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ARTICLES

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UNIVERSITIES AS EMBEDDED KNOWLEDGE HUBS AND THE CHALLENGE OF LOCAL DEVELOPMENT THE US LESSONS AND THE ITALIAN CASE

Abstract: This article discusses the claim of a new paradigm in the knowledge production and diffusion process, and the need to assess the regional and local implications of this modal shift. After introductory remarks included in the first part of the paper, its next section introduces the theme of localisation of knowledge as a source of regional development; section three examines the lessons we can extract from the US university system (with a particular regard to the case of Johns Hopkins University and the recent project for a biotech park in the city of Baltimore); in section four an illustration of the Italian University system leads to a description of the current evolution of the University of Bologna toward a new entrepreneurial role. The last part of the paper discusses the embedded role of universities in the light of the two cases presented in the previous sections and draws the conclusions in terms of regional policy.
Key words: knowledge-based economy, university education, local and regional development.

1. INTRODUCTION: THE KNOWLEDGE HYPE AND THE ROLE OF UNIVERSITIES

The growing attention towards a knowledge-based economy both in Europe and in the US, stemming from the proclaimed need to invest in innovation and tech-transfer to tackle the competition of a globalised world, is definitely shaping and steering economic policies both at global and regional level.[1]

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[1] It is difficult to define a single trigger event for this new policy perspective. In Europe, the EU Council of Lisbon of 2000 is generally held as a turning point in the strategy to catch up with the more technology-intensive US economy and to start invest in the knowledge economy. In the US

In Europe, there has been an increasing emphasis in recent years on the role of tech-transfer programmes in promoting local development, especially with regard to the synergies that may arise between firms' R&D and the research conducted externally in university-based or private laboratories. This emphasis in Europe has tended to highlight the potential benefits of a new knowledge-based competitiveness, in accordance with the Lisbon Agenda.

From a historical perspective the rise of a knowledge economy seems to be accompanied (and explained) at least by four factors: a growth in the share of intangible capital (investment towards training, education, R&D, health expenditure etc.), the centrality of science and technology (especially in sectors such as pharmacy, biotechnology, information and communication technologies, new materials), the growing speed and intensity of innovation and the information technology revolution (David and Foray, 2002).

Although knowledge has always played a pivotal role in economic development since time immemorial, and this role has been recognised by several authors (Smith, Marx, Shumpeter, Simon, Hayek, Arrow, Machlup, Bell, Solow, Romer among others), the so called knowledge-based economy has only recently acquired the status of autonomous discipline thanks to the recognition of an unprecedented expansion of knowledge-intensive activities (Foray, 2000).

A growing body of economic research has also been devoted to analyse the mechanisms by which knowledge is transferred (or spills over) and the degree to which this process is geographically localised. A major conclusion of many scholars' contribution is the recognition that knowledge spillovers matter in the formation of industrial clusters and agglomeration (Audretsch and Feldman, 1996).

There is also a growing evidence on the relevance of technology and knowledge for the trajectory of economic development, which is not in itself a new perspective (Shumpeter, 1911; Marshall, 1916), but has been assuming, over the last ten years, a new 'useful analytical' orientation 'linking the knowledge generation sub-system (mainly laboratory research) to the knowledge-exploitation system (mainly firms and, say, hospitals or schools) via technology transfer organizations in regional innovation systems' (Cooke and Leydersdoff, 2006).

Above all, the rise of the knowledge economy has entailed a major reconsideration on the issue of knowledge production. The principal conceptual shift has occurred in the last 15 years after the publication of *The New Production of*

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formal action plans towards a knowledge based economy are more recent (Council on Competitiveness report *InnovateAmerica* of December 2004 and the report by the National Academy of Sciences and the Committee on Prospering in the global economy of the 21st century *Rising above the Gathering Storm: Energising and Employing America for a Brighter Economic Future* of 2005).

Knowledge (Gibbons *et al.*, 1994). In that book the main proposition is that a new mode of knowledge production has emerged (Mode 2) that basically occurs in *contexts of application* and through *transdisciplinary practices*, differently from Mode 1 when knowledge was produced primarily in scientific institutions and structured by scientific disciplines. The idea of a contextualised science is reasserted in a second volume by the same authors (Nowotny *et al.*, 2001) highlighting the view of a knowledge production that is 'socially distributed' and of society speaking 'back to science'.

There is a tendency in papers on the role of universities to start from the assumptions of this new knowledge production mode. It must be said, however, that the conclusions reached by Gibbons and his colleagues have not gone uncontested and some criticism has been raised, for example, against the notion of transdisciplinarity (Hessels and van Lente, 2008).[2] Indeed, the acclaimed model put forward by Etzkowitz and Leyesdorff (2000) of a 'triple helix' with the State, Academia and Industry generating a 'knowledge infrastructure in terms of overlapping institutional spheres', considers Mode 2 as an 'emerging system', not entirely substituting Mode 1.

In the present paper we accept nonetheless the claim of a new paradigm in the knowledge production and diffusion process, but we also raise a point concerning its embedded nature in given socio-economic context and therefore the need to assess the regional and local implications of this major modal shift.

Even admitting that the new knowledge production mode retains more of a normative than a descriptive nature, there has been nonetheless, over the last decades, a fundamental transformation in the way science, academia and economic development relate to each other (Etzkowitz and Leyesdorff, 2000), highliting the new entrepreneurial role of universities (Etzkowitz, 2003), originally starting in the US with the experiences of Stanford and MIT.

The central role of universities in knowledge diffusion has prompted research on the commodification or commercialisation of knowledge in terms of intellectual property and patents (Powell and Snellman, 2004), technological transfer offices, spin offs and incubators.[3]

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[2] Hessels and van Lente (2008) refer to critics' view that Mode 2 transdiciplinarity has not been yet demonstrated. On the opposite side, attention has been devoted to the implications that multidisciplinary trends and the convergence between Information Technologies (IT) and biosciences will imply for the evolution of science and technology over the next years. We have confronted this argument with various experts in the fields of technology and technology transfer. The verdict is not without ambiguities, since if it's true, for example, that IT technologies have accelerated the pace of data analysis, molecular modelling and parameters monitoring, there is not yet a knowledge product that 'blends' the two technologies. Reportedly, cross-fertilisation is occurring though, and nanotechnologies for example represent a step in that direction.

[3] The increasing role of Intellectual Property arrangements and patents in biotech for example has spurred reflection on the 'anticommons tragedy' of contemporary basic research, whereby the

The key interpretative framework for this new scenario has been introduced by Etzkovitz (2000) through the concept of the triple helix of university – industry – government relations, which the author has described in a wide series of publications, even introducing a useful distinctions between the different roles that each actor of the helix picks up in different national contexts (entrepreneurial university as driver; government pulled model; university as collaborator in corporation or SME's – led model). We will use this distinction when discussing the differences between the US and the Italian case in section four.

However, what is most important is that universities play a crucial role at the crossroads between national and regional systems of innovation. They actually negotiate their role in a multi-level governance mode and act as integrators of various forms of knowledge including the commodified type of knowledge described above, human capital and social capital (Charles, 2006). In this context universities can be properly described as 'knowledge hubs' (Youtie and Shapira, 2008) since they are 'local innovation systems that are nodes in networks of knowledge production and knowledge sharing […] and fulfil three major functions: to generate knowledge, to transfer knowledge to sites of application; and to transmit knowledge to other people through education and training'.

The perspective of universities as knowledge hubs is particularly valuable in that it introduces an attention to tacit knowledge (Youtie and Shapira, 2008), and puts universities at the center of institutional networks at regional level to foster the diffusion of knowledge (Poma and Ramaciotti, 2008).

It also allows a different perspective with regard to mid-range universities (Wright *et al.*, 2008), to account for universities that do not have world-class research and are located in regions where there is less demand of innovation. This perspective is important when tackling stories of universities and localities in Europe and particularly in Italy, where the tacit content of knowledge of local industries prevails over the codified one and local universities tend to get a larger share of funding through contract research rather than intellectual property licensing.[4]

Along these lines, this paper argues that universities are embedded knowledge hubs that interact with *local milieux*, especially for tacit processes of knowledge diffusion.

In the Italian context the rise of the new knowledge production paradigm represents a challenge for the national economic system that heavily relies on

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highly regulated process of knowledge appropriation reduces incentives to engage in basic research. As argued by Charles (2006) the commodification of knowledge may be regarded in conflict under a system of publicly funded science with a presumption of open science as a public good.

[4] Contract research involves more tacit knowledge than licensing (Wright *et al.*, 2008).

traditional manufacturing districts. The role of Italian universities in this scenario is crucial in that they are the main producers of research (one third of the total R&D against 19% in EU Nordic countries and 15% in the US) and faced with an increasing reduction of national funds for research, they are stimulated to take up an entrepreneurial role in terms of contract research and licenses agreements. Yet the modal shift in Italian knowledge production system is not an easy task. Italian industry is made up in 98% of firms with a size below 10 employees, lacking the sufficient scale for big R&D projects and for embarking in the purchase of licensed technology. Most of the knowledge exchanges between universities and businesses occur through the tacit level of consulting and contract research. Firms, even in medium-to-high-tech sectors do not perceive universities as main sources of knowledge of commercial significance (Antares, 2007). On the other hand, on the university front, academic institutions like that of Bologna compete for excellence and tend to divert their attention towards wider EU research platforms, but see an increasing share of research funding coming from local sources (CRUI-Netval, 2007).

Universities are key actors for national systems of innovation but in fact participate in 'triple helix' mechanisms that operate in regional contexts. The embedded nature of this conundrum is in fact a matter of regional policy that is called to coordinate the efforts of all actors involved (universities, firms and institutions). A problem therefore remains in terms of proper tech-transfer mechanisms that can be tailored to regional economic realities. This paper will attempt to answer two questions: to what extent does the embedded nature of universities as knowledge hubs shape the trajectory of local innovation?; and is the US model the most appropriate model for EU mid-range universities that are trying to define the boundaries of their entrepreneurial role?

2. KNOWLEDGE IN PLACE: IS THAT A SUFFICIENT CONDITION FOR DEVELOPMENT?

To what extent does knowledge production and diffusion depend on the geographical dimension? This question has accompanied much of theoretical debate on cluster formation and development over the last two decades. Two perspectives have dominated the scientific debate: on the one hand the contributions building on work on agglomeration economies and industrial clustering; on the other hand, the research focused on national systems of innovation and the institutional framework that helps sustain knowledge-based and innovation-oriented policies at regional and national level (Nelson, 1993). Closely related to the latter argument is the notion of learning regions seen as places which foster social learning process among firms (Morgan, 1997). More recently, some authors have put forward new theories of spatiality, stressing the new dimensions of spatial distanciation of learning as forms of organisation that ‘permit relational proximity at a distance’ or ‘cognitive proximity’ (Boschma, 2005) and allow to conceive networks substantiated by ‘mental proximity’ (Sacchetti and Sugden, 2005).

On the whole, the intersections between place and science are recognised as crucial in a knowledge-based society. Hall (1998), in a remarkable intellectual voyage across the history of cities in different centuries and civilisations, has argued that the success of cities like Manchester in the 18th century, Berlin in the 19th century, Detroit in the early 20th century or San Francisco over the last 40 years, seems to show that, for the blossoming of a particular trade or industry, a particular ‘combination of the person, the place and the time was just too propitious for it to be otherwise’. Recently, it has been recognised that other important concomitant factors like the massive presence of public research contracts and world leading university research labs, in the case of Boston for example, contribute as well (Best, 2005). This kind of interpretative framework has led to the analysis of the local advantages of innovation. In particular Saxenian (1994) has illustrated the concept of regional advantage from the perspectives of Silicon Valley and Boston ‘Route 128’ agglomerations.

It has been acknowledged, however, that whereas this thread of research is helpful in understanding the dynamics at work, it should not be seen as a general recipe for tech-based development, since those particularly successful stories, are a hard match for any other locality or city in the world that do not happen to have that particular mix of timely opportunities, infrastructures and human capital endowment (Hall, 1998). The story of some US university-industrial partnerships show that the timing and the choices made under specific circumstances by local actors is equally important in shaping a region’s prospects of success or failure (Leslie, 2001). In other words, efforts to foster regional through the dimension of the knowledge dimension development can prove sometime unlikely to determine the expected results, unless a number of proper conditions and ‘complimentary assets’ (Teece, 1985) obtain. The challenge is one of orchestrating all factors (both of a technological and institutional kind) along a trajectory aimed at regional development.

3. UNIVERSITIES AS KNOWLEDGE HUBS: THE US LESSONS

Universities are educational, social and economic institutions whose histories have always been enmeshed with the history of the city where they happened to be physically located (Bender, 1988). They are the quintessential purveyors of knowledge, the source of basic research and the natural seat of learning. In many urban contexts, after the decline of manufacturing, as a major base of employment, universities remain also the principal source of jobs.

The role of universities in the overall production of research can appear limited by an analysis of the share of overall R&D executed in the US: close to 70% of all R&D is conducted by the industrial sector (Audretsch *et al.*, 2002). Obviously the picture changes if the types of research are considered, with universities accomplishing 60% of all the basic research that is carried out nationally (Hill, 2006). To assess such 'intensity' of basic research over actual application and development, a proxy can be analysed using total research disclosures by US universities (AUTM survey, 2007) and comparing these figures to the number of patents filed and approved: academic disclosures in USA have reached a record 19,827 in 2007 and they are twice as many as the number of new patents applications and represent five times the number of patents issued for the same year.

The US picture does not entail a big involvement of private industrial funds into academic research,[5] but it illustrates a post cold war Research and Development pattern, where, the role of industry-sponsored research has overtaken, in terms of total research investment, federally sponsored research: it now accounts for almost 70% of the national US R&D total (Audretsch *et al*., 2002). Against this backdrop, the US public healthcare R&D has increased by 3% since 1987, reaching a record $ 27 billion level in 2003 (Cooke, 2004). It can be argued, that the 'genome project', into which much of the efforts and funds for basic biotech and medical research are currently funnelled, is the '21st Century Manhattan Project'.[6] A new collective effort to rise to the challenge of science and innovation occurs under a reduced role of the federal level of government and with a new emphasis on civil and health-care applications.

US universities have always been conceived as embedded institutions. The US tradition of land-grant institutions, started with the Morril Act in the 19th century.[7] As far as their position of knowledge hubs is concerned a fundamental

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[5] Which hover on average at 7% in the US, compared to 65% of academic research expenditures covered by the federal level (AUTM, 2007).

[6] Comment made by D. Henton, President of Collaborative economics, Mountain View, California, to the author during an interview.

[7] The Morrill Acts funded educational institutions by granting federally-controlled land to the states. The mission of these institutions, as set forth in the 1862 Act, is to teach agriculture, military tactics, and the mechanic arts, not to the exclusion of classical studies, so that members of the working classes might obtain a practical college education. The oldest land-grant university is Rutgers University, which was founded in 1766. The pioneer land-grant university is Michigan State University founded in 1855, from which all land-grant universities were modelled. The first university designated as a land-grant university was Iowa State University. The first land-grant university created under the Morrill Act of 1862 was Kansas State University. The mission of the land-grant universities was subsequently expanded by the Smith-Lever Act of 1914 to include cooperative extension — the sending of agents into rural areas to help bring the results of agricultural research to the end users. http://en.wikipedia.org/wiki/Land-grant_universities.

hallmark for US university research evolution is provided by early 1980s legislation, namely the Stevenson-Wydler Act[8] and the Bayh-Dole Act.[9] Technology transfer, as a strategy to 'transfer technology, technique or knowledge' has since then increased its influence on university research policies. In this perspective, the US experience sets a completely different record *vis a vis* European universities that still largely depend on State 'general university fund' resources for their survival (Geuna, 2001).

Obviously, there are still differences in the way different US universities approach this strategy. The spectrum can range from universities as 'ivory towers' of pure research, to university largely devoted to technology comercialisation. Differences in the 'knowledge capitalisation' mode can be related to the tradition of university/industry linkages in a specific region (Gunasekara, 2006) or even to the organisational structure of university offices devoted to that mission (Bercovitz *et al*., 2001).

For universities engaging in processes of licensing and commercialisation, though, it is not royalties gained from technology transfer that create the major incentive for a knowledge transfer process: those royalties represent a small contribution to university budgets (Nelsen, 2005) and some statistics point to a scenario where 80% of total university disclosures in the US earn less than $10,000 a year.[10] The real incentive has become the protection of property rights and the capacity to accelerate the growth of start-ups (Nelsen, 2005).[11] In fact, the presence of a property protection system can fortify incentives to undertake risky projects.

A close look to the research and licensing results of a few universities across the US may prove revealing of the different models of approaching basic research. Different patterns of research can be traced by analysing the distribution of some universities according to licensing income and the number of patents issued. Patents issued are not the best proxy for 'knowledge production' since they lag behind annual disclosures. Still, they can represent a good source of information, since, presumably, given the high costs of filing and issuing a patent, the number of actual procedures signals those commercialisation processes for which the university (staff, OTLs and board) may have committed upon some sort of reliable market information. Roughly, a first distinction can

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[8] The Stevenson-Wydler Act required federal laboratories to establish Offices of Research and Technology Applications (ORTAs)

[9] The Bayh-Dole Act allows for the transfer of exclusive control over many government funded inventions to universities and businesses operating with federal contracts for the purpose of further development and commercialisation. The contracting universities and businesses are then permitted to exclusively license the inventions to other parties.

[10] Interview of the author with J. Kirschbaum, Director of Technology Licensing office of the University of California San Francisco.

[11] This is the case of MIT with biotechnology start-ups.

be made between 'high patent performers' and 'high commercial performers'. 'High patents performers' have a high number of filed issued per year; 'high commercial performers' have a significant amount of income coming from licensing. University of California and MIT are in a peculiar situation of top-performers on both fronts (see table 1).

Table 1. Patents issued, income from licensing and start-ups for selected US universities

Universities	Patents issued in 2007	USD gross income from licenses (cumulative 2005–2007)	Start-ups 2007
University of California (system)	331	360,330,462	38
MIT	149	129,187,162	24
WARF/University of Wisconsin Madison	124	n.a.	6
Stanford University	106	n.a.	6
University of Michigan	87	46,566,700	7
Georgia Tech	58	8,274,891	9
University of Minnesota	44	163,990,475	4
Johns Hopkins University	43	35,508,677	4
Harvard University	42	51,896,640	6
University of Pennsylvania	40	21,475,342	3
University of Colorado	21	71,052,217	10
University of Pittsburgh	21	18,826,436	8

Source: data AUTM survey, FY (2007).

The foregoing indicates the presence of a series of factors that affect the type of research conducted: the presence of federal and industry support, the regional economic context, the mission of the university and the mission assigned to the Technology Licensing office. Interestingly, for example, Johns Hopkins University, which has been generally held as an example of a weak commercialisation strategy in virtue of its history and its original mission (Feldman and Desrochers, 2003), appears to have a highly competitive knowledge production and knowledge protection systems, which could become formidable assets in applied research strategies at regional level.

A further strategy that is worth considering, in terms of university involvement in local development processes is the one related to firm incubation and start-up formation. Here the traditional argument sees start-up strategies providing economic benefits accruing to regions in terms of innovation and job creation. Different strategies exist according to different missions of the academic institutions and different regional contexts. Roughly, one distinction can be made between institutions with formal incubators (like Georgia Tech in Atlanta), institutions with 'virtual incubators' (like MIT[12]) or institutions that use their 'location habitat' as a major incubators (Stanford and Silicon valley). Obviously, the local milieu and the cross-fertilisation occurring between universities and territories can prove an immense resource of incubation and innovative firms creation. There is some evidence, though, that deliberate strategies based upon physical location of start-ups within an incubator facility still play an important role in tech transfer acceleration.[13]

Over the last decade, universities have increasingly become also a crucial actor of economic development and urban revitalisation (Perry and Wiewel, 2005). As major urban landowners they have been requested to play a leadership role in the complex governance process for neighbourhood improvements and urban revitalisation.

Universities therefore face a double challenge: as key actors of the knowledge-based economy, their role as 'anchor institutions' (Gertler and Vinodrai, 2004) has required them to act as connectors between city-regions and global flows of knowledge and technology. The role of universities as engines of local development requires a leadership role for local development purposes.

Johns Hopkins University in Baltimore represents a case in point for this double challenge. Johns Hopkins, a world renowned academic institutions for medical research, is a university that has been traditionally closer to the 'ivory tower' end (Feldman and Desrochers, 2003), differently form MIT in Boston which is frequently associated with the other end of the spectrum. The distance from commercialisation strategies is compensated with a high level of publicly funded research. Johns Hopkins University ranks first in terms of research awards received from the National Health Institute.

In Baltimore City, Johns Hopkins Hospital is the largest employer in the area with 9,110 employees (which corresponds roughly to 4% of the employed labour force in Baltimore according to 2000 census).[14]

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[12] This is how a virtual incubator works at MIT: 'we do offer lots of encouragement, and provide matchmaking services with source of funding and potential management talent. Also, the TLO will pay for patent applications to protect the technology while the fledging (and unfunded) business is setting itself up' (Ittelson and Nelsen, 2002).

[13] This consideration is particularly reinforced by a description of the type of work that physical incubators conduct. During the present research work two incubators were visited. One is the ATDC Georgia tech incubator in Atlanta, the other is the ETC incubator in Baltimore. They can be considered on many accounts successful incubators. Probably their success is to be seen from a territorial perspective that has not traditionally assigned to the Atlanta and Baltimore regions a rich history of entrepreneurial innovation like the kind witnessed in Boston or San Francisco. A reflection is in order, though, on what can be the 'right strategy' for a specific territory or locality.

[14] In Baltimore city, educational and health services employ 27% of the labour force and represent the largest employment source.

A peculiarity of Johns Hopkins is its local milieu. In the US context, Baltimore is more than one city (Levine, 1987). There are in fact at least 'three Baltimores': the Renaissance City, the underclass city, the prosperous suburbia. This image of a multiple city offers the proper context to analyse the severity of socio-economic problems affecting east Baltimore neighbourhoods (the underclass city) where the Medical Campus of the Johns Hopkins University is located. East Baltimore lags behind the rest of the city of Baltimore for a wide range of indicators (with particular reference to median household and family income and labour participation rates). In the early 1990s, the state of decay of the area had already raised profound concern on how to pragmatically tackle the problem of Baltimore's east neighbourhoods predicament. Revitalisation efforts on the part of public and private actors had to be aimed at what was, under a general perception, 'the worst neighbourhood in the US'. Against this general background, a major revitalisation effort has been put forward since 2000, focused on a major biotech park project sponsored by and adjacent to Johns Hopkins University.

The biotech project is essentially a municipality initiated development project in which Johns Hopkins is participating as a sponsor institution. It is not a university pushed project and in this perspective is different from other urban revitalisation projects in the US that see the active leadership of universities (like University of California San Francisco with its present expansion project in Mission Bay, or even the research commercialisation strategies of the University of Maryland in Baltimore, in a different neighbourhood of the City, with a similar Biopark initiative).[15]

In this respect Johns Hopkins is also much different from the experience of the Georgia Institute of Technology (Georgia Tech) described in Youtie and Shapira (2008), where the academic institution is an actor of regional development. Moreover, Baltimore lacks the economic cluster tradition that has forged the identity of places like Boston or the Silicon Valley. Johns Hopkins University therefore does not appear to participate actively in the present trajectory of regional development.

The foregoing helps clarify that although the US university dominant role is one shaped in entrepreneurialism (Etzkovitz, 2005) there are other factors that intervene in defining a position of a university *vis a vis* regional development strategies.

[15] To which we could add patterns of land speculation (like those run by Harvard). There can be primary and secondary objectives. For example, even if University of Maryland asserts its purposes of research commercialization, undeniably there are also objectives of revitalisation for which an agreement was easily found with the City. The rationale for university engagement in neighbourhood development can be related to the need of providing a high quality of life to attract talents and skilled workers. Cities in general do not benefit directly from university expansion (because of exemption from local property taxes), but special agreements can be found adjusting the different needs of actors involved.

4. THE ITALIAN CASE: THE UNIVERSITY OF BOLOGNA AND THE THIRD MISSION OF ACADEMIC INSTITUTIONS

In Italy, research by universities represents one third of the overall R&D conducted in the country. It is the highest percentage in the EU and OECD area. On the other hand though, just 47% of R&D is conducted by the industrial sector, well below any other OECD country. University research is funded by the national government for 24%, by contract research for 23%, for 16% through own funds, for 12% by EU, and for 7% by regional and local governments (CRUI-Netval, 2007).

A peculiar situation of university research in Italy relates to tech transfer laws which have long supported a system of individual property on the part of academic researchers which has certainly hampered any entrepreneurial roles for academic institutions.

The university of Bologna is the oldest university in Europe. In 2004 it has initiated a gradual policy of revision of its research activities, setting up a technological transfer office and hiring an external CEO for the management of the entire R&D mission. Its laboratories especially in the departments of Chemistry and Physics are participating in European platforms of research and it is the first university in Italy for the number of EU sponsored research awards. It is an anchor institutions but more than that it is a recognised education hub, especially for engineering secondary education. Over the last 10 years its decentralised campus, in the southern part of the region Emilia Romagna (Romagna), has initiated an acknowledged 'third mission' of innovation, beyond education and research (Etzkowitz and Leydesdorff, 2000), through the setting up of teaching courses research laboratories and contract research initiatives with local firms. Not so paradoxically the University of Bologna is succeeding to shed some of its tradition of Ivory tower far from the city of Bologna, exporting its quality research to localities that are benefiting from the collaboration with university laboratories and academics.

In the Italian context, Bologna is an affluent city located in an affluent region (Emilia Romagna). Over the last 10 years, in a difficult competitive scenario for Italian cluster firms, the local economy has showed good signs of resilience (Banca d'Italia, 2007), thanks to the traditional specialisation in the mechanical sector. The territory of Bologna and Emilia Romagna have therefore managed to preserve the traditional manufacturing base, over the last decade, relying on the diverse and dynamic composition of its medium-to-low tech firm clusters. Yet, small and medium sized enterprises, which represent the backbone of the territory's economy, face a changing competitiveness scenario. Technological change is occurring in leading firms in key specialised clusters (e.g. packaging machinery) and calls for an increasing adaptive capability on the part of the local subcontractor's network. Whereas the leading firms' drive to technological change has led to a reorientation of regional policies towards the creation of a network of high-tech districts coordinated through the regional innovation agency, the low-tech small firms that represented an essential part of the 'district's recipe' to development lag behind and face effects ranging from 'skills mismatch' to complete closure. There is not a cut and dried solution to this scenario. Small firms' associations strive to introduce programs that can help to reduce the imbalances within the supply chain, but many of these efforts seem to clash against leading firms goal to decrease costs and increase their pace in technological change.

This, in turn, calls into question the role of University research, since even leading firms are dependent, to some extent, on external R&D.

The current debate on local economic development at the regional level is indeed centred on the role of the University system as a vital actor for tech-based programmes. The region Emilia Romagna has just launched a multi-year programme aimed at creating a network of Technopoles in the region. So far this programme has produces 27 centres of industrial research, 24 centres for innovation, and 6 parks for innovation. The whole system operates around 7 key sectors: mechatronic, environment and energy, food industry, construction, life sciences, organizational innovation, and ICT (information and communications technologies). Emilia Romagna is also the region in Italy with the highest number of spin off firms (Balderi *et al.*, 2007).

The local and regional challenge of tech-based development is compounded by the fact that so far regional policies have relied on tech-transfer to streamline productive excellence and not to reduce the inequalities of technological development (which would require a wider inclusion of small firms in tech-transfer programmes).

The model through which the university of Bologna is participating in this regional development programmes is not hinged upon a classical commercialisation mode (at least in the US meaning of commercialisation) in that it has to face a prevalent tacit demand for knowledge on the part of local small and medium sized firms (that represent 95% of all firms in the region). Its model is one of collaboration with local actors, basically through channels of contract research and consultancy. Also spin-off firms are an important part of the overall picture. This strategy has been especially implemented in the new decentralised campus area in Romagna. The actual planning of this collaboration occurs in a 'bottom up' perspective. Recently an initiative promoted by local foundations in Romagna and the local faculty of engineering has produced the first technological transfer Institution aimed at R&D projects especially in the ICT sector in collaboration with a major Research institution of the University of Milan. It is a challenge in many respects, even because it aims at the strengthening of a system that can operate through a mechanism of codified knowledge transfer. University of Bologna is, in many respects still an ivory tower, but its gradually moving towards a collaborative mode of entrepreneurialism.

5. DISCUSSION AND CONCLUSION

As a place-bound institution the university is an actor of urban and local development. Differently form the US situation, innovation in Italian regions is predominantly demand pull and is focused on a prevalent mode of tacit knowledge diffusion.

The two cases help formulate the following conclusions, with regard to the two original questions:

– the embedded nature of universities as knowledge hubs shapes regional development if a university chooses to engage as a local leader, unlike Johns Hopkins University and participate in regional networks with regional institutions as in the case of the University of Bologna. From this perspective the lessons from US and Italy can be of significance for the planning of knowledge hubs;

– however, the US system provides useful insight on the management of codified knowledge transmission, but given the prevalent tacit dimension of knowledge exchanges in small and medium size localities and the relative idiosyncratic nature of development in mid range regions in Europe, the US system cannot be the model of university led local development, especially since collaborative partnerships in mid-sized European localities are not centred upon commercialisation of codified knowledge.

Universities in mid-range localities, as in the case of Bologna, can participate in global platforms of research and produce quality research, but tend increaseingly to rely on local funds for research and are obliged to forge a partnership with regional actors for the implementation of local tech-based development programmes.

A similar issue concerns the question whether the presence of a university is *per se* a sufficient condition for local development. As we have argued in section one, there is more than one single factor that help explain the success of a locality. Universities cannot represent by themselves the recipe for a successful path of local development. An institutional network, a triple helix at local level, should be in place to guarantee that all the types of knowledge capital that a university has (educational, human and social) can act in synergy with regional policies and business needs.

As this models of collaboration proceed in Europe, a major question will have to be asked on the preservation of the quality of research and of the autonomy of the academic to avoid that out of the need for funds, universities lower their standards of research to adjust to local contractors.[16] It is a risk that can be avoided if universities engage in the process with a leadership role, and are recognised as a collective actor (unlike what has happened so far in Italy with the leading role of star academics in terms of Intellectual property regimes) and as knowledge hubs for local development.

Finally the kind of economic texture of given localities and their path-dependent processes of development cannot be completely ignored. Indeed universities can take on a leadership role in local development initiatives in that they can avoid the risk, through their social networks and international relations, that the local economy falls into the trap of lock-in or decline. The experience in Emilia Romagna teaches a lesson where leading mid-size firms are rather independent in the access of new knowledge and tend not to rely on academic sources for their technological advances (Antares, 2007), but on the other hand localities rely on universities to activate local transfer programmes that can be beneficial for the entire system and for small firms as well. Results on the impact of these programmes are weak so far, given their recent history, but it will be worth evaluating them in a local development perspective.

This is a huge responsibility for universities and for academics. It is a completely new role conferred upon this old institution and one that will be necessary to explore and examine through further research, even under a comparative perspective.

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[16] It is a danger that has been very well voiced during a panel discussion on the future of universities and the role of the academic at the 11th European Network of Industrial Policy (EUNIP) conference in San Sebastian in September 2009.

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