

The role of universities in regional development: conceptual models and policy institutions in the UK, Sweden and Austria

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Abstract

The literature on universities' contributions to regional development is broad and diverse. A precise understanding of how regions may draw advantages from various university activities and the role of public policy institutions in promoting such activities is still missing. The aim of this paper is to provide a framework for analysing universities' contributions to regional economic and societal development in differing national contexts and the policy institutions that underpin them. To do this, we review four conceptual models: the entrepreneurial university model, the regional innovation system model, the mode 2 university model, and the engaged university model. The paper demonstrates that these four models emphasise very different activities and outputs by which universities are seen to benefit regional economy and society. It is also shown that these models differ markedly with respect to the policy implications and practice. Analysing some of the public policy imperatives and incentives in the UK, Austria and Sweden the paper highlights that in the UK policies encourage all four university models. In contrast, in Sweden and Austria policy institutions tend to privilege the RIS university model, whilst at the same time there is some evidence for increasing support of the entrepreneurial university model.

Introduction

There is a broad literature on the role of universities in regional development (~~Arbo and Benneworth, 2007; Etzkowitz et al., 2000~~). Higher education institutions (HEIs) are expected to fulfil their traditional missions (teaching and research) and in addition undertake new ones that reflect economic, social and cultural contributions to regional evolution (Arbo & Benneworth, 2007; Goddard et al., 2013). This is both nationally and regionally. ~~The literature on the role of universities in regional development (Etzkowitz, 1983; Etzkowitz et al., 2000; Varga, 2009)~~ Scholarly work has reflected both where universities have been key players in economic development, and where policy makers have sought to replicate successful models. What is still missing in the literature, however, is a precise understanding of the relationship between policy institutions and HEI contributions to regional development, sometimes called ‘third stream activities’, that is, targeted engagement with external organisations, outreach, enterprise formation, and so on (PACEC, 2009). The paper ~~develops a framework for analysing~~ how the national as well as the regional policy context to these missions may influence the ways in which university contributions to regional development differ between countries. Such variations may have many sources, including the type of university (e.g. research-led, teaching intensive, discipline-based) (~~Lawton Smith & Bagchi-Sen, 2012 and Lawton Smith, 2013~~) and the capacity of local public and private organisations to absorb and utilise knowledge created in universities. In this paper we shed ~~some~~ light on one specific factor that might create differences between countries, that is, third mission policy institutions (policy imperatives and incentives).

The aim of this paper is to provide a framework for analysing universities' contributions to regional economic and societal development in differing national contexts and the policy institutions that underpin them. It also aims to ~~offer~~provide insights into the 'fit' between different theories, policies, practices and contexts. The paper provides evidence from the UK, Sweden and Austria for differences in public policy institutions that promote universities' regional engagement. The countries provide illustrations of both policy imperatives at the national scale and where the balance between national scales construct 'incentives' for engagement and the form they take. In the UK universities are autonomous entities, but are incentivised by various government initiatives to develop strategies which have 'third mission' responsibilities. In the two smaller countries, Sweden and Austria, there is a specific commitment to regional engagement but with different emphases. In Sweden, as in the UK, national government has responsibility for HEIs, but legislation requires that they will cooperate with surrounding communities. In Austria, since 2004, as in the UK, universities have become independent entities under public law, but with a vaguely defined third mission role, that of promoting the use and practical application of research findings.

To conceptualise how ~~the~~ policy institutions shape HEI's institutional strategies, four different concepts are considered: (i) the entrepreneurial university model, (ii) the regional innovation system (RIS) university model, (iii) the mode 2 university model, and (iv) the engaged university model. All reflect how universities are changing in order to be capable of generating regional economic growth and development. It is worth noting, however, that only one of these, the RIS model, is explicitly regional. The others reflect the boarder scale at which universities work, for example through research collaboration, although some of their impact is local/regional. Drawing on an analysis of the theoretical and empirical literature, the paper addresses the following research questions: Which specific university contributions (i.e. activities and outputs by universities) to regional development are highlighted by the

conceptual models and how do they differ in terms of policy conclusions? Do policy imperatives and incentives in the UK, Sweden and Austria favour different university models?

The remainder of this paper is structured as follows. Section 2 presents an overview on four approaches that conceptualise from different perspectives ~~the main~~ university contributions to regional development in addition to teaching and research. Section 3 compares policy institutions designed to stimulate various forms of university 'third mission' activities in the UK, Sweden and Austria. Section 4 summarises the main findings and draws some conclusions.

Conceptual Approaches

Over the past years various approaches have been developed to illuminate the roles of HEIs in regional development (Goldstein, 2010; Uyarra, 2010). The following section identifies and compares four academic models of university engagement that seek to capture and explain activities by which universities can support regional development in addition to their traditional functions of teaching and research. To some extent the literature dealing with these concepts also contain normative elements. Depending on the focus on economy, society, knowledge production and innovation, or their inter-relationships, different roles and activities of universities are emphasized: some are mainly concerned with knowledge commercialization and university-industry partnerships whilst others suggest a broader perspective that also takes into account social and cultural contributions of HEIs. ~~Although these are generic models, they are each embedded in particular geo-political regional, national and international contexts. The following section identifies and compares four models of university engagement that emphasise the main areas on the spectrum of how universities can support regional development in addition to their traditional functions of teaching and~~

~~research. Broadly, these are: direct economic benefits such as spin-offs, consulting and interaction processes (captured for example in the entrepreneurial university model and the regional innovation systems approach), recruitment, and more indirect economic benefits through involvement in processes underpinning knowledge accumulation and problem-solving (such as the Mode 2 knowledge production view), and social and cultural benefits that are highlighted in the engaged university model[†].~~

Entrepreneurial university model

The entrepreneurial university concept (~~Clark, 1998~~; Etzkowitz, 1983; Clark, 1998; Etzkowitz et al., 2000; Etzkowitz, 2014) argues that HEIs are increasingly complementing their traditional missions (research and teaching) by a third one, that is, economic development. Universities are seen to contribute to regional prosperity by taking an active role in commercializing their – mainly natural science – knowledge through spin-offs, patents, and licensing (Grimaldi et al., 2011). Such activities are intimately related with the implementation of new incentive and reward structures for commercialization for university scientists, a business culture within academia, and the creation or enlargement of interface functions such as technology transfer offices (Goldstein, 2010; Siegel et al., 2007; Fayolle & Redford, 2014).

Several studies have linked the entrepreneurial role of HEIs with the growth of industries and clusters of inter-related firms in regions such as in the area of ICTs and of biotechnology (Audretsch & Feldman, 1996). Regions are found to profit from the entrepreneurial activities of HEIs through job creation, spin-offs, and spillovers in the form of formal and informal

[†]~~It is recognized that universities can have numerous other roles in addition to teaching and research, such as for example regional governance and influence upon regional and national politics and policy (Arbo & Benneworth, 2007). The governance role of universities has, for example, not been given as much policy attention as the other areas (economic, social, innovation) and that is why we have not included it, and others, in our framework.~~

knowledge sharing. HEIs may also emerge as ‘anchors’ for local industry by attracting new talent, providing research that may be translated into products and services, and maintaining regional specialisation especially in science-based industries (Feldman, 2003). ~~Other reports have highlighted the contributions that arts, humanities and social sciences as well as science and engineering can make to regional development and innovation (EU 2011).~~

University entrepreneurial activities are considered being affected by national policy aspects, such as funding and intellectual property rights (IPRs) (Agrawal, 2001). In some countries commercialisation is explicit in national and regional policies. For example, in the UK “third-stream funding” is a key indicator of HEIs performance and has an influence on the level of future government funding (PACEC, 2009). ~~Since 1985, universities have been able to set their own rules on the ownership of IPR arising out of employees’ and students’ research and on allocation of income derived from subsequent commercialisation (see for example Oxford University²).~~ In the US, studies have found an increase in HEIs’ patenting and licensing activities after changes in IPR started by the 1980 Bayh–Dole Act or Patent and Trademark Law Amendments Act (Henderson et al., 1998).

The entrepreneurial university model is not uncontested. Firstly, HEIs exhibit much diversity internally, from each other, and in their respective regions and nations. The diversity of types of universities is insufficiently recognised by scholars and policy makers. In particular, the notion of the global university ‘isomorphic development path’ towards entrepreneurial activities (Etzkowitz et al., 2000) has been criticised for neglecting contextual specificities and lack of direct applicability to European countries with a tradition of the Humboldtian university model (Philpott et al., 2011). Secondly, there is no automatic correspondence between HEIs’ commercialisation efforts and the needs of the regional economy.

² ~~<http://www.admin.ox.ac.uk/researchsupport/ip/> (accessed December 16 2014)~~

Entrepreneurial universities do not necessarily have a strong regional impact. Casper (2013) has shown that universities' success to commercialize science does not only depend on factors internal to universities but also on the regional environment (more precisely, on the structure of regional social networks through which business relevant information travels). Other studies suggest that the co-presence of specific sectors such as biotechnology or computing (Feldman, 2003; Lawton Smith & Bagchi-Sen, 2012), firm R&D intensity and absorptive capacity (Agrawal & Cockburn, 2003) influences HEIs' abilities to commercialize their research.

RIS University Model

The regional innovation systems (RIS) approach (Cooke, 1992; Cooke et al., 2004; Asheim et al. 2011a) conceptualises universities as having a fundamental role in interactive innovation processes. Universities are key actors of a region's knowledge infrastructure. The RIS concept focuses on their interactions with other RIS players and how these interactions lead to systemic innovation. According to the RIS notion, HEIs are important knowledge producers that may play bridging roles in the innovation-production spectrum at the regional level.

Similar to the entrepreneurial university model, the RIS approach emphasises knowledge exchange between HEIs and the industrial world. In contrast to the entrepreneurial university model, the RIS concept does not only focus on commercialisation activities but takes into account a much wider set of knowledge transfer mechanisms. These include contract research, formal R&D co-operations and forms of knowledge transmission that do not involve financial compensations for HEIs such as knowledge spillovers (for example through the provision of graduates to the local labour market) and informal contacts with firms. Empirical work suggests that these knowledge transfer mechanisms are more common than those related with commercialization such as patents and licenses (Kitson et al., 2009). Within the RIS framework, an important task of universities is seen as transferring knowledge to SMEs and

clusters located in the region (Uyarra, 2010) as a determinant of an efficient system (Fritsch & Slavtchev, 2011). HEIs are considered to place such activities at the heart of their strategy and transform into RIS universities or what Kitson et al. (2009) call “the connected university”.

A key assumption of the RIS approach is that the role of HEIs does not only depend on their own strategies, activities and internal organisational characteristics. The configuration of the RIS and the innovation and absorption capacities of other RIS elements are central for specifying how university outputs are translated into regional development. The RIS university model points to a high degree of contextual specificity of university contributions to regional innovation and highlights that the role of universities in regional development might vary, depending on RIS structures (Tödtling & Trippel, 2005), prevailing knowledge bases (~~Asheim and Gertler, 2005~~; Asheim et al., 2011b) and the dominant regional growth path (Lester, 2005; ~~Isaksen Trippel 2014a~~).

Earlier contributions to the RIS approach have been criticised for overemphasising regional knowledge circulation and underplaying the importance of extra-regional knowledge for the innovation dynamics of regions. However, there are many studies that have taken the global dimension into account, finding support for universities as attractors of talent to the regional economy and enabling firms to access knowledge from global pipelines of international academic research networks with considerable regional impact (Lawton Smith, 2003~~Bramwell and Wolfe, 2008; Lawton Smith, 2003~~). ~~Moreover, in some places as we will show, universities are de jure part of regional governance systems, in others by their sheer local economic and political importance they are de jure system actors.~~

Both the entrepreneurial model and the RIS model highlight universities’ contributions to the economic dimension of regional development. A more comprehensive view that takes social,

cultural and societal activities of universities into account is proposed by the mode 2 and engaged university models.

Mode 2 University Model

A large body of work claims that there is a fundamental transformation of science systems that forms the context for the changing role of universities in regional development ([Hessels & van Lente, 2008](#)). ~~Several competing approaches of this view have been developed (see Hessels and van Lente, 2008: for an overview).~~ The most prominent approach is the “new production of knowledge” (NPK) theory (Gibbons et al., 1994; Nowotny et al., 2001; Gibbons 2013). The NPK theory discusses the role of universities in relation to new forms of knowledge production (referred to as mode 2), which are seen to increasingly challenge established ones (mode 1). More precisely, traditional, linear and disciplinary forms of university research are complemented by knowledge generation that arises from interactions between different disciplines and is directly applicable to current societal challenges (Gibbons et al. 1994; Nowotny et al. 2001). Key features underpinning mode 2 are knowledge production ‘in the context of application’, transdisciplinarity, heterogeneity, reflexivity, and new types of science governance and quality assessment (Gibbons et al. 1994). Contextual applicability suggests that HEIs are engaged in collaborative research with other organisations. Through these processes they produce knowledge that is relevant and connected to its environment. Heterogeneity amongst actors broadens accountability, transparency and quality appraisal of HEIs activities to audiences beyond academic ‘peers’. Instead of being remote from society, HEIs are portrayed as contributing to the solution of societal problems (Nowotny et al., 2001).

Changes in university and science funding have been identified as one key driver shaping university shifts to mode 2 (Nowotny et al., 2001). Many universities are facing national

funding constraints and a directing of research priorities towards research areas of direct industrial, political and social importance, such as for example issues of EU relevance through Framework Programmes, and demands of higher public accountability and; user involvement (Shove & Rip, 2000; Klenk & Hickey, 2013) ~~and in the UK ‘impact’ of research (RCUK, 2012).~~

Regional expressions of mode 2 activities can take several forms, reflecting a wide participation of HEIs in regional development and responses to social and economic demands. Some scholars highlight involvement of HEIs as “co-producers” of knowledge relevant to the regional industrial context and complex practice-based knowledge production (Geuna & Muscio, 2009). University engagement may also involve research projects in the solution of local problems such as urban planning, transportation or health.

The mode 2 concept has been criticised for several reasons, such as its conceptual value, empirical basis and its implications for university research and policy (Hessels & van Lente, 2008; Hardeman et al., 2014). Carayannis & Campbell (2011) challenge the mode 2 approach for its neglect of institutions, systems, natural eco-system and environment. They suggest a ‘mode 3’ of knowledge production to take into account these dimensions.

Engaged University Model

The ‘engaged university’ is a concept for understanding the adaptation of university functions to regional needs (Boyer, 1990; ~~1996~~; Uyarra, 2010). Engaged universities demonstrate a localised developmental as opposed to only the knowledge-generative role (Gunasekara, 2006). The engaged university is perceived as focusing its activities towards local industry and society and actively shaping regional identity (Breznitz & Feldman, 2012).

University engagement can take a variety of forms. HEIs may adjust their teaching activities to local needs through the provision of regionally focused programmes, local student recruitment and retaining of graduates. Engagement is also expressed in activities such as formal integration of regional needs in university priorities, coordination of regional networks and policy advice (Gunasekara, 2006). Furthermore, engaged universities may involve themselves directly with local firms, providing assistance and research support.

University engagement is influenced by a shift in policy agenda from a focus on national challenges and basic research towards orientation on regional contexts (~~Arbo and Benneworth, 2007; Goddard and Chatterton, 1999~~ Arbo & Benneworth, 2007). In Europe, a key factor in changes in orientation has been the European policy level with its funding programmes (structural funds) animating universities to strengthen their focus on regional economic development within the EU Europe 2020 initiative and the goals of ‘smart specialisation’ (~~Foray and Goenaga, 2013; Kempton et al., 2013~~). ~~Specific characteristics of regions and universities are considered to affect the extent and degree to which HEIs engage locally. Boucher et al. (2003) find that characteristics such as the regional identity, commitment to the region and structural features of the regional economy play a role in shaping university region relationships.~~ Empirical work suggests that the extent and type of regional engagement of HEIs are influenced by the age of universities and their locations. Younger universities and those located outside metropolitan regions tend to have a stronger focus on regional engagement (Boucher et al., 2003).

The arguments advanced by the protagonists of the engaged university model have not remained unquestioned. One key issue of critique is that the concept lacks empirical foundation. Except from a few examples, empirical evidence of successful forms of engagement is scanty. Due to the lack of systematic evidence, the core mechanisms and

effects that are related with various types of engagement in different fields (social, economic, political) are still poorly understood (Uyarra, 2010). In conceptual terms, the engaged university model fails to clarify how HEIs can integrate and coordinate different missions and functions in effective ways. Finally, this approach overestimates the capabilities of HEIs to realign their activities in response to external signals (Gunasekara, 2006). The engaged university model takes for granted that HEIs have multiple opportunities for pursuing explicitly a regional mission. It downplays the fact that in many countries it is still national and not regional framework conditions (public funding, regulation of teaching programmes, incentive structures) that shape the scope of action of HEIs.

University Models in Comparative Perspective: Contributions to Regional Development and Policy Implications

As shown above, conceptualizations of university contributions to regional development are various and diverse. The four university models reviewed in the previous sections overlap to some extent but they also differ in many respects. Figure 1 highlights key commonalities and differences regarding the specific activities by which universities are seen to contribute to regional development, and the policy implications that can be drawn. The entrepreneurial model claims that universities promote the development of their regions by engaging in patenting, licensing and academic spin-off activities, generated from university subjects such as engineering, information technology, and biotechnology, in which the knowledge produced overlaps more readily with products and processes that industry and market structures can absorb. The RIS model suggests a broader spectrum of university activities by adding “softer” forms of knowledge transfer (such as contract research, research collaborations and informal networking with industry) to the direct commercialization activities emphasized by the entrepreneurial model. Both models, however, focus only on forms of university activities that target the economic dimension of regional development. Thus, they reflect a technology-

oriented and economic interpretation of the role of universities. This narrow perspective overlooks non-economic societal activities that HEIs potentially conduct. They are based upon the arts and humanities subjects and relate to the socio-cultural functions of universities.

Whilst not ignoring university contributions to regional economic development, the mode 2 and engaged models go well beyond the narrow view, directing attention to social, cultural and societal activities by universities. A key difference between these two models concerns the type of HEI activities that are highlighted. The main focus of the mode 2 model is on new forms of research activities that address big (regional) societal challenges in fields such as environment or health, while the engaged model also includes teaching and other university functions, directing attention of university contributions to regional development that are related with their social, political and civic roles and include activities such as. ~~For example, Goddard et al. (2013) demonstrated, that in six English universities in three large cities, significant numbers of academics engage in 'public good' activities such as~~ informing policy, contributing to health and well-being, environmental sustainability, cultural enrichment and helping the socially excluded (Goddard et al., 2013).

The four models lead to different policy conclusions. Policy actions geared towards the promotion of entrepreneurial activities cover the regulation of IPRs, public support for the establishment of technology transfer organizations, science parks and incubators as well as more direct forms of encouragement of academic spin-off processes. Stimulating universities to adopt the RIS model require policy measures that foster the creation of various types of university-industry links and the integration of universities in regional cluster and innovation strategies. Mode 2 activities are best supported by policy programmes that promote transdisciplinary research activities and by public funding of research that considers societal challenges. Finally, the engaged university model requires a rather broad mix of policies at

various levels and the proactive integration of universities as key players in regional or local innovation and governance networks.

Figure 1 about here

Policy Institutions and University Models in the UK, Sweden and Austria

In this section, we look at national policy imperatives and incentives designed to promote university contributions to regional development in the UK, Sweden and Austria. These three countries were chosen because they are similar in their developmental levels and at the same time quite heterogeneous in their university populations, contexts and approaches, ~~which is useful for informing both national strategies and large scale supra-national programs that affect universities, such as Horizon 2020.~~ The aim is to explore if and how policy institutions (i.e., imperatives and incentives in the form of funding schemes) in the three countries tend to “privilege” one of the university models identified in Section 2. Our main focus is on ‘third mission’ policy institutions. Arguably, many other policy institutions under various policy domains (such as science policy, research policy, education policy, economic policy, industrial policy) can support or constrain the regional impact of HEIs. Furthermore, not only policy institutions but many other factors (such as features of the university population, traditions, regional characteristics, and so on) may shape university contributions to regional development. It is, however, far beyond the scope of this paper to analyse the full spectrum of policies and factors that might exert an influence in this regard.

The methodology has been to collect data on policy institutions from both academic and grey literature sources that have discussed characteristic policies relating to the translation of third

mission concepts to practice. Here policies are understood as laws, regulations and incentives that underpin third mission activities. The advantage of using academic and grey literature sources is that it enables a vast array of policies affecting universities by scholars acknowledged as experts in the field to be distilled. A disadvantage of using these sources is the possible biases that result (such as a greater focus on the UK case, and a lesser focus on the Swedish and Austrian cases). To lessen this bias we complemented our sources with grey literature from these countries.

United Kingdom

In England, Wales and Northern Ireland, HEIs are independent, self-governing bodies. They are established by Royal Charter or legislation, and most are part-funded by government. In 1992 the Further and Higher Education Act enabled all polytechnics to become universities. The UK (with a population of more than 60 million people) hosts around 280 HEIs. UK's hierarchical HEI system comprises some 115 universities and 165 colleges. The 24 older research-intensive universities form the Russell Group including four (Oxford, Cambridge, Imperial College, and University College London) which are amongst the world's top ten research institutions. Other categories are the more recent research universities established in the 1960s and the post-1992 'new' universities which were mainly former polytechnics and colleges under local authority control. Now higher education embraces a variety of forms including hybrid colleges of further education. ~~The number of students has increased by 15% over the period 2000/1 and 20013/14, having increased by 22% up to 2010/11, when numbers peaked. The decline in numbers is associated with a decrease in part-time students, especially undergraduates, who until 2015 were not eligible for student loans.~~ It is many of the post-1992 universities as well as the universities that were not polytechnics (such as colleges of higher education, teacher training) that have expanded the most rapidly. Local student recruitment is increasing, particularly in those HEIs that are most engaged in their local economy, pointing to a rise of the engaged university model.

(i) *National policy institutionsfluences – laws and regulations:* The UK was the first European country to develop a national university commercialisation policy (Geuna and Muscio, 2009), enabling HEIs to pursue "entrepreneurial university model" activities. In 1985, the British Technology Board lost its monopoly access to IP arising from universities and public sector research institutions from Research Council-funded projects. HEIs were

expected to give the fullest opportunity and scope to researchers to assume responsibility for exploiting their scientific findings and to provide support for those academics.

(ii) National policy *institutionfluences* – incentives: Types of UK funding for ‘third stream’ activity include: (i) non-spatial research grants with conditions relating to projections of impact for example those funded under the seven UK research councils, (ii) funding programmes specifically designed to have commercial outcomes (e.g., spin-offs), and (iii) funding that has regional/local engagement or governance built in. In 2009, the government launched the framework for the future success of HEIs, setting out the key role universities will play in securing the country’s long-term prosperity, in *Higher Ambitions: the Future of universities in the knowledge economy*. This emphasized the importance of research, high-level skills and widening access. The 2013 Witty Review of *Universities and Growth* (Witty, 2013: 6) recommended that ‘incentives should be strengthened to encourage maximum engagement in an enhanced Third Mission alongside Research and Education, and that universities should make facilitating economic growth a core strategic goal’.

A key funding body is the Higher Education Funding Council for England (HEFCE), which regulates and funds activities in the some 130 English HEIs. This organisation’s approach to the regions recognises the diversity of HEIs and of regions, and does not seek to impose any blueprint, but rather to support the relationships that are already being developed between regional and local bodies and HEIs. The Higher Education Innovation Fund (HEIF) programme established by HEFCE in 2001 provides funding for universities to support them in developing activities such as knowledge transfer to firms and interactions with the wider community. The Science Enterprise Centres (focusing on entrepreneurship, aimed at both staff and students) and the University Innovation Centres (focused on collaboration between HEIs) were set up as separate funds under HEIF 1 (Charles, 2003). As the HEIF programme

has expanded, it has become more commercially orientated and has sought to be more inclusive. Under HEIF3 it was intended that rather than the largest grants being awarded to the elite, research-led Russell Group, support should be given for less research-intensive university departments. HEIF 4 rose to £150 million per year in 2010-11. For the first time money was allocated by formula rather than by competitive bidding. In the following four years to 2015, the government is continuing HEIF at its cash level from 2010-11 ([HEFCE, 2011](#)).

A report by PACEC (2012) concluded that Knowledge Exchange (KE) looks to permanently embedded within many HEIs. HEIF funding, alongside other external funding such as through the former regional development agencies (see below) and European Union funds has helped to raise economic and social impacts of HEIs through KE. A conservative estimate of the impact of HEIF funding is that for every £1 of HEIF invested, it returns £6 in gross additional knowledge exchange income. However, the report finds that HEIF is one of a dwindling number of funds available to secure leverage for other KE funding (see also Ulrichsen, 2014). Other government agencies which fund innovation, primarily Innovate UK fund, support and connect innovative businesses to accelerate sustainable economic growth. However, some of this funding is geared at supporting university industry interaction through for example through Knowledge Transfer Partnerships (a scheme by which a graduate works in a company but supervised by an academic).

(iii) Regional institutions: One of the distinctive features of the UK compared to Austria and Sweden is that it does not have a regional structure of government – and now not even one of regional governance. The sub-national system is a mixture of counties, unitary authorities and metropolitan cities. The nine regional development agencies (RDAs) established by the 1997 Labour Government in 1998 were abolished in 2012 following the change of government in

2010 (Conservative and Liberal Democrat Coalition) and replaced by Local Enterprise Partnerships (LEPs) (see below). A range of other initiatives have been designed to facilitate university-industry interaction at the regional and city level, and more recently to local levels.

The origin and the length of survival of regional institutions designed to support university interaction at the regional level reflect prevailing political priorities, and what Charles et al. (2014) identify as the context of spatial governance shifts over time. For example, nine English Higher Education Regional Associations were established at the same time as the RDAs, although one predated that period and one was established later. HEIF 2 provided partial funding. They were designed to encourage “RIS university model” and “engaged university model” activities through promoting the role of HEIs in their areas, placing a particular emphasis on fostering collaboration between HEIs, and building partnerships between higher education and other organisations within their regions.

Some such as London Higher and Universities for the North East still exist, but with other sources of funding. Others such as the Higher Education South East and the North West Universities Association (NWUA) ceased trading when the RDAs’ funding ran out in 2012. In the case of the last, the NW Universities European Unit Limited (NwUEU) was formed in March 2012 in order to continue the European activities undertaken by North West Universities Association³. In the 2000-2006 programme, NWUA were allocated over £138 million ERDF and European Social Fund (ESF) funding (Charles et al 2014). With the demise of the RDAs went financial support for regionally focused activities involving HEIs. Charles et al. (2014) argue that without public support for collaboration provided by RDAs and HEFCE, the incentive for universities to collaborate across institutions within and across regions is far less.

³ <http://www.nwueu.ac.uk/> (accessed March 28 2015)

In 2005, the ‘science city’ initiative was launched, aiming at harnessing the research capacity of HEIs, the entrepreneurial skills residing within the local economy and promoting public engagement in science. Six cities (Newcastle, Birmingham, Bristol, Manchester, Nottingham and York) were designated as “Science Cities”. These were also affected by the loss of RDA funding. For example, Newcastle Science City has survived in spite of the loss of RDA financial support (OneNorthEast) by joint funding provided by Newcastle University and Newcastle City Council⁴.

Policy institutions in the UK favour various HEI contributions to regional development, supporting all university models discussed in Section 2. National policy and funding have had impact on HEIs’ perceptions of their regional role due in part to the incentives that funding provides (PACEC, 2009). The HE-BCI survey 2009-10 provided further insights, showing that just over 30% reported meeting regional needs and a very small percentage identified spin-off activity as making an essential regional contribution, compared to the major roles of providing access to education and supporting SMEs. HEIs’ role as a source of new firms is increasing over time. In 2009, institutions reported 2,045 start-ups, an 11-fold increase in nine years. Other studies have found regional differences in the relative importance of revenue from IP and university spin-offs. The South East England is one of only a few regions where income from spin-offs and IP is above average (Lawton Smith and Bagchi-Sen, 2012).

Central government influence, however, remains strong both on the universities through the Research Excellence Framework and on the remit and funding for the LEPs. The 2014 Research Excellence Framework (REF) organised by HEFCE which evaluated universities’

⁴ <http://www.ncl.ac.uk/about/values/partnerships/city/sciencecity.htm> (Accessed march 27 2015)

research performance emphasised the importance of ‘impact’ of academics’ research with ‘impact’ case studies being part of the assessment. As well articulating the significance of that research to society, it also has brought a new dimension to perceptions of the rewards of engagement with public and private sector organisations. If the REF continues, the next one is scheduled for 2020, this may provide a greater incentive for universities to work with the LEPs.

LEPs in principle in this context operate as models of locality rather than at the level of the region by bringing together private and public sector organisations in a smaller, defined economic area to support enterprise, innovation, global trade and inward investment (see Ulrichsen 2014). Universities UK (2010) finds that HEIs are well represented on the boards of the new LEPs, and many LEPs, as in Oxfordshire, have defined a strategic role for universities in delivering economic growth (see Lawton Smith & Waterset *et al.*, 2015).

Sweden

In 1970s and 1980s the HEI sector and the university structure in Sweden underwent major changes. A spatial decentralization and expansion of the HEI system could be observed. Throughout the country new HEIs were established (Andersson *et al.*, 2004). Today, the Swedish HEI sector consists of about 50 HEIs, including 13 public-sector universities, 20 public-sector university colleges, three self-governed HEIs entitled to award third-cycle qualifications and a number of independent education providers entitled to award first-cycle and second cycle qualifications. In contrast to the UK, Sweden has a much smaller population (9.5 million) and far fewer universities. Like the UK, it has expanded the number of HEIs, and the younger universities have a stronger focus on teaching, often considering regional needs of the private sector.

The national government has the responsibility for HEIs concerning a wide range of areas such as legislation, regulation, funding and granting of degree awarding powers and university status.

(i) *National policy institutions – laws and regulations:* In the Higher Education Act of 1992 the third mission of Swedish universities is pinned down as follows: “The institutions of higher education shall ... cooperate with the surrounding community and give information about their activities”. In the Higher Education Ordinance (2009:45) “third stream activities” are emphasized: “The mandate of higher education institutions shall also include third stream activities ... as well as ensuring that benefit is derived from their research findings”. However, freedom is granted to academics to pursue technology transfer how they wish. In Sweden’s IP regime, it is individual scientists (the so called “professor’s privilege”) – and not universities – who own full rights to their discoveries (irrespective of the funding source).

(ii) *National policy institutions – incentives:* Looking at Swedish science and research policy, it can be observed that from the 1990s onwards attempts have been made to strengthen “strategic” and mode 2 research activities at HEIs, i.e. interdisciplinary research that is linked to industrial and societal interests (Edqvist, 2003). Several new funding organisations have been established to promote strategic research and the mode 2 university model. However, evidence of major changes in the structure or content of HEIs’ research activities has so far been limited.

The Swedish national innovation policy system supports HEIs’ contributions to regional development in a variety of ways. Several institutions and programmes are worth mentioning in this regard. The Swedish Agency for Innovation Systems VINNOVA (founded in 2001) provides funding for needs-driven research and intends to stimulate cooperation between

firms, universities and policy actors in the Swedish innovation system ([Elg & Håkansson, 2012](#)). Each year around ~~SEK 2,5 billion~~ [220 million Euros \(Anaya-Karlsson & Lundberg, 2014\)](#) are invested in new and ongoing projects. According to Pålsson et al. (2009) VINNOVA's mandate includes promoting a change of the academic culture, fostering the rise of values such as entrepreneurialism and competitiveness within the HEIs sector. VINNOVA runs several initiatives. The national programme Key Actors (launched in 2006) aims at improving the capacity of HEIs to cooperate with firms and other actors and to diffuse and commercialize research. Another initiative is the VINN Excellence programme that supports establishment of Centres of Excellence to foster collaboration between firms and HEIs. [An assessment of these centres has shown that in the year 2012 158 product and process innovation were generated, eight companies were founded and 32 patents were pending or have been granted \(Anaya-Karlsson & Lundberg, 2014\)](#). The VINNVÄXT programme focuses on stimulation of regional development by promoting collaboration between HEIs, firms and policy actors and need-oriented research in RIS. Another key actor is NUTEK (reorganized into Tillväxtverket (Swedish Agency for Economic and Regional Growth) in 2009), providing amongst other initiatives the Regional Cluster Programme that supports clusters in which HEIs are involved as key actors. In 2005, "Innovationsbron" (Innovation Bridge) was set up (reorganized in 2008) by the government, aiming at increasing commercialization of publicly funded R&D. Innovationsbron acts as a seed investor in the early growth phase of new businesses. Each year around 30 to 40 companies are supported. The Knowledge Foundation (KK-stiftelsen) supports research carried out at Sweden's new universities (i.e. those established after 1977) with co-funding and active participation by industry as a requirement. Key initiatives promoting the development of knowledge and collaboration between HEIs and firms are the programmes HÖG and KK environments. Since its establishment in 1994, KK-stiftelsen has invested around SEK 7.8 billion in more than 2,100 projects.

Whilst interaction between universities and (large) companies has a long tradition, commercialization activities (spin-offs, patenting and licensing) by HEIs are a more recent phenomenon. As noted above, in Sweden the “professor’s privilege” applies. Over the last years, Swedish universities have increased their capabilities to support entrepreneurship by establishing and strengthening support structures such as TTOs (Etzkowitz et al., 2008). Nevertheless, it is often assumed that Sweden lacks entrepreneurial spirit in science and performs poorly in academic commercialization. A survey of 295 Swedish academic researchers (Bourellos et al., 2012), however, indicates the opposite. It was found that Swedish university researchers have positive attitudes towards patenting and spin-offs and a considerable share of them is involved in commercialization activities. Furthermore, an important role of technology transfer offices, incubators and entrepreneurial courses and training in supporting academic commercialization was found.

(iii) Regional institutions: Within the Swedish government structure, regional authorities have only limited influence on economic policies when compared with the national state government and local (municipality) authorities. Regional innovation policies are thus often the outcome of collaboration with national and local policy levels. Swedish regional policy has changed considerably, evolving from a regional distributive policy to a regional development policy and eventually a regional growth policy. ~~The Government White Paper 1997/98: 62 “Regional tillväxt — för arbete och välfärd” formulated a new policy approach, emphasizing life-long learning and ascribing a key role to HEIs (Hudson, 2000). More recently, VINNOVA has stimulated university industry policy links at the regional level (see the VINNVÄXT programme described above).~~

A study (Lindqvist et al., 2012) found that Swedish HEIs increasingly play an active role in regional development. Their respective strategies and activities, however, differ strongly, depending on the type of HEIs under consideration. New HEIs often have a strong focus on education, focusing on regional needs for competence in the private or public sector, whilst traditional universities employ research-oriented activities (see also Pålsson et al. 2009). The distribution of VINN Excellence Centres (one of VINNOVA's main policy programmes) among Swedish universities is extremely uneven, as only a few HEIs have successfully applied for the establishment of such centres.

To summarize, policy institutions in Sweden appear to favour in particular the RIS university model. However, there are also some institutions in place that promote activities that correspond with the entrepreneurial, mode 2 and engaged models.

Austria

Austria, with a population of 8.2 million people is similar in size to Sweden but has approximately half the number of universities. The Austrian HEI sector has about 21 institutions and is divided into two groups, i.e. universities and “Fachhochschulen” (universities of applied sciences). The latter group constitutes a relatively new and rather small segment. The primary role of “Fachhochschulen” (FHs) is in teaching, offering practice-oriented professional education at university level. FHs do not get basic public funding for research and, as a consequence, research-related contributions to regional development are modest in extent. Austrian universities still rely on the Humboldtian idea of unity of research and teaching. In Austria, there is no such division between elite research universities and teaching universities as in the UK. Austrian universities can be divided into “full-scale” universities (with a full range of faculties) and “specialised” universities such as technical, medical or arts universities. There are pronounced differences among the various types of Austrian HEIs as regards engagement in economic development. Technical and medical universities, although in most cases much smaller than full-scale universities, are by far more successful when it comes to collaborating with firms and to draw financial advantages from such partnerships (BMFWF & BMVIT, 2014).

(i) National policy institutions – laws and regulations: For a long time, universities in Austria have been directly controlled and regulated by the state. A paradigm shift took place in 2002 when a new university act (UG 2002) was passed. The law was implemented in 2004, transforming universities into independent legal entities under public law and endowing them with autonomy and full legal responsibility. As a consequence the relation between universities and the state has been substantially reshaped. New forms of state control include performance agreements (negotiated between each university and the ministry of science and

research), complementing control processes created through the competition between universities. UG 2002 also laid the foundations for HEIs to become more entrepreneurial, as it involved changes in the regulation of IP, granting IPR emanating from publicly funded research to HEIs. Before 2002, IPR had belonged to the state that, however, had handed it over to the individual inventor. It was not until 2002 that HEIs could claim title to the inventions made by their employees. As a consequence, professional IPR management structures at universities are a rather recent phenomenon. UG 2002 contains a rather vague account of the role of universities in economic and societal development. In this act (§ 3), the respective tasks of universities are described as “promotion of the use and practical application of their research findings, and of community involvement in efforts to promote the advancement and appreciation of the arts”.

(ii) National policy institutions – incentives: From the 1990s onwards many national policy programmes and initiatives have been launched to promote knowledge transfer from universities to firms and to stimulate university-industry partnerships. Among the most important current ones are the programmes COMET, BRIDGE and COIN as well as Christian Doppler Laboratories. COMET promotes the establishment of competence centres that are jointly run by universities and companies. COIN promotes R&D projects and networks between HEIs and SMEs and BRIDGE aims at enhancing translational research activities by HEIs. University-industry interaction is also promoted through financial support for the establishment of so called “Christian Doppler Labs” which are jointly run by HEIs and firms. Policy measures designed to stimulate academic spin-offs are a more recent phenomenon. An important initiative is the AplusB programme launched in 2002. It funds incubators that provide support for scientists in the process of turning research results into a viable business.

By the end of the year 2013, [550438](#) academic spin-offs have been founded ([AplusB, 2014](#)).

A plethora of programmes exist to foster HEI-industry links and academic spin-offs. Policy

incentives at the national level thus clearly privilege the RIS university model. Promoting universities' engagement in commercializing science is a rather recent phenomenon. The promotion of the RIS university model is reinforced at the regional policy levels.

(iii) Regional institutions: In Austria, the university sector is regulated by the Federal Ministry of Science and Research. The federal provinces do not have direct competencies for university matters, but they have formal competencies for developing their own regional innovation policies. Vienna, the nation's capital city and scientific centre, hosts a large number of Austrian universities (nine out of 22) and almost 60% of all Austrian students. Until recently, however, university contributions to regional development were not an important issue, neither for HEIs themselves nor for policy makers. Vienna's economic structure is characterised by a high diversity of sectors and a dominance of SMEs, resulting in low levels of university-firm links. Vienna displays features of a fragmented RIS, although in a few ~~high-tech~~ sectors (such as biotechnology, ICT ~~and food~~) higher levels of connectedness have emerged recently ([Trippl & Tödting, 2007](#); [Trippl, 2011](#)). In other Austrian regions such as Styria and Upper Austria HEIs are used as an asset in a more active way. Both regions exhibit specialised economic structures and HEIs have with the support of regional policies played a key role in renewing old sectors and creating new ones (~~Isaksen and Trippl, 2014b~~; [Trippl & Otto, 2009](#); [Isaksen & Trippl, 2014](#)).

Comparing the Cases

The country studies show that ~~'third mission'~~ policy institutions in the UK, Sweden and Austria tend to favour rather different university contributions to regional development. Several important characteristics stand out in the policy features explored. First, one finds strong differences between the three countries as regards the dates at which policy targeted university-society interaction. The UK was much earlier than Sweden and Austria in

providing policy incentives to HEIs' entrepreneurial activities. It can be dated to 1985, with the passing of the UK equivalent to the US Bayh-Dole Act of 1982. However, it was not until the late 1990s that specific national funding was directed towards commercialising university research. In Sweden and in particular in Austria, legislation was introduced later but unlike in the UK, there is a specific commitment in law to cooperation with the local community. Unlike in the UK and Austria where universities have asserted the rights to their academics' IP, in Sweden the 'professors' privilege' means that the academics own their IP. In the UK universities are 'incentivised' to engage in third stream activity through a variety of national funding streams many of which have spatial outcomes. The engaged university model has been articulated through the former RDAs. It is now up to the LEPs to promote contributions by HEIs in their regions through representation on their boards, bringing in them in principle into local systems of governance. In Austria and Sweden from the 1990s onwards, national programmes were designed to encourage in particular the RIS university model.

~~Second, policy institutions in the three countries differ in their intentions. In Austria they are rather vague ("practical application of research findings" and "community involvement in efforts to promote the advancement and appreciation of the arts"). Sweden focuses on linking communities with HEIs through information provision and benefit (a broad term) from research findings, which encompasses all four university models. In the UK policy incentives have invoked universities to make "economic growth a core strategic goal", making much more explicit the (narrower) focus on direct economic benefit, and hence the entrepreneurial role of HEIs.~~

~~Second~~^{Third}, there exist important similarities and differences in the ways in which the regulatory measures and policy instruments promote university contributions to regional development. In the UK, although the policy rhetoric focuses on direct economic value of

universities, the programmes in place are more nuanced, promoting commercial outcomes, local engagement, and knowledge transfer to firms. Over time, UK policy has evolved even more towards a differentiated approach, recognising the diversity between universities (some are more able to commercially exploit their research, others more able to engage locally, and the intention has developed to support these already existing capacities). Policy instruments in Sweden have reflected a (broader) mode 2 approach, and the promotion of inter-organisational interactions (RIS university model). Many programmes in Sweden have come out of VINNOVA initiatives, but their impact is difficult to assess because it is much more difficult to measure contributions to the RIS (for example, knowledge flows) and to the community than it is to quantify commercial outcomes such as spin-offs and patents. In Austria, there is an obvious difference between policy mandates (community oriented) and the incentives actually in place (more entrepreneurship focused, such as changes in regulation of IP, and a variety of programmes that support the RIS model). In Austria and Sweden, relatively little has been done so far to tailor policies towards individual university capacities.

Third~~Fourth~~, in all three countries, it is national programmes that dominate funding for university contributions to regional development. In the UK, a small number of regionally funded initiatives have developed. Initiatives led by the RDAs were hampered by low levels of funding and the LEPs will have even less, thus limiting the incentives for HEIs to collaborate. Similarly in Sweden, regional authorities have limited funds. In Austria, the regions have competencies for formulating their own regional innovation policies but have no responsibilities for university matters.

Finally, our analysis has shown that the UK has the longest tradition of third mission, but has the least well mandated regional role. National policies have resulted in all four university models. The sheer scale of HEI activity dwarfs that of the smaller countries of Sweden and

Austria, although this no guide to quality of impact. In Sweden and Austria policy institutions favour in particular the RIS model whilst at the same time a growing emphasis on the entrepreneurial university model can be observed.

Conclusions

This paper has offered a conceptual framework for analysing how policy institutions influence universities' activities that contribute to regional economic and societal development in differing national contexts. These are 'third mission' activities. By highlighting policy imperatives and incentives designed to facilitate broader and deeper engagement of universities in the economy and society, the paper has shown which elements of the range of theories have most usefully informed national and regional policy strategies, and how the differing national and regional contexts interact with the institutional shaping of university policy.

Our results indicate that not all four third mission models flourish to the same extent in all countries and regions. A key issue for future research relates to the need for closer interrogative explication of the pattern found. Policy path dependence and paradigms, HEI traditions, public acceptance of university engagement, the overall institutional context (as suggested for instance by the variety of capitalism approach) may be key explanatory variables for varying forms of HEI engagement across countries and regions. There is a need for further conceptual and empirical workresearch to shed more light on the conditions that favour and hamper the realisation of each of the four models. This paper has examined the role played by national and regional policy institutions in this regard, focusing on laws and regulations and incentives in the form of funding schemes that support various forms of universities' third mission activities in regions. Future studies may benefit from taking a broader perspective by going beyond the 'third mission policies' analysed in this paper.

Several other institutions under various policy domains (research funding, education policy, industrial policy, and so on) have an influence on the regional impact of universities. Understanding the effect of a larger set of policies on university activities is an important line of future research. Furthermore, scholarly work needs to clarify the relation between policy institutions at various spatial scales, that is, to what extent and in which ways they complement, reinforce or contradict each other, and how this affects universities' engagement in regions. In addition to the factors considered in this paper, future research should devote attention to a broader set of determinants (including, for example, public acceptance of the four models, the role of political paradigms, etc.) and examine how they vary across different nations and regions.

References

AplusB (2014) *Leistungsbericht 2013* (Vienna: AplusB).

Anaya-Carlsson, K. & Lundberg, M. (2014) Results from 18 VINN Excellence Centres reported in 2012. Vinnova Analysis VA 2014:02, Stockholm

Agrawal, A. (2001) University-to-industry knowledge transfer: literature review and unanswered questions, *International Journal of Management Reviews*, 3(4), pp. 285-302.

Agrawal, A. & Cockburn, I. (2003) The anchor tenant hypothesis: exploring the role of large, local, R&D intensive firms in regional innovation systems, *International Journal of Industrial Organization*, 21(9), pp. 1227-1253.

Andersson, R., Quigley, J. & Wilhelmson, M. (2004) University decentralization as regional policy: the Swedish experiment, *Journal of Economic Geography*, 4(4), 371-388.

Arbo, P. & Benneworth, P. (2007) Understanding the regional contribution of higher education institutions: A literature review (Paris: OECD).

Asheim B and Gertler M (2005) *The Geography of Innovation: Regional Innovation Systems*. In: Fagerberg J, Mowery DC and Nelson N (eds) *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Asheim, B., Lawton Smith, H. & Oughton, C. (2011a) Regional Innovation Systems: Theory, Empirics and Policy, *Regional Studies*, 45(7), pp. 875-891.

Asheim, B., Boschma, R. & Cooke, P. (2011b) Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases, *Regional Studies*, 45(7), pp. 893-904.

Audretsch, D. & Feldman, M. (1996) R&D Spillovers and the Geography of Innovation and Production, *American Economic Review*, 86(4), pp. 253-273.

Bundesministerium für Wissenschaft, Forschung und Wirtschaft (BMFWF) & Bundesministerium für Verkehr, Innovation und Technologie (BMVIT) (2014) *Österreichischer Forschungs- und Technologiebericht* (Vienna: BMFWF & BMVIT).

Boucher, G., Conway, C. & Van der Meer, E (2003) Tiers of Engagement by Universities in their Region's Development, *Regional Studies*, 37(9), pp. 887-897.

Bourelas, E., Magnusson, M. & McKelvey, M. (2012) Investigating the complexity facing academic entrepreneurs in science and engineering: the complementarities of research performance, networks and support structures in commercialization, *Cambridge Journal of Economics*, 36(3), pp. 751-780.

Boyer, E. (1990) *Scholarship reconsidered: The priorities of the professoriate* (Princeton, NJ: Carnegie Foundation for the Advancement of Teaching).

~~Boyer E (1996) The scholarship of engagement. *Journal of Public Service and Outreach* 1: 11-20.~~

~~Bramwell A and Wolfe D (2008) Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy* 37: 1175-1187.~~

Breznitz, S. & Feldman, M. (2012) The engaged university, *Journal of Technology Transfer*, 37(2), pp. 139-157.

Carayannis, E. & Campbell, D. (2011) *Mode 3 Knowledge Production in Quadruple Helix Innovation Systems* (New York: Springer).

Casper, S. (2013) The spill-over theory reversed: The impact of regional economies on the commercialization of university science, *Research Policy*, 42(8), pp. 1313-1324.

Charles, D. (2003) Universities and territorial development: reshaping the regional role of English universities, *Local Economy*, 18(1), pp. 7-20.

Charles, D., Kitagawa, F. & Uyarra, E. (2014) Universities in Crisis - New Challenges and Strategies in Two English City-regions, *Cambridge Journal of Regions, Economy and Society*, 7(2), pp. 327-348.

Clark, B. (1998) *Creating Entrepreneurial Universities: Organizational Pathways of Transformation* (New York: Elsevier).

Cooke, P. (1992) Regional Innovation Systems: Comparative Regulation in the New Europe, *Geoforum*, 23(3), pp. 365-382.

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Cooke, P., Heidenreich, M. & Braczyk, H-J. (Eds) (2004) *Regional innovation systems. 2nd ed.* (London and New York: Routledge).

Edqvist, O. (2003) Layered science and science policies, *Minerva*, 41(3), pp. 207-221.

Etzkowitz, H. (1983) Entrepreneurial scientists and entrepreneurial universities in American academic science, *Minerva*, 21(2), pp. 198-233.

[Elg, L. & Håkansson, S. \(2012\) Impacts of innovation policy. Vinnova Analysis VA 2012:01, Stockholm.](#)

[Etzkowitz, H. \(1983\) Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva*, 21\(2\), pp. 198-233.](#)

Etzkowitz, H. (2014) The second academic revolution: The rise of the entrepreneurial university and impetuses to firm formation, in: T. Allen & R. O'Shea (Eds) *Building technology transfer within research universities: an entrepreneurial approach*, pp. 12-32 (Cambridge: Cambridge University Press).

Etzkowitz, H., Ranga, M., Benner, M., [Guaranys, L., Maculan, A. & Kneller, R.](#) (2008) Pathways to the entrepreneurial university: towards a global convergence, *Science and Public Policy*, 35(9), pp. 681-695.

Etzkowitz, H., Webster, A., Gebhardt, C. & [Terra, B.](#) (2000) The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm, *Research Policy*, 29(2), pp. 313-330.

Fayolle, A. & Redford, T. (Eds) (2014) *Handbook Of The Entrepreneurial University* (Cheltenham: Edward Elgar).

Feldman, M. (2003) The Locational Dynamics of the US Biotech Industry: Knowledge Externalities and the Anchor Hypothesis, *Industry and Innovation*, 10(3), pp. 311-328.

~~Fritsch, M. and Slavtchev, V. (2011) Determinants of the Efficiency of Regional Innovation Systems, *Regional Studies*, 45(7), 905-918~~

~~Foray D and Goenega X (2013) The Goals of Smart Specialisation. S3 Policy Brief Series No. 01/2013, European Commission Joint Research Centre Institute for Prospective Technological Studies, Seville.~~

~~Geuna, A. & Muscio, A. (2009) The governance of university knowledge transfer, *Minerva*, 47(1), pp. 93-114.~~

Gibbons, M (2013) Mode 1, Mode 2, and Innovation, in: E. Carayannis (Ed) *Encyclopedia of Creativity, Invention, Innovation, and Entrepreneurship*, pp. 1285-1292 (Berlin: Springer).

Gibbons, M., Limoges, C., Nowotny, H., Schwartzmann, S., Scott, P. & Trow, M. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies* (London: SAGE).

~~Goddard J and Chatterton P (1999) Regional Development Agencies and the knowledge economy: harnessing the potential of universities. *Environment and Planning C: Government and Policy* 17: 685-699.~~

Goddard, J., Kempton, L. & Vallance, P. (2013) The civic university: connecting the global and the local, in: R. Cappello, A. Olechnicka & G. Gorzelak (Eds) *Universities, Cities and Regions, Loci for knowledge and innovation creation*, pp. 43-63 (London: Routledge).

Goldstein, H. (2010) The 'entrepreneurial turn' and regional economic development mission of universities, *Annals of Regional Science*, 44(1), pp. 83-109.

Grimaldi, R., Kenney, M., Siegel, D. & Wright, M. (2011) 30 years after Bayh-Dole: Reassessing academic entrepreneurship, *Research Policy*, 40(8), pp. 1045-1057.

Gunasekara, C. (2006) Reframing the Role of Universities in the Development of Regional Innovation Systems, *Journal of Technology Transfer*, 31(1), pp. 101-113.

Hardeman, S., Frenken, K., Nomaler, O. & Ter Wal, A. (2014) Characterizing and comparing innovation systems by different 'modes' of knowledge production: A proximity approach, *Science and Public Policy*, doi: 10.1093/scipol/scn070.

HEFCE (2011) Higher Education Funding 2011-12 to 2014-15. http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2011/1116/11_16.pdf (accessed April 6, 2015).

Henderson, R., Jaffe, A. & Trajtenberg, M. (1998) Universities as a source of commercial technology: A detailed analysis of university patenting, *Review of Economics and Statistics*, 80(1), pp. 119-127.

Hessels, L. & van Lente, H. (2008) Re-thinking new knowledge production: A literature review and a research agenda, *Research Policy*, 37(4), pp. 740-760.

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Isaksen, A. and Trippel, M. (2014a) Regional industrial path development in different regional innovation systems: A conceptual analysis, *Papers in Innovation Studies No 2014/17*, CIRCLE, Lund University. Isaksen, A. & Trippel, M. (2014b) *New path development in the periphery*. Papers in Innovation Studies, Paper No. 2014/31, CIRCLE, Lund University.

Kempton, L., Goddard, J., Edwards, J., Hegzi, F. & Elena-Perez, S. (2013) *Universities and Smart Specialisation*. S3 Policy Brief Series No. 03/2013, European Commission Joint Research Centre Institute for Prospective Technological Studies, Seville.

Kitson, M., Howells, J., Braham, R. & Westlake, S. (2009) *The Connected University: Driving Recovery and Growth in the UK Economy*. NESTA Research Report, London.

Klenk, N. & Hickey, G. (2013) How can formal research networks produce more socially robust forest science? *Forest Policy and Economics*, 37(1), pp. 44-56.

Lawton Smith, H. (2003) Universities and local economic development: an appraisal of the issues and practices. *Local Economy*, 18(1), pp. 2-6.

Lawton Smith, H. & Bagchi-Sen, S. (2012) The research university, entrepreneurship and regional development: research propositions and current evidence. *Entrepreneurship and Regional Development*, 24(5-6), pp. 383-404.

Lawton Smith, H. & Waters, R. (2015) Regional synergies in triple helix regions: the case of local economic development policies Oxfordshire. *Industry and Higher Education*, 29(1), pp. 25-36.

Lester, R. (2005) *Universities, Innovation, and the Competitiveness of Local Economies: A Summary Report from the Local Innovation Systems Project-Phase I*. MIT Industries Performance Center Working Paper 05-010, Cambridge, MA.

Lindqvist, M., Smed Olsen, L. & Baltzopoulos, A. (2012) *Strategies for Interaction and the Role of Higher Education Institutions in Regional Development in the Nordic Countries*. Nordregio Report 2012:2, Stockholm.

~~Maier G and Trippel M (2011) New Path Creation in Old Industrial Regions: The Case of Software Park Hagenberg in the Province of Upper Austria. 51st European Congress of the RSAI. Barcelona, Spain.~~

~~Martinelli A, Meyer M and von Tunzelmann GN (2008) Becoming an entrepreneurial university? A case study of knowledge exchange relationships and faculty attitudes in a medium sized research oriented university. Journal of Technology Transfer 33: 259-283.~~

Nowotny, H., Scott, P. & Gibbons, M. (2001) *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty* (Oxford: Polity Press).

PACEC (2009) *Evaluation of the Effectiveness and Role of HEFCE/OSI Third Stream Funding: Culture Change and Embedding Capacity in the Higher Education Sector Towards Economic Impact*. PACEC, Cambridge.

PACEC (2012) *Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding. A Report for HEFCE.* PACEC, Cambridge.

Pålsson C, Göransson, B. & Brundenius, C. (2009) Vitalizing the Swedish university system: implementation of the 'third mission', *Science and Public Policy*, 36(2), pp. 145-156.

Philpott, K., Dooley, L., O'Reily, C. & Lupton, G. (2011) The entrepreneurial university: Examining the underlying academic tensions, *Technovation*, 31(4), pp. 161-170.

~~RCUK (2012) Pathways to Impact: Research Councils UK. <http://www.reuk.ac.uk/kei/impacts/Pages/home.aspx> Accessed: 18 May 2012.~~

Shove, E & Rip, A. (2000) Users and unicorns: a discussion of mythical beasts in interactive science. *Science and Public Policy* 27(3), pp. 175-182.

~~Siegel, D., Veugelers, R. and Wright, M. (2007) Technology transfer offices and commercialization of university intellectual property: performance and policy implications. *Oxford Review of Economic Policy* 23: 640-660.~~

Tödting, F. & Tripl, M. (2005) One size fits all? Towards a differentiated regional innovation policy approach, *Research Policy*, 34(8), pp. 1203-1219.

Tripl, M. (2011) Regional innovation systems and knowledge sourcing activities in traditional industries – evidence from the Vienna food sector. *Environment and Planning A*, 43(7), pp. 1599-1616.

Tripl, M. & Tödting, F. (2007) Developing biotechnology clusters in non-high technology regions – The case of Austria. *Industry and Innovation*, 14(1), pp. 27-47.

Tripl, M. & Otto, A. (2009) How to turn the fate of old industrial areas: a comparison of cluster-based renewal processes in Styria and the Saarland, *Environment and Planning A*, 41(5), pp. 1217-1233.

Ulrichsen, T. (2014) Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector: Report for HEFCE <https://www.hefce.ac.uk/pubs/rereports/Year/2014/keheifimpact/> (accessed March 28 2015)

Field Code Changed

Universities UK (2010) Making an impact: Higher Education and the English Regions. <http://www.universitiesuk.ac.uk/Publications/Documents/MakingAnEconomicImpact-HigherEducationandtheEnglishRegions.pdf> (Accessed July 22 2012).

Uyarra, E (2010) Conceptualizing the Regional Roles of Universities: Implications and Contradictions. *European Planning Studies*, 18(8), pp. 1227-1246.

Witty, A. (2013) Final report and recommendations. Encouraging a British invention revolution: Sir Andrew Witty's Review of Universities and Growth. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249720/bis-13-1241-encouraging-a-british-invention-revolution-andrew-witty-review-R1.pdf (accessed November 13 2013).