

“University spin-off policies and economic development in less successful regions: learning from two decades of policy practice”

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Abstract

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Abstract

Although there is great interest in the new knowledge economy, less favoured regions seem permanently disadvantaged because they lack a critical mass of knowledge capital to initiate accumulation, growth and economic development processes. This is a problem for policy-makers seeking to promote economic growth and territorial cohesion in such regions. Despite this, examples from two such regions, Newcastle, UK and Twente, Netherlands, suggests that such companies can be very successful. This paper seeks to develop a conceptual model of how USOs can improve their regional economies. We explore the economic benefits that such companies bring, to identify those elements which can potentially upgrade regional economies through knowledge accumulation, which we term ‘building up territorial knowledge pools’. We conclude by developing a conceptual framework for the operation of the territorial knowledge pool; we highlight four different roles played by USOs in improving regional innovation environments and consider the conceptual and policy implications of this raised by this framework model.

1. Introduction

Although there has been in recent years a remarkable consensus that we are moving towards a global knowledge society, there still remains considerable disagreement concerning the processes through which knowledge adds value and creates competitive advantage (Temple, 1998; Armstrong, 2001). The generally accepted understanding of how a ‘knowledge economy’ might function is provided by the so-called ‘new growth’ or ‘endogenous growth’ theory; the increasing importance of ‘knowledge capital’ as a growth factor, characterised by increasing returns to scale, the consequent potential for knowledge overspill and agglomeration (Longhi, 1999; Lorenz, 1999). Knowledge ‘work’ now involves applying different knowledges together besides generating new knowledge, and the organisation of science has shifted qualitatively to enable more application-focused collaborative research (Gibbons *et al.*, 1994; Chesbrough, 2003). As governments are seeking to promote knowledge-based activities whilst reducing overall expenditure, governments have looked to universities to support the creation of these knowledge economies (Goddard & Chatterton, 2003), and universities have become something of a ‘golden goose’ for

governments seeking light-touch (i.e. inexpensive) valorisation policies producing significant economic benefits.

There are a wide range of arguments concerning universities' economic benefits for knowledge societies (Schutte & van der Sijde, 2000). The national system of innovation literature includes universities as key actors (Freeman, 1995), whilst the Triple Helix approach envisages universities working together with industry and government to evolve new competitive industrial forms (Etzkowitz & Leyesdorff, 2000). There is also an increasing regional literature, looking at the multi-faceted benefits which universities bring to their territories (Boucher *et al.*, 2003). However, it is clear that these benefits are contingent on particular situations, rather than an intrinsic feature of universities. Universities' greatest successes in regional engagement have been seen in places where all these contextual economic factors are already positive, places that Armstrong (2001) has characterised as the "totemic sites of the new economy" (e.g. Silicon Valley, Research Park Triangle, and Silicon Fen). This has made it more difficult to isolate and rigorously conceptualise universities' contributions to economic development processes, which in turn hinders developing effective regional innovation policies for these places (Malecki, 1997).

In this paper, we explore this issue in one particular – and increasingly popular – domain, university spin-off companies (USOs). Our key research question is whether USOs bring economic benefits to what we might call "non-totemic" sites. Less successful regions face location-specific barriers to the accumulation of knowledge capital; as USOs rely heavily on their knowledge capital, it is unreasonable to assume that USOs will bring the benefits to less successful regions that they have in Silicon Valley.

In this paper, we use anecdotal evidence from two peripheral regions to show that USOs can create innovative activity in such regions. However, much recent theoretical development stresses that such poorer places can promote economic development if they can build learning activities which improve the quality of their regional innovation environment. What the anecdotes do not do is demonstrate that the innovative activity causes the improvement in the peripheral economic conditions. This challenge stimulates us to draw on Fontes & Coombes (2000) model of densification of the regional techno-economic network, to develop our own conceptual framework which allows us to address the systemic contributions USOs

can make to regional innovation environments. We highlight other linkages within the region that are important in building up territorial networks of relationships that hold together ‘pools’ of knowledge capital that other firms can dip into . These relationships provide pathways for others to access the knowledge pools, transforming bilateral relationships into a diffuse but territorialised knowledge asset. We conclude with some theoretical and practical implications raised by our conceptual framework.

2. Spin-outs in the periphery?

There is a clear geographical dimension to the new economy: knowledge capital stocks are extremely unevenly distributed. At a macro-scale, new growth theorists arguments imply that this unevenness is a barrier for the economic development of less successful places. Solow (1994) and Romer (1994) noted that knowledge capital differs from other forms of capital in that there are no discernable diseconomies of scale. Consequently, knowledge production has become increasingly centralised in the ‘totemic sites of the new economy’ (Armstrong, 2001) creating significant problems for those less successful places which lie outside the economic core of knowledge-rich regions. Such places we refer to in this paper as “peripheral”, not necessarily peripheral in a cartographic sense, but lacking the knowledge resources to create agglomeration economies, and hence develop a competitive advantage in knowledge-based activities.

New growth theory suggests that such places face difficulties in accumulating sufficient knowledge capital to create economies of scale to retain and attract firms whose activity is the driver of local economic development. It is possible to differentiate two theoretical barriers within new growth theory for peripheral places. Firstly, those regions lack existing stocks of knowledge capital, and so lack the returns to scale of core regions: each ‘unit’ of knowledge capital in a peripheral places deployed brings lower returns to the same unit deployed in a ‘core’ region. The second problem is the tendency for knowledge capital to accumulate through a virtuous cycle restricted to core regions, also suggesting that the knowledge economy has a strongly self-reinforcing nature, implying a hopeless situation for peripheral regions.

2.1 *Spin-offs outside core knowledge agglomerations*

In this paper, we focus on one particular feature of the knowledge economy, University Spin-Off companies (USOs). Pirnay *et al.* (2003) define these generically as “[n]ew firms created to exploit commercially some knowledge, technology or research results developed within a university” (p. 356). There has been rising interest from policy-makers in promoting spin-off companies as a regional innovation policy to generate stocks of knowledge capital in less successful regions. This policy has certainly dramatically increased the rates of numbers of new firms created (AUTM, 2003; HEFCE, 2002; ARC, 2002). Association of University Technology Managers (AUTM) figures suggest that US universities created around 500 new firms in 2001 (AUTM, 2003). Other countries have also followed American practise; in 2000, 199 spin-offs were formed in the UK whilst 47 spin-offs were formed in Australia (HEFCE, 2002; ARC, 2002).

However, it has not been established that promoting USOs represents an effective or efficient regional innovation policy, and the attractiveness of USOs to policy-makers is more dependent on faith than fact (Malecki, 1997). Past experiences with science parks (*cf.* Massey *et al.*, 1992) suggests it is stronger regional economies that tend to disproportionately benefit from regional policies which favour innovation. Elgen *et al.* (2004) note that knowledge-intensive service spin-offs (such as consultancies) in Germany tend to move away from their parent university to big cities where clients are easier to find. If all USOs did relocate from their parent institutions to growth centres, a scenario also hinted at by new growth theories, this implies that policies promoting spin-offs were actually undermining the economic development of peripheral places.

New growth theory suggests two main theoretical arguments supporting this view. Firstly, in less successful regions, where economic conditions are less prosperous, and entrepreneurial environments tend to be less munificent (Dubini, 1989), one would expect USOs – as a subclass of all start-ups - to more difficult to generate, and require greater effort, government support and subsidy to produce a lesser effect. This is a consequence of the fact that all start-ups are heavily dependent on external resources, which tend to be more widely available in core rather than peripheral regions. For USOs, knowledge resources such as local networks and spill-over effects, which cut the costs of innovating, are particularly important (Elgen *et al.*, 2004).

“In a developed environment there is already an entrepreneurial community with the capability to select the best projects and allocate resources to them ... In contrast, in environments with less demand for innovation, characterised by a weak entrepreneurial community and a lack of other resources, [research institutions] may need to play a more pro-active incubation role” (Clarysse *et al.*, 2004, p. 1-2).

Secondly, implicit within new growth theory is an argument that as USOs emerge in less successful regions, they tend to move away from those regions, either through direct relocation or through take-over and rationalisation by more competitive businesses in more successful places (*cf.* Elgen *et al.*, 2004). Lycos is a famous example of a spin-off company which formed in Boston – a totemic new economy region - despite being a spin-off from, and partly owned by, Carnegie Mellon University in the American rustbelt city of Pittsburgh.

These two arguments together imply that USOs have a very limited scope to improve the economic performance of less successful regions. However, this is a problematic position, both practically and theoretically; in theoretical terms, these arguments merely suggest a tendency for peripheral regions to benefit less from such policies and activities. In practical terms, there are very few examples of where USOs have undermined their regional economy. Indeed, there is a growing body of countervailing theoretical arguments which demonstrate how less successful places *can* accumulate knowledge capital through spin-off activities.

Although there are macro-economic arguments that knowledge tends to accumulate in core places, economic geography is increasingly interested in exploring how knowledge and learning processes operate as socially contextualised processes. Peripheral regions clearly have very different social contexts to the core regions in which knowledge-based economic development theories were developed. Cooke’s (1995) seminal book *The rise of the rustbelt* looked at how old industrial regions reinvented themselves through innovation and learning. A whole host of concepts have since been developed to explain knowledge-based development in an abstract sense, (Storper, 1995; Boekma *et al.*, 2000), such as learning regions (Morgan, 1997), regional innovation systems (Cooke, 2002) and clusters (Porter, 1998). This is a specific case of a more general and fundamental tension in current debates over regional economic development in less successful places, what Cooke (2004) calls the ‘scalar envelope’. The problem is that because theories of knowledge and learning

have mainly been developed in more successful places, the concepts they produce they seem unachievable for less successful places. By an extension of that, economic development in the periphery, and key actors controlling economic development processes, are conceptually shorn of any agency, and they exist merely “in passive receipt of changes handed down to them from some higher national or international level (Massey, 1995, p. 115). As Cooke notes...

“As a consequence ... economic geography tends to be dominated by (ideographic) case studies, broad (and untestable) stylised statements on what propels regional economic development, or, even less productive, high-level theory discussions that remain uncoupled to real-world experience.” (p. 8).

The new regionalist research which comes closest to addressing this spatial envelope are those analyses which look at how particular regional economic changes affect the relationship between a region and its' external context. Chapman *et al.* (2004) used the Aberdeen oil and gas complex to explore how the process of local firms' renewal of their external relationships changes the attractiveness of the territory for external firms in that sector. Hospers (2004) uses the idea that long waves of economic change permit entrepreneurs in less successful places to incorporate the waste products of restructuring, creating innovative and place-specific assets in niche fields which in turn act as growth poles. In this paper, we now apply this argument to USOs, asking how particular sets of economic changes associated with spin-off firms can improve particular regional innovation environments to improve their attractiveness and value to external actors.

3. *Spin-offs in the North East & Twente: in what sense a regional development?*

We have already noted that there is little evidence that USO policies harm less successful regions; furthermore, there is an emerging and growing body of empirical evidence which has demonstrated that USOs do act as drivers of economic development in 'ordinary' places (*inter alia* Lawton Smith, 2000; Dahlstrand & Jacobsson, 2003; Asheim & Coenen, 2003; Clarysse *et al.*, 2004). Aalborg, Flemish Brabant and Turku, are all less successful regions where there has been significant spin-out activity. This activity has in turn promoted broader economic growth in those sectors, relating to wireless communications in Aalborg and Turku, and medical

technologies around Leuven (Rutten *et al.*, 2003). There are many other examples, identified of spin-outs bringing tangible economic benefits¹. However, these examples illustrate clearly the tensions of Cooke's spatial envelope critique. Even with case studies that show an economic benefit, they seem much less convincing in making a case that those benefits were 'regional', that is they have improved the environment for others.

To illustrate this, we outline from two such regions in which there have been successful spin-out activity and two institutions in which readily available material suggests that USOs *might* have made a significant difference to the economic development of that region². The two universities that we focus on are Newcastle and Twente, which are different types of peripheral area, Newcastle as an urban area built on carboniferous capitalism whilst Twente was a predominantly rural region with a strong textiles industry. Universities in both regions have succeeded in generating spin-offs, but the evidence is inconclusive concerning the broader regional effects of the spin-offs. We use the information anecdotally to problematise the initial challenge to our research question, that it is not a simple process to determine whether spin-offs have had systemic regional economic benefits. It is outwith the scope of this paper to analyse whether the particular outcomes in Newcastle and Twente have achieved the entrepreneurial, transformatory, and revitalising effects necessary to justify the value of USOs for the periphery. Rather, we seek to produce a better conceptual framework for asking those questions in particular places, as a first step in seeking to produce a deeper and more rigorous set of answers to these questions.

Newcastle is the main city of the old industrial region of the North East of England, one of the first regions in the world to industrialise (from the 1780s onwards), and whose decline spanned the entire 20th century, to point of the virtual disappearance of its once-dominant coal, steel and ship-building industries. The university at Newcastle began as a marine technology college, supporting local firms, and its practical origins continue to this day through its close relationships with industrial partners. Newcastle University lists 26 companies on its web-site as having spun-out from the university in the last twenty years³, and these companies are contributing in many ways that could be thought of as improving the regional innovation environment. There are around 5,000 people employed in regional spin-offs in the North East (although that figure is highly dependent upon the inclusion of one

particular firm, Sage⁴). A number of university companies have themselves spun-off further local companies, indicating that the spin-offs have developed an internal regional dynamic. Thirdly, a number of the companies are putting research back into the university through joint and contract research projects, contributing significantly to very low levels of regional R&D employment. Finally, spin-offs from Newcastle are helping to improve the conditions for venture finance in the region, from some former university entrepreneurs acting as business angels, to mentoring, supervision down to the details of helping other firms deal with venture capitalists themselves.

Twente is an old textiles region which emerged under Royal support at the time of the formation of Belgium in 1830, and whose decline dates to the post-war loss of Dutch cotton colonies in the 1940s and 1950s (Hospers, 2005). The University of Twente (UT) was created in 1962 to revitalise the declining textiles industry, but by the 1970s, textiles and the wider regional economy faced imminent collapse. UT reinvented its mission in response to this, focusing on diffusing its' knowledge base as new technology into regional firms. UT's *Tijdelijke Ondernemers Programma* (TOP, Temporary Entrepreneurs' Scheme) created 3000 jobs in its first twenty years (van der Sijde et al 2002). More importantly, spin-offs have been an important part of rebuilding the regional economy after the collapse of the textiles industry. A number of spin-outs have grown significantly, and spawned their own spin-offs with varying degrees of connectivity to the university, again suggesting the creation of some kind of autonomous regional dynamic. The presence of the university has attracted nationally funded independent Top Technology Transfer institutes which employ highly skilled graduates and in turn are producing their own spin-outs; one of these, the Telematica Institute, has used its' wealth to underwrite the redevelopment of a poor suburb.

Taken alone, these figures are easily dismissed – 26 companies out of 66,000 in the case of the North East or 3,000 jobs out of 330,000 in Twente hardly seems significant, particularly given the multiple structural problems which afflict both these regions. However, the regional benefits are not merely reducible to the 26 spin-off firms (Rappert et al, 1999; Benneworth, 2001; 2002) or the 3000 TOP-related jobs. Indeed, above, we begin to hint at some of the highly convincing stories others have told of how university spin-offs have played a fundamental role in terms building a new knowledge economy in the North East or Twente (Benneworth, 2002; Schutte &

van der Sijde, 2000). But each narrative can easily be dismissed for ignoring a bigger picture in which the place of the region has not improved within the national space economy; to this day, the North East GDP is some 80% of the national average, and Twente fares little better with 85%. Once more, this anecdotal presentation of evidence does not make the compelling case that opens the scalar envelope to demonstrate that USOs and their associated activities have materially and qualitatively improved their regional economic situation.

How can we make sense of these two diverse situations, which defy simple readings? Our research question demands a framework against which evidence can be evaluated to answer this question. On the basis of the anecdotes from the two examples, it appears that spin-offs may be key players in various processes of assembling resources within a regional innovation network. These resources are regional because other firms can draw upon them, such as tacit knowledge, financial resources, and entrepreneurship. These resources are vital to firm growth, particularly for new and small firms, and also tend to be already lacking in peripheral regions (*cf.* Todtling & Kaufman, 2001; North *et al.*, 2001). But how can we evaluate if this apparent build up of resources really contributes to a change in the regional situation?

4. The stylised facts of university spin-outs

It is possible to identify a wide range of economic benefits that USOs bring to their host regions, although as Malecki points out, these benefits are not uniformly distributed (1997). Their wealth and employment creation is a ‘free’ return to past scientific investment, at relatively low direct cost (Di Gregorio & Shane, 2003). They provide income streams to their parent universities, allowing new investment in basic science, relieving pressures on public science funding (Dahlstrand, 1999). Finally, they embody a modish light-touch partnership approach between the state, university and firms (Etzkowitz & Leyesdorff, 2001). These empirical examples hint at a set of generalisations, ‘stylised USO facts’ which explain why USOs could potentially be valuable for their territories:-

1. USOs are ‘high-tech’ employers, paying good wages and promoting entrepreneurship (Etzkowitz, 2001),
2. USOs build on global technological and client knowledges in building new networks to access finance, sales and marketing (Dahlstrand, 1999),

3. USOs retain close linkages back to their ‘parent’ institution, through equity holdings incubators, technological transfer, recruitment and research collaboration (Heydebrook *et al.*, 2002),
4. USOs are sources of entrepreneurs whose technological entrepreneurship can transform the wider regional economy (Etzkowitz, 2001).
5. They are sources of technological spill-over, and can promote and shape the emergence of regional technology clusters (Di Gregario & Shane, 2003;) and
6. USOs stimulate business support services and infrastructure, benefiting other start-ups (Lockett *et al.*, 2003).

It is possible to further classify these facts into the direct and indirect benefits they bring. “Facts” 1, 2 and 3 are a set of direct benefits and relate to the type of firms which USOs tend to be; extending Malecki’s critique, the direct benefits that they bring are likely to be significantly less in peripheral regions to the benefits to the successful regions in which the theories were developed. By contrast, “facts” 4, 5 and 6 represent a set of broader, indirect, territorial benefits which universities create for their host regions. In conceptualising how USOs can deal with the issue of the spatial envelope, making a material improvement to the regional innovation environment, we will restrict our concern to these three ‘indirect’ stylised facts. This raises the question of the mechanisms through which the three processes bring about the material changes in the regional innovation systems. What are the real mechanisms through which technological entrepreneurship transforms regional economies in particular places? How do spin-offs create and support regional clusters and configure business support environments? Groen & Jenniskens (2003) argued that spin-offs in peripheral regions build entrepreneurial networks not previously present, in which others participate and hence derive benefit. University spin-offs act as a conduit for other firms to access the expertise and skills within universities without those firms having to expend the effort in developing strong linkages back to the universities themselves. This suggests a ‘knowledge pool’ builds up in the region, in which spin-offs make knowledge more accessible to other firms.

5. The indirect contribution of spin-outs to a regional economy: upgrading the local environment

Our argument so far has been that the key to understanding how USOs benefit their regions is in the way they encourage network-building, and this network then becomes an asset for others to draw upon, providing particular resources which are otherwise lacking in the periphery (*cf.* Kaufman & Tödtling, 2001; North *et al.*, 2001). If other companies can access those assets, then they will in turn find it easier to innovate, compete and succeed. The missing link in this intuitive understanding is a mechanism for how a ‘network’ of relationships can become an ‘asset’ or innovation resource. A basic heuristic that we have used elsewhere is that particular people in universities learn how to work with companies by working with spin-offs, and by working with other firms, this makes other university-based technical knowledge more accessible to local SMEs (Jones Evans *et al.*, 1999; Benneworth & Dawley, 2004). More generally, if types of knowledge build up that can repeatedly be drawn on by other actors facing similar problems, then it can be regarded as a shared knowledge asset. We conceptualise this as a territorial knowledge pool, which we represent diagrammatically in figure 1 below (after Muller & Zenker, 2000).

[Figure 1 goes about here]

Although the link with territory is not explicit in figure 1 above, this activity is beneficial if it can be regarded as what Fontes & Coombes call (2000) a ‘densification of the regional techno-economic network’ (Benneworth, 2004a). Figure 1 shows the operational mechanism of the knowledge pool, a network of relationships between USOs and universities, which can be drawn on by other firms. In being drawn on by other firms, the knowledge is re-used; we argue this implies a densification of the techno-economic network, and this makes the regional innovation environment more ‘munificent’ (Dubini, 1989). Whilst this conceptualisation is a useful heuristic for arguing that spin-offs might benefit their regional economy, it is insufficiently developed to explain how university/ USO relationships improve the quality of the regional innovation network. We therefore expand the concept to include interactions with and between other key (regional) actors in this innovation network.

5.1 *Stronger university/ regional relationships: commercialisation
'communities of practise'*

In figure 1, the 'university' is regarded as a single and coherent entity, in which academics are solely responsible for the transfer of knowledge. However, in reality, there is a much broader community within the university involved in supporting commercialisation activity. In differentiating between different actors within the university, we recognise that there are a variety of different actors with different interests within the university who regulate the university's openness and the extent to which its' knowledge is permitted to spill-over. Commercialisation activity can be contested and commercialisation systems may not always produce the desired outcomes. Feldman & Desrochers (2003) present a fascinating case study of how technology 'leaked' out of Johns Hopkins University despite the desire of the university senior managers to prevent business engagement. The interplay between various internal interests within the university is therefore a sensible focus for understanding how academic knowledge moves out from the university.

We conceptualise this activity in the terms that the actors within the university involved in commercialisation can be understood as operating as a community of practise. This theory was developed by Wenger (1998) to explain situations in which groups appeared to spontaneously self-organise a cultural infrastructure to deal with the uncertainties, problems and ambiguities in their own environments. Wenger's own analysis included an example of an insurance claims processing office with a relatively high staff turnover, focusing on how workers built an understanding of particular recurrent problems and processes of enculturating new recruits into accepted practises, norms and shared identity (Benner, 2003).

The focus on the single organisation community does seem well positioned to generate insights into understanding the learning processes at work within the boundaries of particular universities. Just Wenger's claims processors had to transform data written by a range of individuals into a common format acceptable to the payment firms, technology transfer officers within universities can be regarded as transforming knowledge between that produced to a set of academic norms into knowledges that can be applied in ways that firms find useful (Klofsten *et al.*, 2000). This activity requires and produces embodies particular forms of tacit knowledges, which build up in the community, and hence in the techno-economic network.

Clearly, if we regard the community as just those agents promoting commercialisation within the university, then it is hard to see roles for USOs in this community. Wenger's original idea has been since extended in a variety of different directions, particularly expanding from work-place to the scale of regional, sectoral or multi-site communities, what Seely Brown & Duguid (2000) refer to as a 'network of practise'. USOs are not merely an output of processes within the community (or network) of practise, but they are also a core activity and participant within the community. We would highlight the following activities described elsewhere which appear to represent significant repertoires and *morés* for such communities, which in turn can be used to explore the permitted level of knowledge spill-over from the university (Jones-Evans, 1998; Rappert *et al.*, 1999; Benneworth, 2001):-

- Experience: individuals in the university learn about the process of spinning-off a firm which they can apply into other situations,
- Shaping the ILO: although USOs are peripheral within ILOs at the start and end of the process, they may move to become central players for a time, and so shape the culture and routines of the ILO itself,
- Resources & output: the USO may provide dividends, royalties, equity sales or research funding to the university which encourage further spin-out work,
- Partner: the USO can be consulted or otherwise involved in the institutional development of the university, through equity committees, Senate and personal networks, and
- Prestige: universities use USOs as proof of their commitment to regional engagement, individuals hold directorships, USOs are common targets for external funders.

The value of the Community of Practise approach within the model is in understanding how knowledge pools within the university become broadened into generalisable territorial assets. Using the cliché of university-as-ivory-tower, does the operation of the community make the universities easier to access as a source of innovation resources, knowledge and technologies? Does the USO community have wider impacts on commercialisation? Are other firms (not themselves spin-offs) involved in commercialising these now-more accessible technologies? Answering these questions will provide evidence about the value of the university-centred

network to the innovation process, about whether the university is densifying the regional techno-economic network and consequently improving the quality of the regional innovation system.

5.2 *Direct USO links to the regional innovation system*

A second set of actors participating in the regional innovation system with which USOs may work to improve the regional innovation environment, are those other firms, whose own innovation performance may be upgraded by contact with USOs. Any large and successful innovating firms may configure its local innovation systems, imbuing it with a regional version of what Lundvall (1998) calls the ‘style’ of innovation. A university in a poor innovation environment can potentially play the role of a large firm and configure that innovation environment through its’ spin-offs. In the weakly innovative regional environments with which we are concerned, this suggests that possibly USOs can act as a knowledge bridge between universities and firms, but the question then is raised of how to operationalise this bridging function.

USOs may build networks, which parallel the linkages that they built up whilst in the university environment, and other firms may benefit by coming into contact with them. Dahlstrand (1999) argues that spin-off directly “encourages the development of inter-organisational linkages and personal networks through which new technologies and knowledges can be shared and created” (p. 381). In terms of our conceptual framework, USOs may work directly with non-spin-off firms to access (both draw on and contribute to) the territorial knowledge pool in a variety of different manners:-

- R&D Partnerships: encouraging other local firms to extend or sustain their technical and technological bases.
- Demanding clients: encouraging their local suppliers to be more innovative, and to adopt innovative practises and technologies (*cf.* Porter, 1990).
- Consultants: many spin-offs are consultancy activities, and this may help (after Wood, 2002) particular domain expertises to build up in .
- Drivers of new organisations: spin-outs may try to replicate some of the benefits they enjoyed in universities by creating new network organisations (Klein Woolthuis, 1999)

- Shared assets: common labour markets, peer mentoring, knowledge-spill-overs, clustering etc.
- New spin-offs: USOs can themselves lead to second generation spin-offs which may also be well-connected high technology small firms (Benneworth, 2004b).

There are a range of methodologies that can be used to explore the significance of changes in relationships within networks. In Benneworth (2004a), we analyse networks of corporate spin-offs in three dimensions, whether there is growth in nodes, whether linkages are becoming denser, and whether the network topology is leading to the development of so-called ‘core nodes’, that is centres with an autonomous growth dynamic. The second-generation spin-offs we have noted in both Twente and Newcastle are examples of new core nodes, whilst small spin-offs that rapidly wither are contra-indications, signifiers that the changes have not been of benefit to the regional economy. Wicksteed’s (2000) and Lawton Smith *et al.*’s (2000) family trees from spin-off firms in Cambridge and Oxford respectively are interesting illustrations of how this can have significant effects on the regional innovation environment in more successful regions.

5.3 Interactions with innovation and entrepreneurship policy-makers

Two final sets of actors who influence the regional environment for innovation are policy-makers and business support organisations. Both are involved in creating territorial innovation assets; policy-makers indirectly create the conditions for innovation and provide policy instruments for innovators to draw on, whilst business support agencies provide both what Bellini (2002) calls ‘real services’ as well as subsidies and other forms of support. But what is the relationship of universities to the policy community, and how do spin-offs affect the functioning of that relationship?

Firstly, universities, and in particular their ILOs, are providers of innovation support services which drawn on their experiences with their USOs and therefore reflect the needs of small, innovative, high-growth businesses. Writing about one particular programme in Scotland, Collinson & Gregson note that organising entrepreneurship networking events does “significantly increase interactions between the relevant

constituencies responsible for new business development” (p. 204). USOs function, as a coincidence of their origins, as an initial cohort for the services, and future services reflect what universities themselves learn from working with their SMEs. The role of USOs in these cases is in providing initial customers to provide the university the experience in working with firms, and to adapt best practise ideas to local conditions. It is possible to envisage a range of circumstances under which those services, targeted on spin-offs, would also be of value to other SMEs:-

- University-based infrastructure: such as incubator units or science parks.
- Spin-off mentoring projects (such as Collinson & Gregson’s Connect Scotland example), and
- USOs’ own experiences as points of reference for other firms and advisors (Benneworth & Dawley, 2004).

A second relationship that may exist is that universities may act as advocates for USOs, to encourage policy-makers and business support organisations to be better at working with USOs. Universities can enrol USOs when they debate with government and development agencies about what is appropriate for meeting the needs of new and emerging high technology firms to argue that policies should favour their activities. In the UK for example, a number of entrepreneurial universities lobbied the UK Finance Ministry (HM Treasury) in the wake of tax rules that effectively university prohibited spin-offs. Likewise, in the Netherlands, there are members of universities active in the national “innovation platform” who have reinforced enthusiasm within the Dutch government for better funding for spin-offs such as the Biopartner programme. This support is helpful for spin-offs, because USOs tend to be very small organisations, and their managers often are preoccupied with core issues of company survival, continuing R&D and growth of shareholder value. However, these changes can also have territorial impacts; in each case, the USOs are used to make a more general case to government that particular policy changes are legitimate and rational, but those policy changes also have other beneficiaries. If those beneficiaries are also in the same region as the university, then the lobbying has regional benefit, and the success of the lobbying has drawn, albeit indirectly, on the presence of the spin-offs, in arguing that its case is legitimate. USOs can therefore have a symbolic power in the debates in particular places about business support activity (*cf.* Benneworth, 2002).

These type of relationships are highly political and politicised, in part a response to the importance policy-makers attach to promoting spin-offs. We have elsewhere (Benneworth & Dawley, 2004) argued that it is possible to regard the development of ‘innovation policies’ as an innovation process. Because policy makers are, as we have seen, broadly enthusiastic about university entrepreneurship, USOs can become part of a solution to the problems raised by inappropriate policy implementation in peripheral regions. In the case of the Dutch government siting a Top Technology Institute in Twente, successful spin-offs were ‘used’ by UT managers to overcome mental barriers in the minds of national policy-makers to the possibility of a high-technology Twente region. If universities and regional development agencies are seen as being successful in promoting USOs, then external policy-makers may be willing to develop broader policies which reinforce those successes and benefit the region. Thus, specific cases of USOs can become politicised and used as political assets in ways that benefit their regional economy more broadly than the heuristic in figure 1 suggests.

6. *Towards a conceptual framework of upgrading regional economies: a concluding discussion*

In the outline concept, the knowledge pool in figure 1 is not problematic; it is assumed USOs and universities collaborate freely, to create knowledge on which other firms can draw. In section 5, we have critically examined the relationships which control how USOs and universities create territorial knowledge pools. Thus, whilst figure 1 remains a useful heuristic, a more reflective conceptual framework, capable of being operationalised into case studies requires incorporating the different relationships and their respective dynamics. In the previous section, we have elucidated some of the key mechanisms, processes and barriers by which the knowledge pool is created, sustained and revitalised. Alluding back to Hosper’s (2004) neo-Schumpeterian model, the fundamental question for a particular regional study to address is “Do a set of changes within a region add up to a regional transformation?” The review of various literatures above suggests that there are a number of key questions which can be used to explore whether a set of USOs in a particular place are contributing positively to expanding the knowledge pool as an asset, or are insignificant or even represent a deterioration in the regional economy. From the review above, some of these key issues can be highlighted:-

- What are the key determinants which have constrained opening up the university to external actors?
- Are academics becoming entrepreneurial and engaging with local SMEs, do they rely on intermediaries such as ILOs, or through students for more passive commercialisation of their ideas?
- Are USOs being used as sources of symbolic power in regional debates about business support?
- What is the relationship between the business support infrastructure and the spin-offs which are emerging?
- Are USOs in the particular regional contexts build up their own significant local supply chain in ways which leaves an imprint on the regional industrial structure? And
- Have USOs participated in embedding a particular regional style of innovation?

In figure 2, we rework the diagrammatic representation of the initial conceptual framework we began with in figure 1. This reflects the above questions concerning what controls the suitability of knowledge assets for promoting regional economic development. The review seems explicit that that the regional knowledge pool remains an important part of the contribution that USOs bring. However, the dynamics of the regional knowledge pool – as a technological transfer flow between universities and firms – is sustained by further sets of relationships that support and regulate access to the pool. In figure 2, we highlight the three additional important sets of relationships within the regional network which have to be explored in order to make sense of the regional impact of USOs.

[Figure 2 goes about here]

6.1 Practical implications for operationalising the conceptual framework

In exemplifying the research question in section 3, we noted that the two cases of Newcastle and Twente were difficult to definitively interpret in the absence of conceptual framework explaining what made changes significant to a region. In this

final section, we return to these two examples to exemplify the practicalities of using the conceptual framework to evaluate whether a set of changes are significant. Although the heuristic process of the knowledge uptake from the pool is simple, the various literatures we have reviewed suggest that the detailed mechanics of creating, holding, refreshing and using the knowledge pool determine the regional value of particular activities. This offers a conceptual framework for analysing how the dynamics of the knowledge pool creation in its broader context determine whether any potential neo-Schumpeterian transformation is realised.

The first network and set of relationships, (1), the commercialisation community of practise, is largely internal to the university. One key issue here is professionalisation, a key issue for the commercialisation community of practice, because their dynamics do not necessarily follow a market organisational principle. Central to professionalisation is a replacement of informal practices and tacit knowledge flow with a market logic based on full cost recovery and assertion of property rights over university knowledge. The incentive to do this in many universities, including Newcastle, has been the potential for high returns which can be invested elsewhere. There are high direct costs associated with creating and regulating market mechanisms within universities, as well as the indirect opportunity costs of the innovation and entrepreneurial activities which are inhibited by an intellectual property regime.

Professionalisation seeks to ensure that firms do not rent-seek on university knowledge, but knowledge can have greatly differing value to universities and to firms. In particular, policies which stop MNCs free riding on university research programmes also have the potential to stop entrepreneurs dipping occasionally into the tacit knowledge pool at universities and exploiting discrete bits of know-how (Blum & Müller, 2004). To answer the main research question, it is necessary to explore how these various evolving policy frameworks affect the operation and accessibility of the knowledge pool. Much of the knowledge transfer comes from firms taking bits of knowledge and then exploiting them in ways that universities would not necessarily consider. Whilst it has been assumed that professionalisation of the technology transfer community is largely beneficial, when the impacts on the knowledge pool are considered, professionalisation can be a problem as much as a benefit.

The second relationship (2) is between the university and the policy community, which is traditionally regarded as unproblematic and uni-directional, as universities transferring their technologies in accordance with other partners' regional development strategies. Within our revised concept, universities have the capacity to be much more active in regional development policy-making, playing an active and strategic role in improving the regional innovation environment. In Newcastle, a great deal of the commercialisation effort of the university has been to build linkages with strategic partners such as the city council and the regional development agency. Newcastle University was instrumental in writing the regional economic strategy for the north east, particularly the section entitled "Placing universities and colleges at the heart of the regional economy". In Twente, the University of Twente has been a key driver of many regional projects from the original TOP programme, to the latest Twente Technology Valley and Knowledge Park Twente initiatives. However, this political and strategic input is not their only involvement in regional innovation policy. When universities start producing USOs, then this creates a new market for business support services in which universities have interests because those services contribute to equity growth in their companies and also create a beneficial environment in which other companies can form.

The third relationship (3) is the knowledge bridge function which USOs play, actively placing university technologies, ideas and know-how into third party companies, taking the knowledge to other regional partners. Part of this activity might be thought of as working collaboratively to solve innovation projects, and more generally from benefiting from mutual proximity. The effect of this clustering is to expand the scope and applicability of the knowledge pool, as USOs and other firms translate university knowledge into commercialisation results. If the innovation environment is improving, then tangible impacts on the regional 'style of innovation' should be evident, as collaborative activities lead to new firm formation. Equally, deeper webs of relationships between USOs, their spin-offs and other firms may indirectly improve the innovation environment and institutional capacity in those places. The Twente Regional Technology Circle is one such example, led by several spin-out entrepreneurs and has for 12 years provided a forum for local SMEs to build purposive relationships and collaborations. Taken together, these may help to imbue

local actors with external ideas which in turn reduce the problems caused by lock-in in less successful regions' innovation systems (Asheim & Isaksen, 2002).

6.2 *Spin-offs and regional innovation policy: lessons from the literature*

As a penultimate set of remarks, this new conceptual framework clearly has messages for policy-makers seeking to understand how best to support the promotion of innovation through USO activities. At the outset, we noted that spin-offs have become widely accepted as a key part of regional innovation activities, and hence frequently the focus of regional innovation policy, often with little thought for how regionalising abstract policy concepts into concrete regions produces policy outcomes. Our conceptual framework suggests that success of such policies require policy-makers and universities to work together in a range of different manners within the development of effective innovation improvement policy. Regionalisation of innovation policy in particular requires active participation from universities and USOs to tailor generic policy concepts, drawing on their knowledge of the local innovation environments within which they are key actors. This suggests that there are practical changes necessary to maximise the benefits of innovation policy which promotes economic success within less successful regions through USO instruments.

The 'knowledge pool' concept implies that spin-offs have the greatest economic impact when they are locally located and active participants in a commercialisation knowledge pool. As Elgen *et al.* have noted, professional business service firms have the greatest tendency to relocate from their region to their client markets, and this has a strong inter-regional knowledge transfer effect. Although Clarysse *et al.* (2004) suggest that this implies universities should - in that situation - focus on technical-based spin-offs, this does raise the question of whether there are policy instruments which could target promoting the types of business service firms which are most likely to remain in the region because they have strong links to the region. In both Twente and Newcastle, consultancy firms have spun-out and remained in the region whilst remaining reliant on (the distant) national government as a major client. Chapman *et al.* (2004) note that technological service firms have been an important part of the revitalisation of the Aberdeen oil and gas cluster. This raises the question for policy-makers of how to promote those knowledge-intensive business service spin-offs which have strong reasons to remain in their host region.

Secondly, the issue of professionalisation is an intriguing tension for universities to manage effectively, but also clearly other regional policy-makers have a stake in the outcome. Even at a heavy discount, the potential future value of bits of unknown technology are very high to universities, whilst indeterminacy makes their value to SMEs very low. A further and clearly significant risk is that any kind of codification and systematisation of knowledge transfer risks undermining the whole knowledge pool, closing it to outsiders and producing a lock-in effect often associated with economic decline. How universities manage their knowledge transfer activities will clearly play a significant role on the openness of the university to local businesses, and hence the accessibility of the regional knowledge pool. If informal knowledge transfer is acting as a 'glue' that is holding the knowledge pool together, then there needs to be a way to meet the costs which universities incur, and to which professionalisation has been the response.

6.3 *Concluding discussion*

There is insufficient evidence presented from the case studies to be able to explore whether the two examples of Twente and Newcastle do represent improvements in their regional situations, but the conceptual framework at least begins to highlight some of the key relationships within the regional networks with potential to contribute to regional development by creating a regional knowledge pool that is actively used, and relevant to, other firms. Although we subdivide the task into exploring three particular networks and their connection to the regional innovation environment, it is important not to lose sight of the main goal, which is answering the question of whether a particular set of regional activities and changes are an improvement in the regional innovation environment. In our conceptual framework, the three different network activities come together as a coherent regional system holding together a knowledge pool upon which other firms can draw. This suggests a future research methodology of exploring the changing topology of the three sub-systems identified above, and their aggregate impact on the uptake and upkeep of the knowledge pool. Although anecdotal evidence suggests that USOs can make significant contributions to their territorial knowledge pools, further - and more rigorous - analysis is required to test the boundaries and validity of this still highly stylised conceptual framework of regional economic improvement.

Of course, this heuristic of a territorial knowledge pool as embedded within regional relationships implies a more general underlying mechanism for economic development in knowledge-intensive economies. If the model is valid, then there are important implications for understanding economic development in successful, as well as less successful places. If knowledge pools in successful places become tightly bounded and inaccessible, or overly privatised in that individuals do not contribute their knowledge as freely to them, then this could lead to their lock-in and decline. This would help to provide a more grounded understanding of where potential diseconomies of scale in knowledge capital could occur. However, our concept remains as yet empirically untested, and although an intriguing heuristic, avoiding Cooke's critique of "untestable stylised statements on what drives regional development" requires further and hopefully exhaustive testing of this model in the ordinary as well as the totemic places of the new knowledge economy.

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¹ Compare for example by members of the European Consortium of Innovative Universities and participants in the EU-funded UNISPIN research programme (Jones Evans, 1998; Shutte & van der Sijde, 2000).

² The information on Newcastle comes from a range of research projects since 1994, and draws on material published *inter alia* in Benneworth (2001), Benneworth (2002), Benneworth, (2004a) Benneworth & Dawley (2004), Boucher, *et al.* (2003), Goddard & Chatterton (2003) HEFCE (2001) and Rappert, *et al.* (1999). The material on Twente is drawn from *inter alia* van den Kroonenberg (1996), Schutte (2000) and van der Sijde *et al.*, (2002a; 2002b).

³ <Newcastle University> <2004> <<<http://www.ncl.ac.uk/business/success/spinout/all>>> <Newcastle University spin-out companies> <Accessed 21 July 2004>

⁴ Sage is an accountancy software firm formed by a printer who relocated from London to escape union pressure, and a graduate of Newcastle University. The graduate went into the printing firm as a consultant through the MAPCON scheme, and wrote code to computerise their accounts, code which became a core part of the product they sold for the first 15 years of their existence. Sage is a significant company because it has switched the roles described above where peripheral spin-outs are

taken over and dismembered by companies in established and up and coming technological clusters. Sage has bought firms in Dublin, Paris and Silicon Valley, and is currently the own quoted software company in the Top 100 UK firms.

Figure 1 Heuristic model of how university/ business interaction creates a more generalisable territorial advantage

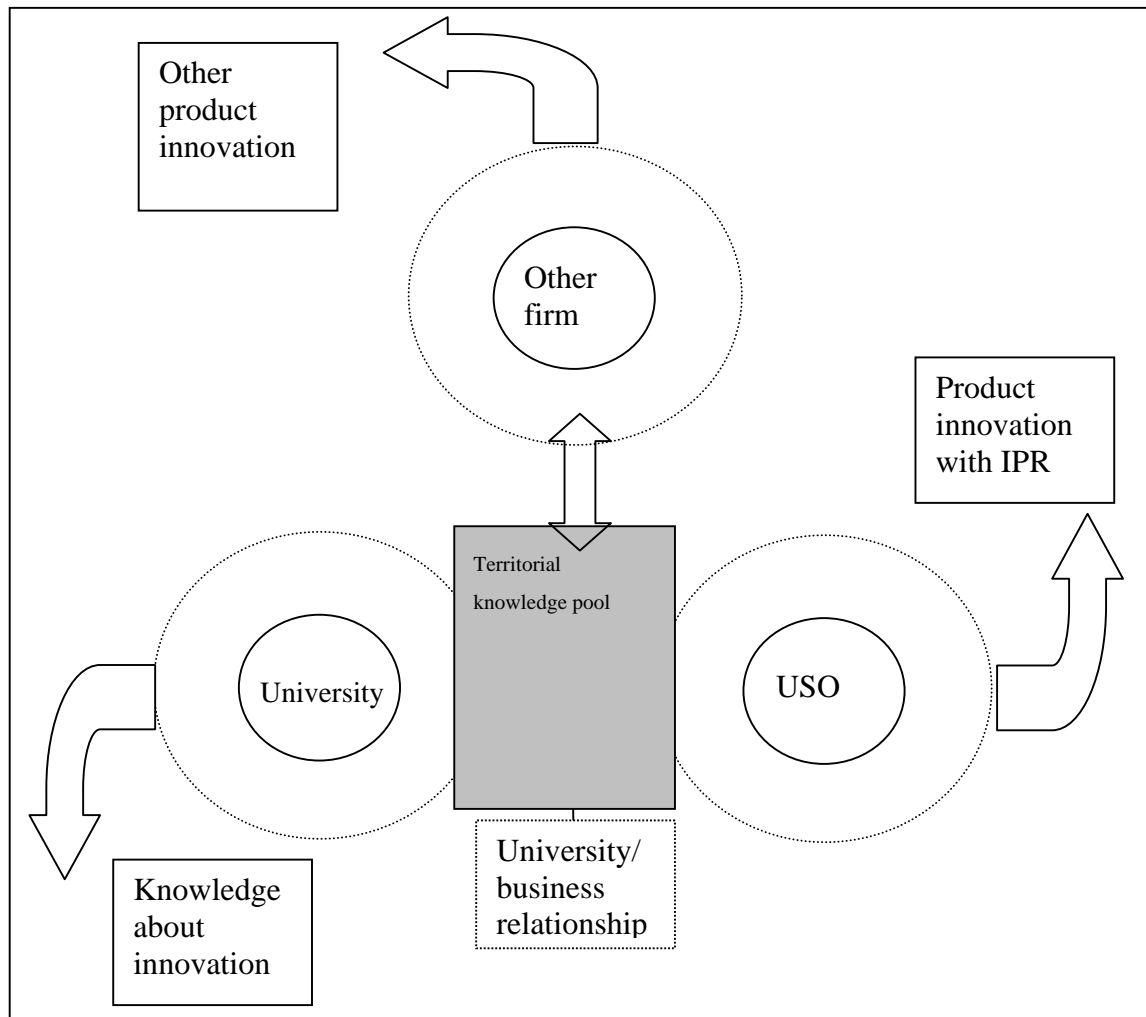


Figure 2 A mapping of the literature onto the heuristic UBI model

