Paper no. 2014/13

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

Michaela Trippl (michaela.trippl@circle.lu.se)
CIRCLE, Lund University

Tanja Sinozic (tanja.sinozic@wu.ac.at)
Institute for Multilevel Governance and Development,
Vienna University of Economics and Business

Helen Lawton Smith (h.lawton-smith@bbk.ac.uk)
Department of Management; Birkbeck, University of London

This is a pre-print version of a paper that has been submitted for publication to a journal.

This version: July 2014

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University
P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN
http://www.circle.lu.se/publications

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JEL codes: I28; R10; R58

Keywords: universities; regional development; public policy; UK; Sweden; Austria

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Michaela Trippl[1], Tanja Sinozic[2], Helen Lawton Smith[3]

[1] CIRCLE, Lund University, P.O. Box 117, 22100 Lund, Sweden.

E-mail: michaela.trippl@circle.lu.se

[2] Institute for Multilevel Governance and Development, Vienna University of Economics and Business, Welthandelsplatz 1, 1020 Vienna, Austria.

E-mail: tanja.sinozic@wu.ac.at

[3] Birkbeck, University of London, Department of Management, Malet St. London WC1E 7HX, UK. E-mail: h.lawton-smith@bbk.ac.uk

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Abstract

The literature on universities' contributions to regional development is broad and diverse. A precise understanding of how regions can potentially draw advantages from various university activities and the role of public policy institutions (imperatives and incentives) in promoting such activities is still missing. The aim of this paper is to advance a more nuanced view on universities' contributions to regional economic and societal development. We identify and review four conceptual models: (i) the entrepreneurial university model, (ii) the regional innovation system model, (iii) the mode 2 university model, and (iv) the engaged university model. The paper demonstrates that these four models emphasise very different activities and outputs by which universities are seen to benefit their regions. We also find that these models differ markedly with respect to the policy implications that can be drawn. Analysing public policy imperatives and incentives in the UK, Austria and Sweden the paper highlights that in the UK national policies encourage and have resulted in all four university models. In Sweden and Austria policy institutions tend to privilege in particular 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. What is still missing in the literature, however, is a precise understanding of HEIs' contributions to regional development, sometimes called 'third stream activities', that is, targeted engagement with external organisations, outreach, enterprise formation, and so on (PACEC, 2009). Another issue that remains poorly understood is to what extent and in which ways universities' contributions to regional development differ between countries. Such variations may have many sources, including amongst others characteristics of the university population, HEI traditions, national institutional set ups and regional factors. In this paper we shed some light on one specific factor that might create differences between countries, that is, policy imperatives and incentives.

The aim of this paper is to advance a more nuanced view of the role of universities in regional development and to provide some evidence from the UK, Sweden and Austria for differences in public policy institutions designed to promote various university contributions to regional economic and societal evolution. 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. Drawing on an analysis of the theoretical and empirical literature, the paper addresses the following research questions: Which specific university contributions (i.e., which activities and outputs) to regional development are highlighted by the entrepreneurial, RIS, mode 2 and engaged

university models and how do they differ in terms of policy conclusions? Which university models are promoted by policy imperatives and incentives in the UK, Sweden and Austria?

The remainder of this paper is structured as follows. Section 2 presents an overview on four major approaches that conceptualise from different perspectives university contributions to regional development. Section 3 compares policy institutions designed to stimulate various forms of university 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 role of HEIs in regional development (Goldstein, 2010; Uyarra, 2010). The following section identifies and compares four conceptual models that figure prominently in contemporary discussions of how HEIs can benefit their regions.

Entrepreneurial university model

The entrepreneurial university concept (Clark, 1998; Etzkowitz, 1983; Etzkowitz et al., 2000) 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 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).

Several studies have linked the entrepreneurial role of HEIs with the growth of industries in regions (Audretsch and 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 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).

University entrepreneurial activities are considered being affected by national policy aspects, such as funding and 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). In the US, studies have found an increase in HEIs' patenting and licensing activities after changes in IPR started by the Bayh-Dole Act of 1980 (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 (Johnston et al., 2012). In particular, the notion of the global university 'isomorphic development path' towards entrepreneurial activities (Etzkowitz et al., 2000) has been criticised for neglecting context specificities and lack of direct applicability to European countries with a tradition of the Humboldtian university model (Philpott et al., 2011). Commercialisation activities seem to be particularly prevalent in research-intensive universities that have global networks and a strong local presence (Lawton Smith and Bagchi-Sen, 2012). Secondly, there is no automatic correspondence between HEIs' commercialisation efforts and the needs of the regional economy. Entrepreneurial universities do not necessarily have a strong regional impact (Martinelli et al., 2008). 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). Other work suggests that the co-presence of specific sectors such as biotechnology or computing (Feldman, 2003; Lawton Smith and Bagchi-Sen, 2012), firm R&D intensity and absorptive capacity (Agrawal and Cockburn, 2003) influences HEIs' abilities to commercialize their research.

RIS University Model

The regional innovation systems (RIS) approach (Cooke, 1992; Cooke et al., 2004) 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 regional 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; Perkmann et al., 2013). Within the RIS framework, an important task of universities is seen as transferring knowledge to SMEs and clusters located in the region (Uyarra, 2010). 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 context specificity of university contributions to regional innovation and highlights that the role of universities in regional development might vary, depending on RIS structures (Tödtling and Trippl, 2005), prevailing knowledge bases (Martin and Moodysson, 2011) and the dominant regional growth path (Lester, 2005).

The RIS approach has been criticised for overemphasising regional knowledge circulation and underplaying the importance of extra-regional knowledge for the innovation dynamics of regions. Studies that have taken the global dimension into account find 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 (Bramwell and Wolfe, 2008; Lawton Smith, 2003).

Both the entrepreneurial model and the RIS model highlight universities’ contributions to the economic dimension of regional development. A more comprehensive view that takes also non-economic societal activities by 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. 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). 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, user involvement (Shove and Rip, 2000) 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 and 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 and its implications for university research and policy (Hessels and van Lente, 2008). Carayannis and Campbell (2011) challenged 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 knowledge-generative role (Gunasekara, 2006). The engaged university is perceived as focusing its activities towards industry and society and actively shaping regional identity (Breznitz and Feldman, 2012).

University engagement can take a variety of forms. HEIs may adjust their teaching activities to regional 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). A key actor of change 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' which emphasises good institutions and strong policy capabilities at the regional level (Foray and Goenega, 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).

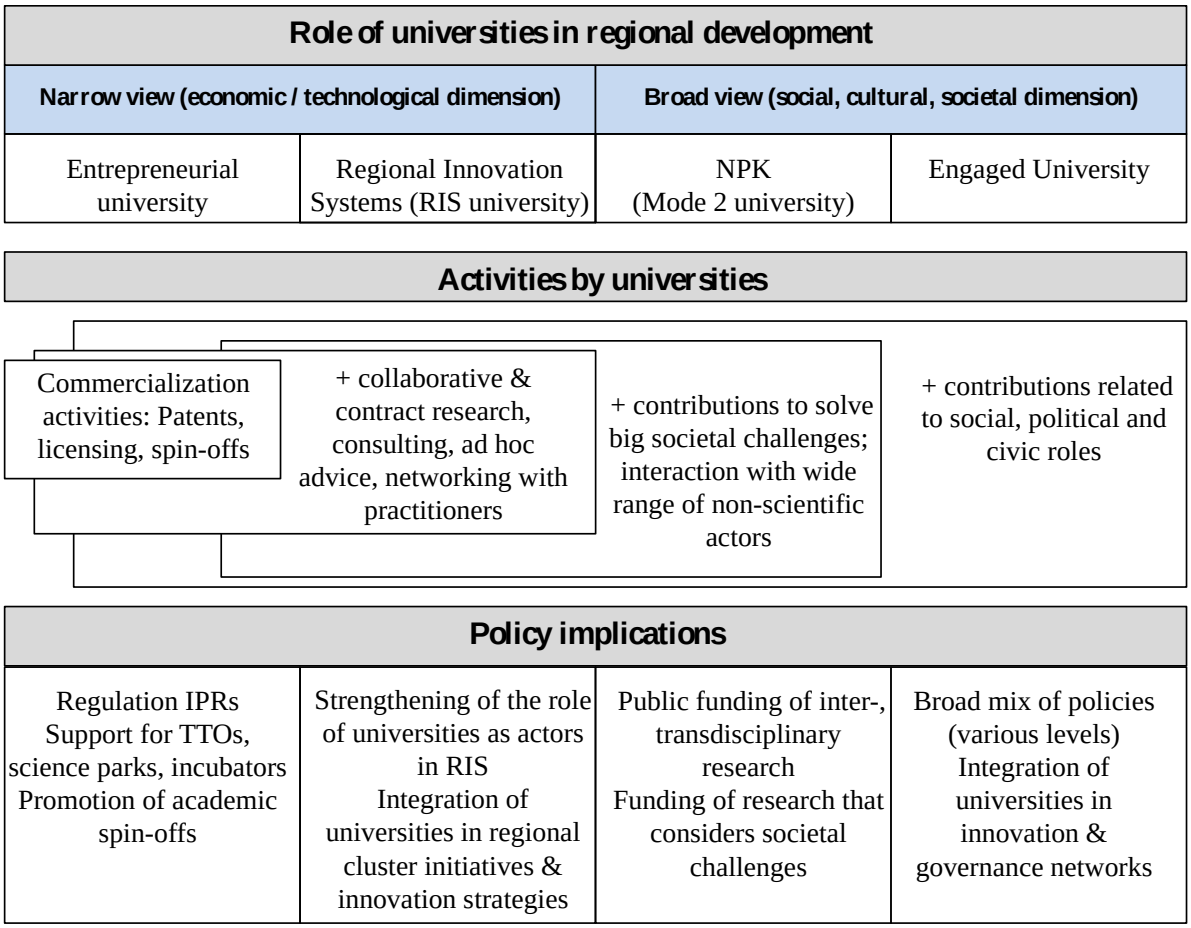
The arguments advanced by the protagonists of the engaged university model have not remained unquestioned. One key issue of critique is that the concept lacks empirical foundation. Except from a few examples, empirical evidence of successful forms of engagement is scanty. Due to the lack of systematic 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 differ in many respects. Figure 1 highlights key 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. 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 in addition to research and teaching. 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. 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.

Figure 1: University models: Activities and policy implications



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.

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. The aim is to explore if and how policy institutions (i.e., imperatives and incentives) in the three countries privilege specific university model activities identified in Section 2. Arguably, 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 factors that might exert an influence in this regard.

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. By 2012, 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 numbers of students has

increased by 28% over the period 2000/1 and 2009/10. 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 influences – 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 influences – 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'.

The HEIF programme 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 in 2010-11, redistributing funding from the richer to poorer HEIs. For the first time money was allocated by formula rather than by competitive bidding.

The Higher Education Funding Council for England (HEFCE) covers 130 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. A range of other initiatives have been designed to facilitate university-industry interaction at the regional scale, such as Higher Education Regional Associations, designed to encourage "RIS university model" and "engaged university model" activities. HEFCE 2 provides funding for the nine regional associations in England that promote the role of HEIs in their areas. The associations place a particular emphasis on fostering collaboration between HEIs, and building partnerships between higher education and other organisations within their regions.

Universities also work with cities with central government funding. 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".

(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 governance. The sub-national system is a mixture of counties, unitary authorities and metropolitan cities. The nine regional development agencies (RDAs) were abolished in 2012 and replaced by Local Economic Partnerships (LEPs). With the demise of the RDAs went financial support for regionally focused activities involving HEIs. Central government influences remains strong, as illustrated by the Witty Review. The LEPs bring together private and public sector organisations in a smaller, defined economic area to support enterprise, innovation, global trade and inward investment. 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. There is, however, a tendency to focus on universities' contribution to skills, and to neglect other dimensions of their economic growth offering.

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 (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 (Harrison and Leitch, 2010; Lawton Smith and Bagchi-Sen, 2012).

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 (Anderrsson 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". 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 (Benner and Sörlin, 2007).

The Swedish 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 intents to stimulate cooperation between firms, universities and policy actors in the Swedish innovation system. Each year around 220 million Euros 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. 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 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 recent survey of 295 Swedish academic researchers (Bourelos et al., 2012), however, indicates 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. A recent 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 model. Mode 2 and engaged activities seem to play a minor role in comparison.

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" 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 (BMWF et al., 2012).

(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 2010, 327 academic spin-offs have been founded, showing a high survival rate of 80% (BMWF et al., 2012). 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 governance aspects: 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 and ICT) higher levels of connectedness have emerged recently. 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 (Maier and Trippl, 2011; Trippl and Otto, 2009).

Comparing the Cases

The country studies show that 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 things happened. 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 to cooperation with the regional 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, which inevitably 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. In Austria and Sweden from the 1990s onwards, national programmes were designed to encourage in particular the RIS university model and more recently entrepreneurial activities.

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"). In a similar vein, Sweden focuses on linking communities with HEIs through information provision and benefit (a broad term) from research findings. 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.

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.

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 sought to offer a differentiated view on university contributions to regional development and to provide insights into the role of policy institutions in the UK, Sweden and Austria to promote such HEI activities. Our review and comparison of four key concepts – the entrepreneurial, RIS, mode 2 and engaged models – have shown that they highlight very different roles and activities. Some are mainly concerned with knowledge commercialization (entrepreneurial university model) and university-industry partnerships (RIS model) whilst

others suggest a broader perspective that also takes into account social and cultural contributions of HEIs (mode 2 and engaged models). Looking at policy imperatives and incentives designed to promote the role of HEIs in regional development in the UK, Sweden and Austria, we have found that not all four university models are promoted to the same extent in these countries. In Sweden and Austria policy institutions encourage the RIS model and more recently also the entrepreneurial model. In the UK, in contrast, national policies provide incentives for the pursuit of all four university model activities. There is a need for further conceptual and empirical research to shed more light on the conditions that favour and hamper the realisation of each of the four models. 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, institutional support structures, characteristics of the university population, HEIs traditions, regional factors etc.) and examine how they vary across different nations and regions.

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