PART II

KEY POLICY ISSUES IN ENTREPRENEURSHIP AND SME DEVELOPMENT

Part II of this report is structured in six thematic chapters. Each chapter starts with a summary of main findings from the local case study areas by the OECD. In the following paper, both theoretical and practical aspects of policy action are discussed in light of new policy approaches and options. References are made to good practice initiatives in East Germany and other regions in OECD member countries. A chapter concludes with the OECD policy recommendations presented as a 'Checklist'. Along with a selection of international learning models and good practice examples in East Germany, this final section of each thematic chapter aims to inspire policy innovation and the development of local approaches to strengthen entrepreneurship.

CHAPTER 4

UNIVERSITY ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER

FOSTERING UNIVERSITY-INDUSTRY LINKS

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Introduction

Aims in context

This chapter outlines the issues in developing strong university-industry links in eastern Germany. The commercialisation of university research is argued in the literature to be a driver of productivity and international competitive advantage. It stands to reason, therefore, that this has been a priority not only across OECD countries but also in emerging economies (Potter, 2008 forthcoming, Mitra, 2008 forthcoming).

To some extent, the debate on the best mechanisms for developing good Higher Education (HE)-industry links is a well-rehearsed one (Lissenburgh and Harding, 2000). In its simplest terms, transferring the knowledge that exists in the research base into commercial applications, creates new market opportunities which fuel job and wealth creation in the economy as a whole and maintain or enhance a country's competitive position in terms of innovation. Similarly, the education and training role (including professional development) that the higher education (HE) sector provides a route for transferring knowledge (know-how and know-why) into commercial and public sector settings.

As with everything, however, the issues are more complicated than this simple summary would suggest and there are generic challenges for policy makers in ensuring that the knowledge transfer process does, indeed, lead to successful commercialisation. These are discussed in more detail below in the form of an international literature search, but in summary are:

1. *Appropriate forms of university (HEI)-industry link:* commonly HEI-industry links are seen as falling into two categories, both of which transfer knowledge – education and training and commercialisation/spin outs. Increasingly as well it is important to see links in terms of consultancy, joint-ventures, partnerships and even informal networking. To some extent, there is a tendency to regard HEI and business links as necessarily a good thing in the literature as a new model of collaboration that yields economic, social and increasingly environmental returns. However, this is only the case if appropriate forms of collaboration are developed – otherwise the links can equally just be seen as "socially inefficient privatisation of research and therefore a threat to science itself" (Sampat, 2006).

2. *Measurement of policy impact:* since the mechanisms for knowledge transfer are not always clear cut, this presents measurement problems. The innovation literature has relied historically on citations and patents as proxies for innovative activity and the effectiveness of innovation systems (of which university-industry links are a key part). However, as the process of interaction starts to include licensing, informal networking, consultancy and joint research ventures as well as formal commercialisation, spin-out activity and private sector investments, the issue of measurement becomes more difficult.

3. *Definitions and intellectual property*: the scientist, the innovator and the entrepreneur are not necessarily the same thing and this leads to confusion over where the rewards from the commercialisation activity should lie.

4. *Closing the finance gap*: much has been done to provide structures for seed-finance and early-stage growth finance in OECD countries to address the imperfections in the market for innovative projects. Two challenges still remain, however: to close the "knowledge" gap – i.e. the language difficulties between the scientist or innovator and the investor that appear both as information asymmetries and lack of management experience and second, to provide a funding escalator that itself ensures that there is continuation and access to growth finance as the project progresses (Wright et al 2006).

5. *Globalisation and the speed of "catch-up":* in many OECD countries, government policy is focused on the need to compete at the high "value added" end of the market in order to address the challenges of rapid catch-up in some of the emerging economies.

There are, however, immense policy and economic opportunities from generating increasingly close relationships between HE institutions and industry. Specifically these are:

1. *The potential for creating innovation "clusters"*: these are agglomerations of actors around a shared technology such as nano-technology or biotechnology. The benefit of clustering activity is the scope for synergies between groups of experts from the scientists in HEIs through to the structures that support commercialisation, including large business, venture capital and specialist legal support (Porter, 1998).

2. *The potential for creating regional growth*: the literature is agreed on the fact that HEIs transfer knowledge locally and regionally rather than nationally and that the measurable benefits of knowledge transfer are strongest in the immediate region around a university (Fritsch and Slavtchev, 2007; Davenport, 2005). The policy implication is that by generating a strong knowledge base regionally with robust links to the industrial base, there will be positive effects for regional development.

3. *Globalisastion and regional development*: HEI-industry links are a critical part of the regional "innovation system" (Braczyk et al 1998, Cooke and Schall, 1997; Cooke, 1998; Cooke, 2001). Increasingly regions compete against other global regions for a share of the research and skills investments of big and small companies alike.

Overall, HEI-industry links are a positive way of creating social and economic wealth. As will be made clear in the subsequent sections, these detailed policy issues and challenges have been met to a greater or lesser extent by specific initiatives on the ground in eastern Germany. To this end, eastern German growth, particularly in innovation sectors, is now faster than that in western Germany (IWH 2007). There are, however, some remaining challenges which reflect the new German states (neue Länder) status as transition economies. In particular, the issue of "global growth but local unemployment" is one that continues to demotivate and to hamper the rapid growth potential that is undoubtedly present in the eastern German economy (Harding et al 2002; Harding 2007a).

Definitional issues

What is intriguing about all the interest in "innovation" and "entrepreneurship" generally and HEI-industry links in particular however, is that, in recent literature and policy discussions at least, they are rarely defined and even more rarely combined in the same unit of analysis (Folkerington et

al). Policies aimed at entrepreneurship typically focus on the small business sector and, in the case of EU policy, on encouraging it to be more innovative. Alongside this, more people are encouraged to set up businesses. Similarly, innovation is viewed in terms of Science, Engineering and Technology (SET) and its commercialisation rather than in terms of the *entrepreneurial processes* driving that commercialisation. Increasing amounts spent on R&D or increasing the number of knowledge workers in the economy is seen as intrinsically a "good thing".

This has little recourse to the broader definition of innovation as "change" and entrepreneurs as "the agency that generates changes in the rules and implements those changes" (Metcalfe, 2006). Instead, innovation policy focuses on increasing the science base in HE and putting mechanisms in place to enhance technology transfer (through funding and collaborative research) while enterprise policy focuses on increasing the numbers of businesses that are established. Both in the end are looking at "enterprises" as business entities, rather than the process of "enterprise" which is an activity associated with experimentation that changes the rules within which decisions are made and introduces "novelty" (new ways of thinking and new ways of doing) to the economy (Metcalfe, 2006 op cit).

The result is confusion in the literature and arguably in policy and practice in the UK and beyond. "Entrepreneurship" and "Innovation" are used in several ways:

1. Synonymously: entrepreneurs are necessarily bringing something new to the market and therefore are innovating (Casson et al 2006).

2. Interdependently: entrepreneurs are active in technology sectors and the small businesses they establish make a direct contribution to job creation and productivity (Armington and Acs 2004)

3. Independently: entrepreneurs are defined by their decision-making and risk-taking capacity and not by the novelty of what they do. Innovators are defined by their novelty. It is therefore possible to be entrepreneurial without being innovative and vice versa (Hayek, 1937, Kirzner, 1973).

There is a tendency to use "entrepreneurship" and "innovation" interchangeably, but the two are quite distinct phenomena. The "entrepreneur" perceives opportunities and makes judgement calls as to the market viability (i.e. the risks) of those opportunities (Casson 1982). The innovator is the source of those ideas and opportunities and is the conduit of knowledge between the knowledge-base and its future commercialisation, effectively converting uncertainty, which cannot be calculated into risk, which can. While the literature from 50 years ago or more was clear on this distinction, the boundaries between the two have become blurred in recent writing and thinking. A workable definition of the "innovative entrepreneur" as a person who identifies an opportunity from an innovation, whether social or commercial, evaluates its market potential based on their own knowledge networks and social, financial or educational capital, and establishes an organisational structure, either within an existing entity or by creating a new one, that allows that innovation to be developed (Harding 2007a).

This is a vital distinction for policy towards HEI industry links and particularly university spin-outs. The researcher in university may generate the scientific knowledge with commercial potential. However, it is the innovator who recognises and articulates that potential and the entrepreneur who calculates and takes the risk in realising its market potential. This is important for four reasons which are discussed in some depth below:

1. Appropriate forms of HE-business links which allow knowledge to transfer appropriately from the science base into the local and regional economy are a cornerstone of regional/cluster policy. Arguably this rests on the effective policy integration of innovation and entrepreneurship measures.

2. Intellectual property (IP) is one of the stumbling blocs to effective commercialisation of scientific research in many OECD countries; arguably a clear definition of the collaborative yet distinct roles of researcher, innovator and entrepreneur help to assign IP and therefore allocate returns appropriately.

3. Measures to support other HE-industry links, such as consultancy, education, training and professional development and support for entrepreneurship training in schools should be encouraged and focused on developing an effective and efficient innovation *system* which improves gross value added of the regional and local economies.

4. Policy makers need effective vehicles to measure the performance of the innovation thus developed through policy which includes both measures of innovation and measures of entrepreneurship as well as proxies for the informal networks, skills base and partnership arrangements that exist between the HE sector and industry (Katz, 2006, Corley et al 2006).

Scope of the chapter

The rest of the chapter is constructed as follows. The next section looks at four key policy issues and challenges in more detail: regional and cluster policy, intellectual property and financing barriers in stimulating spin-outs, other policy measures to increase informal links, for example through training and consultancy and finally, policy impact measurement.

Policy issues and challenges

Innovation policy generally and HEI-industry links policy in particular has increasingly been informed by two important theoretical developments in the literature. The first, broadly termed endogenous growth theory (Schumpter 2006, Romer 2000, Keilbach and Audretsch 2004, Viale and Ghiglione, 2000; Audretsch and Lehman 2005, Audretsch et al 2006), argues that innovation and knowledge transfer from within the economic system is a key driver of economic growth. The number of knowledge workers and how much innovation is generated (measured through patenting and innovation based start up activity) is a determining factor in generating productivity growth amongst small firms, albeit in a random and unpredictable way (MacPherson, A and Holt, R. 2007).

The second, broadly termed the "Triple Helix" approach (Etkovitz 1994, Leydesdorff, and Etzkowitz, (1997, 2000), Leydesdorff, 2005a 2005b) sees knowledge transfer as a function of the complex set of formal and informal linkages between research institutions, finance and commercial businesses and the government (Berg-Jensen, B et al 2007). The interactions between the three strands of the "helix" creates the unique and distinctive characteristics of an innovation system – the "symbiotic tension" that reflects the simultaneous interdependency and competition between actors (Harding, 2000,2001) – at either a national or regional level.

Regional policy

Within the triple helix literature there is a distinct group of authors who regard national competitive innovation advantage as generated at the regional rather than at the national level (Cooke 1998, Braczyk et al 1998, Edquist 2001, Cantwell and Iamarrino 2000, Saxenian 2006, Harding 1999,

Harding et al 2002). This is because the region is a focus for sectoral specialisation and, hence, related know-how accumulation. This in turn allows symbiotic learning relationships between institutions to develop (Harding 2000, 2001) making regions important as drivers of innovation and competitiveness (Azagra-Caro, 2006; Hussler and Rondé, 2007, Heidenreich, 2006), Fritsch and Slavtchev, 2007).

Learning and adapting to changing market and technological conditions is more likely to be effective and sustainable at a regional level since tacit knowledge transfers more easily between actors in close spatial proximity with clear links to the cumulative skills and attributes of the regional labour market (Todtling and Kaufmann, 2001, Dodgson, 2001, Bracsyk et al 1998, Porter 1998, Vickers and North 2001). As expertise starts to build, specialist financiers, accountants and lawyers are established to support the base in knowledge production and, accordingly, any start-up businesses are provided with appropriate and readily accessible advice and consultancy. The evolution of this type of regional "industrial system" is argued to go some way to explaining the development of Silicon Valley and Route 128 in the US (Saxenian, 2006).

This is taken further by Porter who develops the concept of regional "clusters" or agglomerations around specific technologies or industrial sectors. The attractiveness of this, "cluster" approach (Porter 1998, 2002) to policy makers is clear, especially in the area of innovation policy. Innovators are dependent on scientific, innovation, commercial and financial networks both for ideas and for markets. For example, universities or the research function of large corporations are known to act as pulls for entrepreneurial activity (Czarnitzki and Kraft 2001) insofar as entrepreneurs will tend to locate close to research and commercial hubs. If this set of inter-relationships can be systematised, then regionally generated knowledge will add value through the cumulative learning process to create the specialisation that is so important to international competitive advantage, particularly in research-led sectors such as information and communications technology or biotechnology (Cooke 2001, 2002; De la Mothe & Paquet, 1998). The assumption tends to be that the institutional base (venture capital and business angel networks, universities and inward investment, for example) will generate entrepreneurial activity and that knowledge will transfer between knowledge generators and knowledge users automatically.

It is this concept of clustering and regional development that has dominated policy in OECD countries and particularly in Germany over the last ten years. Large as well as small firms compete as much on innovation as they do on productivity and clustering of expertise means that there are innovation synergies between actors in the form of intellectual, technological and social spill-overs (Dohse, 2007). Regions compete globally for the location of Direct Foreign Investment, innovation, skills and, specifically in the context of this chapter, enterprise (Gardiner, B. et al 2004, Kitson et al 2004, Maleki, 2004). The critical success factor for any region in generating this competitiveness is the extent to which it can create learning “networks” or “social capital” to ensure that knowledge transfers between actors in a way that creates competitive advantage in global markets (Saxenian, 1997; Cooke 2007). However, in the context of this chapter, neither innovation in itself nor university-industry links by themselves are sufficient to create market opportunities and therefore increased university spin out activity. For this, entrepreneurs are necessary as well (Harding 2007a, Levie et al 2007).

Intellectual property and finance

Technology-based firms from the university science base are potentially both more suited to venture capital investment *and* more likely to seek venture capital investment. They require significant amounts of capital but, because their business is based on an innovation rather than a proven business concept, investments in them are inherently more risky. In theory, at least, this ought to be the domain

of risk-takers and, hence, also the domain of venture capitalists. Yet an equity gap in the financing of university spin-outs is evident in many OECD countries. This is a clear challenge for policy.

Linking venture capital with technology-based university spin-outs is, at best, complicated:

- *Returns to technology investments are high but inherently risky*: The Bank of England estimates average returns on technology investments to be around 23% (Bank of England, 2000). But one technology investor claimed return rates of 45% in the UK and rates in the US are certainly higher at 33.7% (www.nvca.com). This return rate is evidence of the high growth and wealth creation potential of technology-based firms as much as evidence of their suitability for venture capital funding. Yet venture capitalists themselves will not be able to take advantage of these potential returns unless they can be encouraged into riskier, technology-based investments.

- The growth potential that these companies have is embedded in the value that they add to their initial concept. This value is as much a function of people and networks and therefore particularly high for university spin-outs yet time scales to realise returns are too long for orthodox VCs at the early stages. All technology-based companies start with a commercially unproven innovative idea at the seed stage – this is the risk. The growth process is the cumulative 'proof' of the idea or concept's commercial viability. The value at the end is the return. But, especially in science-based industries like biotechnology, this growth process requires substantial development funding. This funding can be necessary over a long period of time – as long as ten years. This is significantly longer than most venture capitalists will invest without a clearly defined exit route, thus there is a clear role for government support at the seed stage and even at the start-up stage to leverage in informal and formal venture capital.

- The acquisition of substantial capital investments allows technology-based firms to attract key scientists and innovators into their business and this is easier in a university-led venture. It is important that such companies can easily access the high-net-worth individuals that add value to an innovative concept. This is primarily a function of the supply of such people from universities, colleges and industry and, as Fritsch and Slavtchev (2007) argues, this is easier where universities work in close proximity to finance and commercial structures. The role for policy here is in creating an infrastructure that creates such high value 'human capital' in which venture capital can invest.

- Finally, in order that the rate of return is fully realised and venture capitalists continue to invest in technology projects, there has to be a good supply of investment opportunities for venture capitalists. This deal flow stems from universities and colleges through academic entrepreneurs and from indigenous and overseas hi-tech companies with research capacity. Governments can do much to stimulate a culture of science and technology-based entrepreneurship through funding for basic science, significant funding for university-business partnerships, science parks, incubators and programmes to stimulate high technology investments. Yet there is evidence that there is a weakness in the commercialisation of science from the research base across Europe but in the UK in particular (Bank of England 2001).

The other key issue in generating viable university spin-outs is that of intellectual property. Much is made of the importance of robust intellectual property regimes to protect ownership and to generate returns proportionate to the risk taken. The Bayh-Dohl act in the US provided a clear delineation between university research and commercialisation and incentivised not-for-profit and research

organisations (in particular HEIs) to patent. This act has been mimicked around OECD countries to stimulate patenting from the University base including in Germany. The result is growing university/HEI patenting across Europe, for example (Geuna and Nesta 2006).

However, ownership issues have become more complex as David and Hall (2006) point out. For example, where a clear delineation has existed in the past, the frequency of personnel exchange between public and private sector research domains, the increasing returns to individual public sector research from the commercialisation of their innovations and the fact that technology moves quickly and therefore the patenting process slows the process of commercialisation have meant that intellectual property arrangements are no longer easy to define. Allocation of risk and return has become blurred and complex rendering legislative frameworks at best slow and at worst downright inhibitive of innovative effort. The implication for policy, therefore, is that systems must be flexible and lithe as well as robust.

Education, training and consultancy: the growing framework of informal university-industry links

There are other areas where knowledge transfers between universities and the regional economy are more informal. They include education, training, professional development and consultancy as well increasingly, informal contacts and networking enabled through proximity and information and communications technologies (ICT). The effects of these more informal knowledge transfer mechanisms are twofold:

1. Through education, training, consultancy and professional development, research *expertise* (know-how and know-why) is imparted to individuals who then carry it into their place of work. The result can be higher levels of business-related skills that directly improve performance in the workplace as well as higher levels of knowledge and research expertise – in other words, tools that can be used in the workplace (Mitra, 2008 forthcoming).

2. Through support measures to support university entrepreneurs as well as entrepreneurship training to enhance directly the knowledge transfer from the science base to eventual commercialisation (Mitra, op cit).

The first aspect of this knowledge transfer has little to do with generating university spin-outs or with educating the next generation of scientists to be entrepreneurial. Policy, as a result, has focused on the latter providing resources for entrepreneurship courses, student entrepreneurs' networks and business planning competitions to expose students to the realities of venture capital and commercialisation. There are, however, a number of issues in ensuring that such programmes are truly reflective of local business needs as summarised below:

1. New venture creation, business planning and team building are necessary but not by themselves sufficient conditions of effective commercialisation of university research. These programmes often work in isolation from the research base within universities and, hence, do not fulfil their role "translating" and "developing" between the research base and potential business partners or financiers.

2. The rapid process of change in the economy does not render teaching programmes, with substantial lead times to approval and delivery, efficient or effective in delivering dynamic, entrepreneurial responses to business requirements (Luczkiw 2008).

3. Small and medium-sized enterprises (SMEs) are often unaware of or unable to afford the programmes that might generate appropriate forms of knowledge transfer. Use of student

dissertations and projects as well as industrial placements and reciprocal staff exchanges are some policy mechanisms used by OECD countries to ameliorate this situation but these are nevertheless fragmented and patchy in their effectiveness and there is evidence to suggest that some of the most effective mechanisms are informal and proximity-based (Malecki 2004).

Measurement of policy effectiveness

Traditionally the outcomes of university-industry links have been measured through citations of refereed papers and joint patenting activity. Increasingly, policy makers also look to levels of venture capital investment, numbers of spin-outs from university research, numbers of collaborative research ventures, education, training and development and licensing/franchising activity to proxy for "knowledge links" and knowledge transfer activity. All of these measurements are essentially static and presume that knowledge can be codified in terms of specific outcomes.

However, there are two reasons why these quantitative measures may no longer be sufficient to understand the complexities of knowledge transfer: first, HEI-industry links must be seen in the context of regional and national innovation *systems* where many of the interactions are tacit and uncodified. Second, ICT-enabled interactions have become commonplace as vehicles for informal communications. Any attempt to use proxy variables, therefore will not capture fully the breadth and depth of knowledge transfer either in terms of the tacit transfer or in terms of any spill-over effects (Harding 2003; Geuna and Martin, 2001).

More than this, we know relatively little about *how* knowledge transfers (Fritsch and Slavtchev, 2007). We can know a substantial amount about the mechanisms for stimulating transfer: for example private sector grants are more likely to encourage researchers into collaborative projects than public ones (Bozeman and Gaughan 2007) and industry-science links facilitated through technology transfer offices with clear incentives will similarly encourage researchers to collaborate (Debackere and Veugelers 2005).

Yet in a world where public sector resources for expenditure are tight, the evidence base is critical as a justification for expenditure by governments on specific initiatives. Since the process of wealth creation through university-industry links is not obvious to the general public, it stands to reason that policy makers require robust and reliable data, not just to evaluate policy effectiveness but also to identify gaps in provision and market imperfections as they arise.

Approaches to university-industry links in OECD countries

Policy across OECD countries towards university-industry links reflects the definitional ambiguity that was highlighted at the start of this chapter:

- On the one hand, there is substantial activity to stimulate university spin-outs through provision of seed capital, "partnering" activity through technology transfer offices on university campuses, incubator support, support for business angel activity and so on. Much of this is focused on the "innovator" who takes the research and turns it into a commercial opportunity by utilising the infrastructures that exist in the national or regional innovation systems. These innovation systems are locally, regionally or nationally specific and, hence, develop in a unique way depending on their local industrial histories and innovation strengths (Lundvall et al 1992).

- On the other hand, there is equal policy emphasis on the importance of enterprise education from schools through HEIs and into business support structures. Academics stress how important this is in generating enterprise cultures that will enable innovations to be turned into real market opportunties (Sahra and Welter, 2008 forthcoming). The benchmark is often taken to be the United States (Wilson, 2008 forthcoming) but there is increasing awareness amongst policy makers as well of the need to ensure that local conditions, cultures and norms are also taken into account.

In generating effective policies towards HEI-industry links, however, a note of caution should be sounded. Both innovation and entrepreneurship are necessary but not of themselves sufficient conditions to effective knowledge transfer. Understanding innovation and entrepreneurship as mutually interdependent, effectively two sides of the same coin, is critical to developing effective policies towards this critical area (Harding 2007a).

Policy summary

What is clear, then, is that policy has to be:

- Strategic, and integrating entrepreneurship and innovation in order to maximise the knowledge transfer and learning potential of any attempts to foster greater links.

- Have clear clustering priorities that reflect the fact that knowledge transfers best in close proximity to the science base.

- Look at ways of generating cultural change to encourage more informal links between universities and industry (hence over-coming the knowledge gaps)

- Have obvious financing routes.

Each of these is discussed in terms of policy experience across the OECD below.

Entrepreneurial culture and perceptions, motivations and skills

Cultures take a long time to change but through the education and training process, through role models and through appropriate incentivisation, it is possible to make people more positive towards entrepreneurship.

Access to finance

Clearly finance represents the major obstacle to growth and is a function both of limited access to growth funds and of the "knowledge gap" referred to above. The knowledge gap, in turn, is created because potential investee companies from universities are not familiar with articulating their business propositions in a way that makes sense to investors. Similarly access to growth finance becomes critical. Across OECD countries, the availability of seed finance has been enabled through programmes like the Higher Education Innovation Fund (HEIF) in the UK that supports very early stage entrepreneurs from the science base both in terms of coaching and mentoring and in terms of access to small-scale finance.

As companies get through the proof-of-concept stage, however, access to growth finance become an issue. The risks for investors are still high, yet the scope for public policy is limited since "soft money" (i.e. public sector co-investment) just to ensure that growth finance can be accessed

undermined the development the growth finance sector in Germany initially. The resolution is a system of guarantees alongside effective public procurement:

Areas for policy intervention

Since German re-unification, there are a number of areas that have affected eastern German regions in particular in formulating effective policies towards university-industry links. These are discussed in detail by Harding et al (2002) and Harding, (2007b). To summarise:

- The closure of the majority of eastern German businesses by the *Treuhand* in the immediate aftermath of re-unification. The result was unemployment and productivity problems on a scale unimaginable before the fall of the Berlin Wall. By 2002, the overall level of unemployment in eastern Germany was 18% and was little changed in 2007.

- High levels of outward migration of highly qualified workers and young people in particular to western German states.

- Negative economic growth during the late 1990's. Immediately after re-unification, large amounts of money were put into construction programmes and the building industry grew exponentially. However, this growth was relatively short-lived and was followed by slow-down and then recession triggered both by the decline in construction expenditure and by the downturn in the German economy generally.

- High wage costs relative to western German states that prevented large-scale inward investment by global firms and, hence, restricted collaborative partnership.

- Lack of confidence amongst the people of the East German regions in the process of change.

However, there is evidence to suggest that the macroeconomic conditions in Germany are improving and that much of the growth in the economy as a whole is coming from eastern States.

- The German economy experienced a strong recovery in 2006, largely as the result of increased exports but also because of improved investments in machinery and equipment (Economic Forecasts of Joint Research Institutes, 2006). By mid-year 2007, GDP growth eastern Germany was 3% and largely fuelled by innovation-based exports.

- The SME sector (*Mittelstand*) is demonstrating strong competitive performance and is increasingly a vehicle for private-equity investments in Germany. Funds raised for private equity and venture capital have increased (BDK, 2006).

- There is evidence that although the collapse of the Neuer Markt presented Germany and the Germans with a real crisis of confidence in the New Economy, entrepreneurial activity is beginning to increase and confidence is improving[1]. The new economy in Germany is strong, with downward pressure on real wage growth, openness to trade nearly twice as high as

[1] Minniti, M. (2006): "Global Entrepreneurship Monitor, 2005 Executive Report" GEM, London Business School and Babson College.

other industrialised nations, increased investment overall and improved productivity, especially in manufacturing (Deutsche Bank, 2006)[2] .

- Spill-over effects from the rapid "New Economy" growth in areas around technology hubs such as Jena have gathered momentum after a shaky start to the 21st Century (Buehnstorf and Fornhal, 2006). Similarly there is evidence that the initiatives to create regional innovation hubs and networks have been successful and started to generate real growth effects (Eickelpasch and Fritsch, 2005, Harding 2003, Audretsch and Lehman 2006).

- The Eastern German innovation base is being fuelled by public R&D grants to a greater extent than in Western Germany: more R&D tends to be conducted per "R&D Euro" spent in public sector grants than in the West, and there are greater innovative outputs (for example in products and services) although fewer patents. (Czarnitzki and Licht 2006).

Much of this has been fuelled by effective policy at State and Federal level towards regional clustering and innovation and particularly university industry links. The *Innoregio and Bioregio* programmes were both cluster strategy programmes to foster university-industry links and knowledge transfer, the former purely for the east German regions and the latter for all regions (although only Jena and Dresden successfully achieved bioregion status). The policy focus for *Innoregio* was to direct "dynamic development through structures and support systems to promote regional and local level innovation. Behind the idea was a belief that it was the regions themselves who had a knowledge of their local labour markets and industrial conditions and could therefore self-organise in order to strengthen them. Critical to success was a clear regional strategy on how knowledge and know-how was to transfer and generate revenue (Harding 2000, Dohse 2007). The *Innoregio and Bioregio* programmes have now been superceded but nevertheless represented prototypes of cluster-policy.

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FINDINGS AND POLICY RECOMMENDATIONS FROM LOCAL CASE STUDIES

OECD

Whilst across the local case study areas there appear to be several short and medium-term opportunities to strengthen the contribution of the existing science and technology base to entrepreneurship in the local and regional economy by adjusting the current policy approach, a large part of the policy effort should focus on achieving several longer-term shifts. These include changing the attitudes of staff and students to enterprise and their ability to undertake entrepreneurship activity, increasing the scale and breadth of research activity, attracting academics from the rest of Germany and the rest of the world, and strengthening university-industry linkages around higher education institution's (HEI) research specialisation, not just in the region, but also over a much wider area based more on research topic than geographical proximity. The reliance on extra-curricular workshops and networking events could also mean that the full potential of university entrepreneurship is not being reached. The goal should be to promote attitudes and motivation for entrepreneurship beyond self-employment and fostering a culture of high risk and aspirations for high-potential entrepreneurship as part of a university's mission. The local case studies provoked an impression that entrepreneurship programmes focus on quantity rather than on quality. This fulfills the objective of mobilising the high-skilled for entrepreneurial activity, however, in the long term, the mission should be to create growth- oriented businesses that will generate jobs in the region. Hence, in order to better direct, support and tailor initiatives, processes should be designed and implemented to better monitor and evaluate the economic and social impacts of entrepreneurship programmes at HEIs.

Whereas in many other OECD regions most entrepreneurship programmes are centred in business schools and a few institutions target entrepreneurship education toward technical students, the approach in the local case study areas is to provide access to entrepreneurship education to all students throughout all faculties. Furthermore, interdisciplinary project teams include students of economics as well as students of natural sciences. Programmes use experiential learning (engaging in real-world projects to launch businesses) and engage external business experts to mentor student teams. This is a very effective method of teaching entrepreneurship, as it also promotes entrepreneurship by spotlighting the accomplishments of successful entrepreneurs and thereby providing role models for students. Even if some businesses fail, the learning mission will be accomplished. However, most of the learning is done *ad hoc* outside the classroom and programmes are driven by relatively few high-energy professors. In addition, teaching and research obligations and other leave not enough time or motivation to assist students with business start-ups. Professors are rewarded for research and teaching. They are not rewarded for economic accomplishments.

Just as internationalisation and wider networking is vital for fast-growing small businesses, so it is for a research-based university. Current efforts in the local case study areas underline that making a greater national and international impact requires investment to attract academics and create attractive facilities, as well as a promotional strategy to make universities in East Germany and their work much more widely known internationally. The same applies for the co-operation with multinational companies, which can help to accelerate and scale-up commercialisation processes because of their strong access to global markets. Creating, exploiting and managing wider network relations is important to achieve economies of scale as well as accessing and exchanging information about new knowledge, resources and markets. Towards reaching its objectives of promoting university entrepreneurship, a greater outreach would help to

gather and disseminate information about the advantages of internationalisation, such as access to know-how and technology, ways to overcome high production costs on the domestic market, access to new and larger markets for products and services, additional production capacity, access to capital and labour. To this end also a strategy to increase contacts, with and exchanges between University alumni should be enforced; the involvement of alumni that have become successful entrepreneurs could be a valuable contribution to entrepreneurship programmes. Some of the HEIs in the local case study areas aim with their networking activities to follow two directions. Firstly, they link up with other HEIs in the region and connect with other networks in Germany, including some early-stage international outreach. In one local case study area, the spirit of co-operation amongst the partnering HEIs is exemplified by the fact that each university refers student entrepreneurs to the most appropriate resources for their needs, even when those resources are at one of the other institutions. Secondly, one university in the case study university aimed to become the main interface between key local industries and the local science base in facilitating technology transfer from laboratory to industry and from company to company. The approach is meant to help channel public support and private funding into business ideas with high growth potential and small firms with growth intentions, and further, to foster networking between these firms. These two types of networking activities allow universities to develop both individual and collaborative strengths and help establish and spread local linkages between spin-off firms and local companies. Extending the target group, from the initial core group of university students, graduates and academic staff, to local business clusters, financing institutions and venture capitalists can be seen as a promising approach to make full use of the network's potential to contribute to a wider economic development in the region.

Although it might be possible to have vibrant entrepreneurial activities within the HEIs, technology and knowledge transfer into the local SME community require receptive environments on both sides. These prepare for communication and interaction between these two communities, which often develop quite independently. Cultural barriers between local SMEs and the HEIs and research communities often lead to a lack of social networks that are prerequisites for building more formal partnerships. OECD research shows that only inter-personal relationships will bridge the two worlds when they are profoundly separated. In the local case study areas, the efforts initiated by HEIs seem to be fully embedded in the partnership work with business support institutions at both local and *Land* levels, which allow for knowledge and technology spill-overs to non-HEI entrepreneurs. The existing network structures provide the ground for public policy and local entrepreneurship support programmes to further promote interaction between the research community and the local business sector.

HEIs should recognise the value of intellectual property created as a result of their research. For the local case study areas, capitalising on underexploited means of commercialisation will require a maximal reduction of barriers to professors in starting businesses. Universities should, in the long run, provide incentives for professors to start businesses. This includes ways to audit the intellectual property (IP) capacity, also with regard to potential technology and knowledge transfer. Technology-based businesses being spun out of universities primarily commercialise the inventions of students (including graduate students doing research directly with professors). There has been less effort to commercialise technologies invented by professors. As a result, some of the best technologies may not be transferred and the universities where the technologies were invented do not realise all the potential financial benefits of commercialisation in those technologies. Technology transfer is also accomplished by placing students as interns in technology-based businesses. In one of the local case study area which had no HEI within its nearer region, local governments, the Chambers and a University of Applied Science have established a partneship that allows local companies to benefit from technological research by taking in graduate students for their Master theses. There are first initiatives in the local case study areas where HEIs lease expensive scientific equipment to SMEs on an as-needed basis. This facilitates the interaction of HEIs with technology oriented SMEs and allows SMEs to have access to the most current technology, keep skills up-to-date and reduces their relative disadvantage of size.

It is important to recognise the scale of public and European funding in maintaining the current infrastructure of enterprise support in the local case study areas. The existing policy initiatives themselves are impressive, but they might not be sustainable without continued public funding. The current extent and utilisation of public funding would need to be reviewed in terms of its transition to self-sufficiency and away from kick-start activities. All stakeholders of business and innovation support should be involved in devising a strategy for developing a more commercial approach to their work. Ways should be found to increase private involvement in infrastructure development. For future viability of these facilities, the real estate component of innovation support should be considered an asset capable of producing commercial return, against which also further public and private investment could be secured. Hence, the already started gradual reduction of public kick-off funding in the case study areas and the growing attempts to increase private sector involvement can be mentioned here as examples of good practice policy, which should be pursued. Further action to this end could include equity stake taking in spin-off companies, and increased financial sponsorships from local businesses.

The local case studies in East Germany brought to light a number of policy recommendations that can be taken up by local governments and local organisations active in developing and strengthening entrepreneurship. Despite their local provenance, the policy recommendations seem to be relevant, to a greater or lesser extent, to other localities in East Germany and elsewhere. Hence, the following list of recommendations could be consulted as checklist for policy makers and local organisations when innovating entrepreneurship policy for maximising the contribution of the higher education sector to local entrepreneurship development, with a particular emphasis on the development of innovative and growth enterprises through the exploitation of science and technology assets.

	Policy recommendations to foster university entrepreneurship and science industry linkages
☑	*Establish rigorous academic programmes in entrepreneurship.* When resources allow it, universities should capitalise on the interest of large numbers of students from across the faculties to establish rigorous academic programmes in entrepreneurship that go beyond the relatively haphazard current approach using mainly informal workshops and seminars. Appropriate curriculum additions will help students be better prepared to seek capital and operate businesses in the real world. To progress further, the institutions should proactively develop an entrepreneurial mindset and skill set amongst professors and administrators.
☑	*Introduce methods to monitor and evaluate programme impacts*. Processes should be designed and implemented to better monitor the economic and social impacts of educational and extracurricular entrepreneurship programmes at HEI. A systematic evaluation of such programmes would allow for measuring, assessing and steering the university's role and influence in a local or regional innovation system. Widening the target audience of university entrepreneurship education might enhance entrepreneurial attitudes and motivations of non-university entrepreneurs.
☑	*Reduce barriers for professors and university staff to start businesses.* To capitalise on underexploited means of commercialisation universities should work to reduce university internal barriers to professors and researchers starting businesses and should, in the long run, provide incentives for professors to start businesses. Incentives might include reduced teaching requirements, equity in start-ups, and royalties from licenses to those start-ups.
☑	*Increase attention on intellectual property issues*. HEIs should recognise the value of the intellectual property created as a result of their research, more aggressively protect that intellectual property, and pursue all possible means of realising the commercial value of that intellectual property.
☑	*Promote high level innovation*. Existing good practice initiatives should be sustained and lessons applied to other industries. Brokering relationships between larger regional companies with latent intellectual property and SMEs with the capacities to use it should be seen as another potential route for stimulating higher level innovation. The smaller company could buy, licence or pay a commission for the intellectual property. The approach requires a specialised agency with in-depth technology and business awareness to scan for such brokering opportunities and to initiate and facilitate dialogue.

☑	*Increase the focus on high-growth businesses and internationalisation*. Entrepreneurship education at universities should focus more on high-growth businesses and internationalisation. The goal should be to help reinforce a culture for entrepreneurship beyond self-employment. University educated entrepreneurs should be inspired to think more ambitiously about the potential of businesses they launch.
☑	*Encourage university-industry linkages.* In general, local co-operation between HEIs and firms tends to be limited. Networking, however, can be facilitated by the existence of a co-ordinating organisation, which is considered by local companies as being impartial or at least enabling knowledge and know-how spill-overs. Universities are not usual interlocutors for local firms. Even high-technology and growth companies direct, in first place, a request for support or interaction to the Chambers. A closer co-operation, perhaps even on a formalised level, between the HEIs and the Chambers could therefore be useful to reducing the distance and barriers between the University and local enterprises.
☑	*Exploit innovation through a wider group of firms*. The existing innovation infrastructure should be used more intensively to foster collaboration between HEIs and local companies of all sizes as well as with large companies located elsewhere but with relevance for the local value-chain. Multinational companies located locally or elsewhere represent an opportunity for local economies to accelerate and scale-up commercialisation processes because of their strong access to markets. Such links could help to test innovative products and services in market-like conditions and positively influence time-to-market relations. Attention should be paid to the protection of intellectual property when building value release strategies.
☑	*Consider the establishment of business incubators*. Incubation centres can facilitate through the provision of appropriate premises and services the launch and development of new and small businesses. Incubators which include also pre- and post-incubation support are able to address the needs encountered at different stages of company development. The provision of post-incubation support might facilitate contacts and networking activities between previous and current incubator firms that are in different development phases. To ensure that the range of services provided matches with OECD best practice the opportunity for 'twinning' and regular experience sharing with successful and innovative incubators in other countries should be explored. It could be recommendable to conduct a study on the need and possible utilisation of such business incubators or technology centres. In case of insufficient local demand, possibilities to co-operate with existing facilities in the wider region should be considered.
☑	*Increase international networking efforts*. Active involvement in international networks would help to contribute to the internationalisation of the local economy. It is important to expose leading university managers and policy makers to colleagues working in other jurisdictions and to establish working networks with the people involved. This could be tackled through active involvement in international networks of economic development practitioners such as the European Association of Development Agencies (EURADA), which is currently planning to launch a European network of universities and regions, the International Economic Development Council (IEDC) in the US, the European Business Angels Network, and the National Business Incubation Association as well as the activities of the OECD LEED Programme.
☑	*Further develop Alumni networks*. University Alumni networks should be made use of for university entrepreneurship activities. Access to regular information in the form of newsletters and mailing lists and the organisation of regular meetings on specific themes may help to maintain contact. The involvement of those Alumni that have become successful entrepreneurs could be a valuable contribution to entrepreneurship programmes in the university network.

Box 1. Being inspired from good practice in fostering university entrepreneurship and developing local science industry linkages

Centre for Innovation and Entrepreneurship (CIE), University of Linköping – Sweden: Promoting graduate entrepreneurship and allowing local technology firms to tap into the HEI knowledge base.

San Diego CONNECT – United States of America: Making use of necessities and understanding innovation as a social process that relies on interaction, serendipity, trust, and the exchange of tacit knowledge.

Centre for Intellectual Property Strategies (CIPS) – Japan: Designing and managing intellectual property strategies through a one-stop-shop.

Technology Venture Programme (TVP) – a response to the 1980 US Bayh-Dole Act – United States of America: Launching businesses to commercialise university owned intellectual property.

Enterprise Champions (ECs) in Wales – United Kingdom: Linking entrepreneurship to the mission of a university.

Business Incubator Jyväskylä – Finland: 360º-support for high technology start-up companies and young firms.

The Weinberg Campus network in Halle - an international point for science and industry – Germany: Raising the technological level of the region by encouraging intense co-operation between private firms, R&D organisations and universities.

CellTech BioReaktor - an interregional network of SMEs and research institutions – Germany: Exploiting the innovation through a wider group of firms.

GWT-TUD GmbH in Chemnitz (Gesellschaft für Wissens- und Technologietransfer) – Germany: Stimulating networking, through a local, impartial organisation, which enables knowledge and know-how spillovers.

Innovation assistants to stimulate technology transfer in Brandenburg – Germany:

Alumni Networks at the Rochester Institute of Technology – United States of America: Enriching and expanding the pool of knowledge and financial university resources.