann et al., 2021, 2013), but this case study demonstrates a more complex process, at least for new areas. The study contributes to our understanding of academic engagement as a markedly multi-faceted phenomenon, which may be facilitated and supported through a wide array of organisational arrangements. Specifically, teacher-researchers can develop service-oriented structures through teaching, and then engage students – sometimes with a user innovation incentive – to play important roles in universities' external relationships. The case study also shows that university managers operating under competitive pressure may be willing to support activities and stakeholders outside the traditional scope of technology transfer if these promises to be beneficial for student recruitment and branding.

Knudsen et al. (forthcoming) provide an overview of different approaches to universities' so-called 'third mission', with emphasis on different aspects of this mission, and with different organisational setups. Through an empirical study set in the context of drone technology, they demonstrate that different aspects of historical models for how universities interact with external stakeholders are interwoven in contemporary practice. The authors go on to outline an 'Ecosystem model' for universities where researchers'

expertise stands in focus as the key basis for exchange with external stakeholders. They point to the existence of multifaceted relationships, where universities leverage their knowledge assets in several ways. These channels include technology licencing, support for spin-off and startup activities, and collaboration with industry around research facilities or specific projects, but also a set of less formalised relationships. In the context of this special issue, the article demonstrates the quest of universities to find effective organisational arrangements to fulfil new missions. Both the full scope of the mission and the range of relevant internal stakeholders with varying interests and capabilities may have to be discovered in an extended learning process. In this way, superior alternatives to apparent early success models (such as concentrating all transfer activities in the TTO) may be developed. This may be of particular importance when the focus of engagement shifts from individual firms to supporting the emergence of new industries and contributing to sustainable development or addressing other grand challenges.

Lauvås and Steinmo (forthcoming) investigate how relationships between academic researchers and industry stakeholders can be successfully combined in the work of university-industry research centres. The proliferation of this form of organisation during the 1990s and onwards is in itself the result of recognition that the organisation of academic activities shape conditions for external relationships. In their longitudinal study of two such centres, the authors show that considerable efforts and perseverance are required for partners to learn sufficiently much about each other to nurture mutually beneficial relationships. The case study shows how the inherent tension between the objectives of university and industry partners can be resolved in long-term relationships, but establishing a research centre alone is not sufficient for success. In addition to formal organisational structures, mutual commitment and trust developed in repeated interaction between the partners enable the common understanding allowing them to attain the objectives of the research centre.

Researching the challenges for universities in the knowledge economy: the way ahead

Against the broad set of changing conditions that we have outlined above, it is not to wonder that universities struggle with finding their place and ways of working in contemporary societies. Research about universities and their interactions with external stakeholders has an important role to play in taking these discussions forward, both as regards providing advice to decision-makers and as regards informing the broader debates on academic governance and the role of universities in the knowledge economy. In this concluding section, we point at lessons learned from extant research, in order to further articulate the interesting challenges and research questions that need to be addressed in further research efforts.

A first challenge to university leaders, policymakers and researchers is to fully understand the implications of intensified competition in the university system, and in particular of the effects of various agents at different levels of the system competing in multiple arenas and in diverse constellations. ‘Multiple’ competition as such is a pervasive phenomenon and by no means unique to the university system; after all, commercial firms compete in various factor and product markets at the same time. However, based on prices and their adjustment, performance in the various markets is

made commensurable for firms, and hence trade-offs can be coordinated more smoothly in the private sector than in the university system. It is therefore not obvious that the coordinating power of market competition can also be relied upon in the multiple and partially non-market competitions that universities find themselves in. For policymakers, this raises the question whether the hope to make universities cost-efficient and accountable through measures that emulate market competition is warranted, or whether the multiplicity of competitions might even provide universities and their leaders with degrees of freedom allowing them to legitimise their activities by highlighting selected output dimensions in which they perform relatively well while covering up poor performance in other dimensions. Adding to the concern that competition in the university system may not necessarily have the welfare-enhancing properties that economists have suggested to characterise idealised competitive markets is that it often takes the form of contests for positional outcomes, in which competitors tend to engage in societally wasteful rent-seeking activities (cf., e.g., Dixit, 1987; Tullock, 1980). In their use of competitive measures for the internal governance of their organisation, university leaders are confronted with the same issues. At the same time, strategic manoeuvring in the multidimensional university-level competition is an important aspect of successful university management. Thus, as emphasised by Krücken (forthcoming), for researchers of higher education and innovation, understanding the systemic effects of multiple competition on creativity and innovation, as core features of a well-governed university system, is of utmost importance. Part of this challenge is to thoroughly analyse the interrelationships between organisational competition among universities and their relationships to external stakeholders that we discussed above.

A second key challenge for universities is to arrange their activities so as to bring about and make visible collaboration and outreach activities to the extent expected by their stakeholders (Muscio et al., 2015). This conceptualisation helps bring about a much-needed shift in focus from the *transfer* of technology or knowledge to modes of leveraging the research-based competence of university-employed researchers in firms' and policy-makers' efforts regarding innovation. The 'ecosystem' conceptualisation of Knudsen et al. (forthcoming; this issue) offers a much welcome contribution in this regard. While research on the roles of universities in modern economies has long pointed to the need to such a shift (e.g., Perkmann et al., 2021, 2013; Salter et al., 2000), it remains a pedagogical challenge to convey these insights to broader circles of policy-makers and university leaders.

The view that leveraging the research-based expertise of academics in processes 'owned' by external stakeholders constitutes a central aspect of universities' role in the knowledge economy has interesting implications for how we may think about the 'third mission' of universities. Clearly, outreach activities and measures taken to support or stimulate them must be closely integrated with research, and with efforts to stimulate the emergence of vital research environments. We should also expect the most well-reputed universities to be most attractive collaboration partners (Laursen et al., 2011) – at least for advanced firms and other stakeholders (Broström et al., 2009). Universities' ambitions to establish successful outreach activities should therefore be seen as largely going hand-in-hand with their ambitions to foster important contributions to the international academic community (Jonkers & Sachwald, 2018). But this conclusion does not imply that universities can sit back and let their academic achievements drive meaningful

collaboration. It would seem more appropriate to conceive of the former as a prerequisite for the latter. The 'third mission' should neither be managed in isolation from the two other missions, nor be neglected by university managers.

We also need to increasingly understand how students and teaching are also integral to both commercialisation and academic engagement. While collaboration and outreach is often considered from the point of view of the research activities of academic researchers, it would be a mistake to neglect the often close relationship between collaboration and education. For example, external stakeholders may often be at least as interested in opportunities to recruit as in knowledge exchange (Broström, 2012), and such recruitment is often closely connected to outlooks regarding further collaboration (Evers, 2020) and knowledge spillovers (Buenstorf & Heinisch, 2020). It is, therefore, natural to seek to integrate collaboration-enhancing efforts also with educational initiatives. Hermanson et al. (forthcoming) challenge the prevailing focus of the university-industry literature on the activities of university faculty, and suggest that while different in terms of e.g., content and continuity, student-centred collaboration activities deserves further attention by universities and by scholarship seeking to understand their roles in the knowledge economy.

A third key challenge for universities is to provide the best possible conditions for realising the potential benefits and synergies from collaboration. While there are many examples of external relationships generating long-term benefits for academic and industrial partners, efforts to increase the intensity and scope of collaboration may lead to the 'crowding out' of other types of valuable pursuits. The trade-offs identified by Rake, forthcoming, this issue) offer an interesting illustration of this peril. Universities must arrange incentives and structures intended to enable collaboration in ways that lead to as little 'crowding out' as possible. In their contribution to this issue, Lauvås and Steinmo (forthcoming) discuss how such fruitful collaboration may be brought about. Their study of two university-industry research-centres highlights how repeated interactions over time are necessary to build trust and reciprocal knowledge of the respective partners' expertise and objectives. Establishing centres is a particularly important example of how collaboration may need to be institutionalised into the funding and organisation of academic research in order to make certain types of collaboration come about and flourish (Boardman, 2009).

We may conclude that extant research, including that presented in this special issue, provides a number of insights regarding how universities may continue to develop and strengthen their roles as hubs of deep expertise and integrative knowledge. In order to provide further direction for future efforts by decision-makers, we are in need of research that tackles the questions about how the challenges outlined above may be addressed.

In particular, we see a need for research on what types of organisation and initiatives that may build on and strengthen the successful integration of the three missions of universities. Of particular interest is to explore the risks and potential of elements of coordinated action, where universities take steps to function as more 'complete' organisations (Krücken & Meier, 2006). Further research should seek to unpack the relationships between universities' strategic actions and their ability to uphold old and develop new forms of societal interaction (McKelvey & Holmén, 2010), while competing for resources and reputation (Krücken, forthcoming). In this context, we see a need for

studies that approach important questions of governance while building on extant work on the 'microfoundations' of knowledge production and academics' careers. For example, further studies of on how universities may bring about successful integration of its three missions would be well-advised to draw on extant literature discussing the relationship between quality as conceived within academic communities and quality as conceived by external stakeholders in national and regional governments, industry, as well as private donors and prospective students (Baird, 1988; Broström & McKelvey, 2018; Cadez et al., 2017; Perkmann et al., 2011).

Notes

1. Even though the Bayh-Dole Act provided the role model for subsequent policy changes in many European countries, the status quo ante in these countries was fundamentally different. While the US moved the ownership from the public actor to the university, most European countries moved the ownership of scientific results from the individual scientist to the university (Von Proff et al., 2012). These changes were motivated by a perceived weakness of commercialisation performance in Europe, which however is hard to square with the empirical evidence on university patenting (Lissoni et al., 2008).
2. Yet it has often been argued that, perhaps partly as a response to shifts in control to external funding bodies, universities in many countries have experienced reinforcement of hierarchy, e.g., as regards budgeting issues (Bleiklie et al., 2015).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Riksbankens Jubileumsfond [FSK15-1059:1,FSK15-1080:1].

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