

The European entrepreneurial university

An alternative to the US model

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Abstract: *The European entrepreneurial university is based on the teaching mission of the university, whereas US academic entrepreneurship is typically an extension of the research mission. Recognizing that the European professoriate has traditionally been more removed from entrepreneurship than its US counterpart, some European universities have organized programmes to train students to develop start-up firms. Nevertheless, given similar goals of encouraging science-based regional development, and increasing the returns to the university from its research and other activities, it can be expected that European and US universities will adopt each other's entrepreneurial formats in coming years.*

Keywords: *entrepreneurial university; entrepreneurial education; second academic revolution; university strategic direction; European*

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The ability to take a strategic direction, pointed to by some as the hallmark of the entrepreneurial university, has been characteristic of the university since it emerged as a distinctive institutional format in the 12th century at Paris and Bologna, with one adopting a student-led and the other a faculty-led governance structure (Rashdall, 1895). Each successive academic organizational innovation has given the university an enhanced ability to determine its own strategic direction. As the university takes a more strategic view (Clark, 1998), its relationship to society changes. The research university emerged as a distinctive institutional format in the mid-19th century, bringing together two activities, teaching and research, which had developed separately in colleges and scientific societies. The entrepreneurial university, combining a 'third mission' of economic and social development with teaching and research, is a growing contemporary phenomenon, with academia

taking a leading role in an increasingly knowledge-based society.

The first academic revolution occurred as universities undertook a research mission from the mid-19th century (see Jencks and Riesman, 1968). A second academic revolution grew out of the first as commercial opportunities appeared in research. Although the term 'university' had been used since the medieval period to refer to institutions for the preservation and transmission of knowledge, the origins of the research university can be traced to the Humboldtian model, which emphasizes the interconnection between teaching and research, between the university and the nation state (see Rothblatt and Wittrock, 1993). The alternative Polytechnic mode, a precursor to the contemporary entrepreneurial university, combined teaching and relations with industry with a variable commitment to research. Although Polytechnics have been merged with

the university system in the UK – some would say ‘submerged’ – it is the former model that is in the ascendant, even though its distinctive name has been lost.

This article analyses the emergence of economic and social development as an academic mission in Europe. The key distinguishing feature of the European entrepreneurial university is a focus on the teaching mission of the university as source of start-up firms.¹ The European entrepreneurial university is also distinctive in its synthesis of the educational with the economic development mission of the university. In Sweden, for example, entrepreneurship training programmes have been integrated with incubator facilities, making the economic development aspect of the university part of its teaching mission and vice versa. Such initiatives are typically in response to the perceived lack of an entrepreneurial culture in the university and among knowledge workers in general. According to a technology transfer officer at a Spanish university, ‘The problem is that technical people, researchers and students do not consider themselves as entrepreneurs. It is important to introduce this idea, mainly in students, so they feel it is an option.’ The premise of this entrepreneurial academic movement is that entrepreneurship is a learned competency rather than an inherited predisposition or cultural trait.

Theory and method

An entrepreneurial university is the generative principle in the development of a ‘triple helix’ of university–industry–government relations for the fostering of innovation. Such an academic formation takes a proactive stance in putting knowledge to use and in broadening the input into the creation of academic knowledge. The entrepreneurial university plays a key role in reconstructing relationships between government and industry, transforming the traditional dual bases of science and technology policy into a triadic interaction. The ability of the university to transmute knowledge into economic activity is at one and the same time the premise of the entrepreneurial university and the prerequisite for inclusion of the university in the triad of institutions central to the dynamics of innovation.

The entrepreneurial university is an emergent phenomenon that is a result of the working out of an ‘inner logic’ of academic development which previously expanded the academic enterprise from a focus on teaching to teaching and research. Paradoxically, the ability to generate new ideas is rooted in the original purpose of the university, the conservation and dissemination of knowledge. Some changes are internal developments within the academy, such as the

development of the research group that has firm-like qualities. Thus, the research university shares homologous qualities with a start-up firm even before it engages directly in entrepreneurial activities.

The entrepreneurial university encompasses and extends the research university, enhancing it by adding a reverse linear dynamic to the classic linear model. Although some analysts view academic entrepreneurship as a deformation of the purpose of the research university (Slaughter and Leslie, 1997), I shall argue that it constitutes a concomitant feature of its origin and growth. Theories of the university typically fail to account for the metamorphosis of a medieval institution based on charitable and eleemosynary principles into one capable of generating a significant part of its own support. Instead, they argue for confinement to what have previously been accepted as appropriate academic goals, such as teaching and research.

Classic academic entrepreneurship has expanded from an organizational growth regime, focused on internal academic development, into a regional economic and social development strategy. A series of organizational innovations in teaching and research laid the groundwork for academic entrepreneurship. The key elements of an emergent entrepreneurial university include:

- (1) the organization of group research;
- (2) the creation of a research base with commercial potential;
- (3) the development of organizational mechanisms to move research out of the university as protected intellectual property;
- (4) the capacity to organize firms within the university; and
- (5) the integration of academic and business elements into new formats such as university–industry research centres.

The first two of the above elements are within the framework of the research university; the third is part of the transition from the research to entrepreneurial academic models; and the fourth and fifth elements are special features of the entrepreneurial university.

The emergence of the European entrepreneurial university as a widespread phenomenon is a consequence of top–down initiatives, often from the European Union (EU) in alliance with regional authorities, which are often semi-independent extensions of national governments. Cross-border regions such as Oresund, comprising southern Sweden and Copenhagen in Denmark, were encouraged by an EU programme to support joint projects and identity construction across national boundaries. Orseund is based on a combination of geographical features,

physical artefacts, such as a bridge that became a unifying symbol as well as a physical link, and sources of regional collaboration to foster high-tech industry and academic cooperation (Törnqvist, 2002).

Changes in public laws governing the constitution of academic systems have also served as the basis of new initiatives. The university is increasingly seen as a potential economic development resource, both to raise the technical level of existing firms and as a source of start-ups. While US models have been drawn upon as an inspiration for the introduction of technology transfer offices and incubator facilities, Europe has developed an alternative entrepreneurial academic model that combines training and incubation.

Interviews have been conducted at a convenience sample of European universities during the past ten years. Interviewees included faculty members, rectors, incubator administrators, technology transfer personnel, students and start-up firm founders in Sweden, Finland the UK, France, Germany, Italy, Spain and Portugal. More than 60 interviews were also carried out at a stratified sample of old and new universities and regional colleges as part of the 'Third Mission' segment of the 'University Project' of the Centre for Business and Policy Studies (SNS) in Sweden.²

The bi-evolution of the university

The growth of academic entrepreneurship is part of an internal reordering of the university that takes place through a 'bi-evolution' of mission and focus. In addition to the academic revolutions that incorporate new functions within the university, the three missions of teaching, research and economic development are also evolving from an individual to a group perspective. The emergence of the European entrepreneurial university is part of this dual transformation.

The movement from an individualistic to an organizational focus is most obvious in research, especially in the sciences in which the basic unit is becoming a research group consisting of a professor, assisted by graduate students, post-doctoral fellows and technicians. Interaction and collaboration take place laterally as well as vertically, with some supervisory and mentoring responsibilities devolved to post-doctoral fellows and senior technicians. This academic 'quasi-firm' contrasts with the professor-student dyads that are still commonplace in humanistic disciplines.

There is a similar transformation in the mission of economic and social development. Here, the transition is from merely acting as a facilitator for technology transfer to individual firms to becoming a force in fostering regional economic and social development. Instead of a focus on an individual patent or the transfer

of a particular technology, there is a perception that the university should play a broader role in its region. Sometimes, as in Portugal where regional political entities are weak, the university plays the role of 'regional innovation organizer' (RIO), bringing together local businesses and municipalities to develop a joint innovation strategy.

The shift towards a collective focus is more difficult to discern in education since it typically takes place in non-traditional academic contexts, such as incubator facilities and entrepreneurship programmes. Nevertheless, just as the university trains individual students and sends them out into the world, it is now doing the same for start-up firms and other organizations. The appearance of the economic development issue within the teaching mission of the university occurs in parallel to its appearance within the research mission. Research inevitably produces new knowledge that can potentially be commercialized, given appropriate circumstances. Similarly, teaching also leads to the discovery of new knowledge. This process can be seen even in the attempt to retrieve lost knowledge: for example, in the Renaissance project to revive Greco-Roman learning, new interpretations of old texts were generated, influenced by changed circumstances and interests.

In principle and practice, teaching can also be extended to new subject matters, including entrepreneurship, that were previously considered to be transferable by socialization rather than formal education. The academicization, codification and disciplinization of formerly tacit knowledge also make possible its dissemination to larger numbers of people. The classic instance of this phenomenon occurred after the transition from alchemy to chemistry, when chemistry moved out of the kitchen with the achievement of secure replicable methods of investigation. Professor Liebig invented the teaching laboratory, with its rows of work stations – 'benches' – where large numbers of students could be trained, directly supervised by assistants, rather than looking over the shoulder of the master. Training, research and commercialization took place concurrently at the University of Giessen in mid-19th century Germany. Liebig's teaching laboratory trained chemists, analysed the properties of materials and incubated products that were then commercialized by start-up firms which, for example, marketed artificial fertilizer and liver extract (Etzkowitz, 1983).

Precursors to European academic entrepreneurialism

German state governments played a crucial role in developing the research university by using their control

of the university appointments process to make research accomplishment the decisive criterion of academic appointment. Professors were appointed and laboratories were supported, even over the objections of university authorities. German state governments, initially aware of the contribution a distinguished university faculty could make to national prestige, soon also became aware of the contribution that science could make to economic development and funded it for that reason. The development of university–industry connections in Germany occurred despite the increasing appeal of the pure science ideal to many academic scientists. Many of the early German chemical manufacturers had been trained as chemists in the universities and that, no doubt, made it easier for them to relate to chemists who had remained in academia. It also made them aware of the worth of an academic connection for the scientists in their employ.

The social context of German academic science of that era is also instructive. The pharmaceutical origins of early German academic chemistry conditioned its practitioners to seek practical applications of their research skills. The apothecary connection to business provided a framework for these chemists to think of developing chemical products for sale, even as a pharmacist of that era would develop and market a medical preparation. Nor did the terms of university appointment, at that time, appear to preclude commercial ventures. Indeed, the German state governments, who were the ultimate employers of academic chemists, justified their sponsorship of the discipline by pointing to the ability of its practitioners to originate useful products (Gustin, 1975). The sporadic instances in which the German state governments initiated manufacturing operations upon professors' recommendations and provided financial backing for professors' ventures prefigure the more systematic current efforts of US state governments to use academic science for economic development.

It should be noted that the mid-nineteenth century German ventures were an anomaly, not an antecedent of current developments. Although close consulting relationships were established and maintained, especially between academic chemists and the chemical industry, the civil service status of the German professoriat precluded firm formation. Thus there were no developmental links between efforts such as Liebig's and the current situation.

The multifaceted role of students

The focus on students in university–industry relationships in Europe has developed in several formats. An informal 19th century model of firm formation, with former

students acting as professors' agents, has recently been revived in a more organized framework. Students have also served as professors' agents in assisting small and medium-sized enterprises (SMEs) – this was perhaps the most significant aspect of university–industry relationships in many European countries in recent years, especially those with a predominance of low-technology firms, until the recent re-emergence of firm formation. I shall examine each of these in turn, through brief case studies of the role of students in the economic and social development mission of the university in Portugal, Finland and Sweden.

The role of students in European academic entrepreneurship is not new. It can be seen especially in the foundation of chemical and optical firms, such as Zeiss Jena in Germany in the mid- to late 19th century, often by the students of leading academic researchers. These firms typically maintained contact with academia through consulting relationships that persisted through the generations. As some of these firms have downsized in recent years, traditional university–industry ties have declined at academic institutions such as Milan Polytechnic.

Focus on SMEs: students as knowledge transfer agents

Students often play a key role in university–industry relations as an aspect of their training, especially through internships in firms. The University of Aveiro, a campus oriented to science and engineering, was founded in 1973 to help revive a declining northern region of Portugal. Many firms in the area specialize in ceramics and wood pulp and most of them are small, with fewer than fifty employees. The owner is typically the manager and production processes are low- to mid-tech. Some workers have specialized technical skills, but these firms seldom employ a graduate engineer and of course have no R&D department.

Although the emerging research capacities of the University of Aveiro are not immediately relevant to these firms, a basis has been found for linkage through the university's educational activities. Student internships arranged by individual faculty members and departments, especially management science and production engineering, have become a significant method of technology transfer. Initially instigated as informal arrangements between individual teachers and companies, internships are increasingly officially encouraged by the university. The director of a new liaison office, the Forum, arranges meetings between a group of firms in an industrial sector and teachers whose disciplines may be relevant to their needs.

Whether initiated from below by a faculty member or from above by a liaison office seeking partners for the

university, the actual work of transferring knowledge and connecting company problems to university capabilities is carried out by an undergraduate student. Coursework in management and engineering departments provides internship students with knowledge useful to firms, such as production scheduling and procurement logistics. Introducing a software package to meet a firm's needs and training employees in its use has been found to be the most useful first step that can be taken in upgrading the capabilities of these companies.

Interaction with a professor often presents status problems at such firms; the entrepreneur may feel he or she has to defer to the academic. Ideas from a student can be accepted or rejected without the feeling that anything is at stake. The company's relationship with the teacher takes place through the student's continuing contact with his or her academic mentor. There is a two-way flow of knowledge: suggestions often come from the professor, transmitted through the student, to fine-tune a project. The firm's successes and failures are reported back to the teacher, often finding their way into lectures as examples to enliven course material and provide local relevance.

Academic expertise that is useful to firms is not limited to high technology or knowledge at the research frontier. It can be an application of existing knowledge to meet the needs of a company. Such expertise could come from a consulting firm or an independent extension centre. Funnelling it through the educational process is a low-cost, low-key method that allows schools, with or without research capacities, to develop relationships with industry as an extension of their educational mission.

At Aveiro, it is not unusual for a company to offer permanent employment and for the student to join the firm on graduation. Small firms thereby employ their first university trained engineer and concomitantly maintain their link to the university, through the graduate engineer's continuing relationship with his or her professor. Through these interactions organic ties are developed between the university and local industry because the university provides expertise that can be accepted on the firm's own terms. While many universities justify relationships with industry as an extension of their research mission, the experience of the University of Aveiro exemplifies the development of knowledge and technology transfer as part of the *educational* mission of the university.

Creating an academic entrepreneurial culture

A propensity to entrepreneurial behaviour may be a family tradition but, like other skills and attitudes in short supply, it can also be taught in a course designed

to recruit new adherents. The science park of Helsinki University was conceived as a top-down initiative to bring the agricultural and forestry schools together with the genetics and biochemistry departments in a new faculty of 'life sciences'. New buildings were built for the biology departments at the agricultural campus along with space to be rented to firms. However, the traditional agricultural and forestry professors successfully resisted being combined with researchers in biotechnology related disciplines, making it impossible to raise the unified banner of life science at that time. The economic recession in Finland in the early 1990s also left companies less willing to commit to renting space in the park.

Both academics and industrialists were sceptical of bringing the two spheres closer together. Many academic scientists felt that a connection to industry would divert them from their research goals. Some companies were unsure that the universities had anything to offer industry, believing that most academic scientists were five to ten years behind the international research frontier.

As a result of encountering these blockages, the recently recruited director of the science park, a former genetics professor at Stanford University who had helped found a successful biotechnology firm in the USA, returned to his academic position on the Helsinki faculty in the mid-1990s. He had been invited to be director of the science park on the basis of his US experience when he returned home to Finland. He decided to play a role in encouraging academic entrepreneurship as a faculty member by creating an entrepreneurial culture at the university. He started a course on biotechnology business to introduce students to the 'start-up' process, including in the course topics the identification of research that is both scientifically and commercially interesting and examination of case studies of firms in the biotechnology industry. The objective was to introduce students to the idea of forming a firm as part of their career development strategy.

A survey of the career preferences of 800 students at the Helsinki University of Technology in the mid-1990s found considerable support for entrepreneurship as a career option. The appeal of participating in the start-up of a new firm was almost as high as interest in following a traditional career path in a large corporation. However, over 90% of those who expressed an interest in forming a new firm had no plans to take any steps in that direction. Thus there was a big gap between preference and action. The university hoped to narrow this rift through the creation of student internships in high-tech start-ups to 'demonstrate the attractiveness of business venturing as a career option'.

Firm formation from entrepreneurial education

European universities have established training programmes in entrepreneurship designed to create firms, as well as to educate students in the new discipline. Although US universities increasingly have entrepreneurship training programmes in their business schools and 'greenhouses' to encourage student entrepreneurs, there is a greater focus in Europe on student, rather than faculty entrepreneurs, in part because of differences in academic norms and cultures. The European entrepreneurial university educates and graduates organizations as well as individuals. The focus on educating entrepreneurs and training groups of students to function as firms, initially with a support structure and then on their own, may explain some of the rapid rise in firm formation in Sweden, a country previously noted for its complex of large technology firms tied to a comprehensive social welfare system.

Many Swedish academic spin-off firms arise from teaching programmes in entrepreneurship rather than from faculty research. For example, the Entrepreneurship Centre at Linköping University produces 100 spin-offs a year from its training activities and through extensions of its programme at other Swedish universities. In the Linköping model students move from courses into pre-incubator facilities where they can try out their ideas and develop their business plans with advice from consultants recruited from industry. The best prospects are then invited into an incubator facility, often with funding arranged. The Entrepreneurship Centre at Chalmers University in Gothenburg trains groups of students who first go through a recruitment and application process which encourages the development of a firm formation concept and then evaluates it as the basis for acceptance into the programme.³

Focus on start-ups: an unanticipated phenomenon

Although the European entrepreneurial university is a nascent phenomenon, it is one that is gaining internal momentum and public support. A recent UK survey revealed an increasing rate of university spin-offs: 199 in 1999/2000, in marked contrast to an average of 70 during the previous five years (Charles and Conway, 2001). Given a much smaller academic base, this compares quite favourably with the US total of 275 firms during the same period. The report also noted a spin-off rate of one firm for every £13.9 million of research expenditure, in contrast to a US rate of a company for each £53.1 million of research expenditure.

The UK Science Minister used these favourable figures to argue for increased support of universities as

an economic development strategy. Lord Sainsbury told the House of Commons Science and Technology Committee that, '... these [figures] are very clear indications that we will be putting to Treasury of how valuable this money now is in terms of our economic performance' (Davis, 2002). Such national programmes are often follow-ons to EU initiatives which typically include universities in regional development initiatives, both as sources of knowledge and skills for local industry and as an organizational capacity substituting in part for the lack of regional political authorities.

Several aspects of the early development of the European academic focus on creating start-up firms can be identified:

- spin-offs by staff members, typically by those responsible for interaction with industry when the firm formation concept develops from their work with companies (as was the case with the development of business accounting software by a UK university industrial relations staff member in collaboration with the person he was advising in a printing firm);
- entrepreneurship training programmes for students; and
- programme designed to heighten academics' awareness of the economic potential of their research.

These developments are often accompanied by the establishment of mechanisms that are already familiar in the USA, such as industrial liaison programmes, technology transfer offices and incubator facilities. The number of European universities with technology transfer offices has increased rapidly in recent years to approximately 200. An Association of European Science & Technology Transfer Professionals (ASTP)⁴ was organized two years ago, in parallel to the US Association of University Technology Managers (AUTM). Inspired by the annual AUTM Survey, ASTP has begun to survey its members about their patenting, licensing and spin-off activities.

Elite research institutions such as Cambridge University and the Pasteur Institute in Paris have been highly successful, due to the quantity and quality of their research. These institutions transfer technology, induce spin-off firms and attract multinational corporations to locate research labs nearby, simply because of their critical mass. In the absence of policy initiatives, Cambridge and Pasteur would be anomalies in their countries, but through a combination of EU assistance and regional 'bottom-up' initiatives, schools with lesser concentrations of research are also becoming foci of economic development and technopoles for their regions.

Newer universities, like Warwick in the UK and Don Carlos Tresa in Spain, have made entrepreneurship and industrial relations a key part of their mission as an academic development strategy. Some Swedish regional colleges, established primarily to disperse educational opportunities to less well served parts of the country, have also developed a research capability by focusing on the economic development potential of research. For example, the 'Soft Centre' at Karlskronna-Ronneby has become a model for other universities, like Newcastle upon Tyne in the UK, that wish to follow a similar strategy.

The impetus of financial stringency

Financial stringency has been an important impetus to academic entrepreneurship, especially at academic institutions already experiencing resource constraints. At least two strategies can be identified. Some universities have responded to severe cutbacks by reorganizing their existing resources into new combinations in order to market services and gain income. For example, Salford University in the UK organized its faculty members into consulting groups. Another strategy is to develop new income-producing services, which are often initially relatively separate from conventional academic activities, as an 'internal private sector' to support the rest of university. Thus Warwick University has developed conference centres and short courses for industry, using dedicated staff as well as drawing on academics to create a new earning stream for the university.⁵

In the UK third-strand activities are emerging as an academic mission on a par with teaching and research at several universities. The UK shift was driven by severe financial constraints on academia in comparison to the more modest Swedish transition that nevertheless was inspired by economic downturn and the movement of some large firms abroad. Academic change in both countries was driven by government policy and was part of a broader transition to knowledge-based economic development. Innovation required a change in the traditional role of the university, transcending its traditional role of supporting large firms and SMEs. Now, the university has the additional task of assisting the emergence of start-ups.

In some academic circumstances funding stringency has induced cooperation as well as competition. In Hamburg in Germany, thirty publicly funded institutions provide technology training and research. Several years ago everyone expected a funding reduction, so competition increased at first. The prospect of replacing some of the loss of public funds with industrial subventions created a new situation, since no single

institution could credibly meet industry needs. Thus each university was motivated to build on its strengths and identify complementarities with other universities. To enhance a strength under such conditions, a university may have to give up certain less important activities, as well as work with other institutions, in order to achieve critical mass. In New York, academic competition is so intense that cooperation has proved possible only in the most dire circumstances. Thus medical research units at various universities finally agreed to cooperate only when it was clearly apparent that New York's status as a national centre of medical research was in danger of severe decline.

Diverse university species/immanent development

Entrepreneurial universities emerged from different academic conditions in the USA and Europe. The US entrepreneurial academic was quite different from his or her European 'civil servant' counterpart, who was closer in culture and status to a government official. When European countries initially encouraged professors to engage in firm formation, few took up the task, even though funding was readily available: the organizational and cultural gap was simply too great. Nevertheless, entrepreneurship is currently emerging in European academia, using methods that take into account the organizational culture of the academic system.

The European university was typically part of a hierarchical government-controlled academic system. Indeed, the French university emerged as a separate organizational entity only through the reforms of 1968 (Merrien and Mousseli, 1999) – previously faculties had been part of the Ministry of Education and universities had existed in name only. Until quite recently, decisions which might take place as low as the departmental level in a US university were taken in a government ministry responsible for higher education in the national capital. In Italy, professorships at individual schools are awarded through a national competition. Until fairly recently, the Swedish ministry decided how many student places were to be offered in each discipline at different universities. Each major university still has a liaison person assigned by the ministry to monitor the school, an indicator of the close relationship between the national government and the academic sphere.

There is a tendency to assume that a university in one country is basically similar to a university in another, but strong differences can also be found. For example, European doctoral programmes are generally less course-based than in the USA. Indeed, a typical European model is to advertise for a PhD student to perform a set research project for the degree. However,

the US course-based doctoral model is also becoming more widespread – especially in southern Europe (for example, in Portugal where indigenous PhD programmes are relatively new).

US European academic differences are especially evident when comparisons are made to universities in countries like Sweden, in which all schools are basically elements of a state bureaucracy and levels of prestige and funding are similar for all of them. By contrast, US state universities operate as relatively independent entities in competition with their richer, privately endowed peers, and with aspiring peers in their own region and beyond. The Swedish university combines a system of hierarchical chairs with egalitarian features, such as the lack of salary differentials among disciplines. Even more distinctive, in contrast to the US academic system in which mobility is emphasized from undergraduate to graduate school, is the tradition that students remain at a single university, not only for training but also to pursue a subsequent academic career.

Before recent decentralization initiatives Sweden's higher education ministry decided, on the basis of national needs, how many places in each discipline would be made available at different universities. Even without detailed top-down planning, each university is assigned a liaison person from the ministry. The assumption of the university as a sphere largely within the domain of the state makes it more difficult for Swedish universities to embrace expanded definitions of the academic role; unlike their US counterparts, Swedish professors are 'civil servants'.

The academic revolutions in Europe

From at least the mid-19th century the university has expanded its missions from the teaching and conservation of knowledge to include research: the first academic revolution (Jencks and Reisman, 1968). A second revolution, based primarily upon these research capacities, occurs as the university takes on the mission of economic and social development (Etzkowitz, 2002). Both the first and second revolutions occurred in different ways in the USA and Europe, with important implications for academic entrepreneurship. The US entrepreneurial university is a direct outgrowth of an academic entrepreneurial culture that was created as part of the first academic revolution, the introduction of research as an academic mission. US professors who wished to engage in research had to be entrepreneurial in seeking funds from their universities, foundations, companies and later government.

This was in contrast to the introduction of research in European universities, where research funding, especially in universities following the German model,

came with an academic position. In countries such as France and Italy, research and teaching were typically separated. Until quite recently, research was mostly conducted in a separate institute system, with universities largely confined to teaching until quite recently. Indeed, the European second revolution sometimes occurred before the first, since a research mission was stimulated in some universities in consequence of their being given a specific economic development task. In a rapidly developing country such as Portugal, the two revolutions have been found to occur simultaneously (Oliveira, 2000). It has also been suggested that a developing area such as the Northwest Russian sector of the far-northern Barents region, which also includes elements of Finland and Sweden, may find it possible to move ahead more rapidly by combining stages of academic and regional development.⁶

Swedish universities have been given a third mission, to support economic and social development and play a greater role in explaining academia to the broader public. Moreover, even with the opportunities that may arise from their third-mission activities, Swedish academics are going to keep their outside work to a minimum. Unlike the professional situation of US professors, they have to make a decision to leave their university in order to engage directly in entrepreneurial activities, and few want to do that. Nor can they so easily take academic leave to organize firms; the traditional Swedish academic model makes it difficult to devise procedures to accommodate what has become a commonplace practice for professors in the USA.

For many if not most Swedish academics interaction with firms, when it occurs at all, takes place through their regular academic role. The usual relationships have involved transferring different inquiries to the appropriate people and dealing with matters concerning students. Restrictions on their professorial role have largely limited their involvement with professorial firms to part-time, one-person consulting operations.

Nevertheless, Swedish professors own their intellectual property according to the academic law of 1949, but have only rarely taken steps towards commercialization. University-owned companies that have been established to transfer technology find they are able to negotiate for these rights, since relatively few academics are willing to take on the burden and expense of patenting and licensing. Thus, an informal one-third rule of income distribution has emerged which is quite similar to the situation in the USA, where universities have ownership rights to the results of federally funded research but must distribute a significant portion to the inventor. A similar format for technology licensing appears to make sense to reward the contribution of all

the relevant parties – the inventor, the department or research unit and the university – despite the different legal and academic regimes (Etzkowitz, Asplund and Nordman, 2003).

Reforming a top-down academic system

Academic patenting is the result of a bottom-up process in the USA, in contrast to the recent laws regulating university–industry relations in France and Italy. The Bayh–Dole Act was the culmination of more than a half century of development of academic entrepreneurship. Formats for consultation, patenting and firm formation originated at the Massachusetts Institute of Technology (MIT) were transferred to Stanford even as academic patenting was initiated independently at the Universities of Wisconsin and Toronto. When the federal government became a major funder of academic research after the Second World War, government patent officials developed a system of releasing patent rights to universities with demonstrated capabilities for dealing with intellectual property rights. When an administrative action halted this transfer of patent rights, universities and their allies in the small business community successfully lobbied for the passage of a law institutionalizing and regulating market transactions in academic originated technology.

The 1999 French Innovation Law provided incentives for public agents to become academic entrepreneurs. Activities that were formerly outlawed, such as academics creating start-up firms, were now to be encouraged through incentives and public funds. Programmes were initiated to make professors aware of the commercial potential of their research and to provide consultation on what to do next. The results were modest at a Lyon university where courses were offered to teach academics to write a business plan: three participants tried spin-offs without much success. According to the sponsors, other necessary mechanisms were not in place (such as business consultants and access to funding): ‘The participants did not see how to proceed.’ Nevertheless, for other efforts in the future, the legislation has simplified a highly bureaucratic process for the formation of new firms that had been found to be an impediment. In addition to removing barriers, the new legal framework has created incentives by allowing start-up stock options, initiating a national business plan competition and creating a publicly funded incubator programme, funded at the €300 million level for the first three years. A 1997 University Autonomy law instigated similar changes in Italy.

In practice, these legal changes provide a framework for encouraging normative change in academia. An official at the Technical University of Valencia in Spain

described how ‘... we defined a strategy to make the idea of creating a company user friendly, to see it as something interesting to do’. The local problem was a disjuncture between the desire of engineering graduates to find jobs in existing companies and the lack of availability of such positions locally. The problem was to be solved by inducing entrepreneurship. It was necessary to ‘... get the support of the Rector, faculty and student associations. A local organization, the Centre of Innovative Companies, was also a good partner for this project, a way for them to get into the university’. The regional development organization and other local institutions – such as banks and branches of government agencies – and the Department of Employment also supported the initiative.

A regional technology policy for Valencia has been created with the aid of EU structural funds. Past efforts were directed mainly at the modernization of low R&D sectors. This strategy has been realized through Technical Institutes, privately owned by companies in each sector: agrofood, tiles, toys. The new project includes a pre-incubation phase to work out a plan to design the company project and a forum for new companies who want to present themselves to potential investors. The project was based on the premise that ... ‘Many persons are latent entrepreneurs. The question is what turns them into actual entrepreneurs: opportunity, support and the culture of the university.’ These are the factors that change sufficient into necessary conditions.

US versus European entrepreneurial university models

University missions, then, have expanded from teaching to research (the first academic revolution) and to economic development (the second revolution). In the USA, this transformation tends to take a linear course, from teaching to research and then to economic development. In Europe, the academic revolutions are more likely to occur non-linearly, sometimes simultaneously, and even in reverse order from the US case. The emergence of entrepreneurial activities in European universities is an unanticipated development in an academic world of medieval origins that has often been characterized as rigidified and resistant to change.

The European entrepreneurial university has similar goals to its US counterpart: to encourage regional economic development and increase financial returns to the university from its research and other activities. Nevertheless, academic entrepreneurship takes a distinct course in Europe due to the different paths that university development has taken. US academic start-ups appear primarily as an extension of the research mission of the university; in Europe start-ups are being

created in large numbers through an extension of the university's teaching mission.

Recognizing that European professors are at a greater distance from entrepreneurship in their normal academic working life than their US counterparts, European universities have focused on training students to develop start-up firms. Such start-ups may be based on research from an academic lab and thus may involve the professor in an advisory capacity and as part-owner – but less often as the entrepreneur, taking direct steps to organize the firm.

In the USA the focus of academic entrepreneurship has been on the nexus between research and economic development. Technology transfer mechanisms and incubator facilities have typically developed separately from entrepreneurship training. Differences between Europe and the USA are also reflected in the development in the latter of regional high-tech conurbations, which have also been found to take distinct paths. European start-ups are found to be conservative in style, focusing on niche strategies, export-oriented and better able to deal with ambiguity than their Silicon Valley counterparts (Campbell, 2002; see also ACM TechNews, 2002⁷).

The European perspective on academic entrepreneurship can be stated in ideal-typical form as follows. In Europe it is generally accepted that making entrepreneurs out of university scientists is not the best approach to creating spin-offs. It is assumed that university researchers are almost exclusively academically oriented and want to do research. They are not business people, by definition. Professors are likely to be risk-averse: this is assumed by virtue of their having chosen an academic career. Nevertheless, university students who will be making their career choice in the near future are believed to be less risk-averse. It is expected that they can acquire business skills as part of their education. They are at an impressionable age and can be encouraged to become entrepreneurs.

Resistance to academic entrepreneurship is exemplified by the faculty member at a UK university who commented that the appointment of a technology transfer officer would be 'over my dead body'. Similar resistance persists in Italy, where controversies over proposals to introduce formal technology transfer capabilities and incubator facilities have thus far limited their appearance to a relatively small number of polytechnic institutions and universities. Nevertheless, despite the appearance of a backlash from traditional academics (for example, 'Research 2000' in Sweden, calling for a re-dedication to basic research), the emergence of controversies over the development of academic entrepreneurship, and their resolution, is an indicator of normative change.

Conclusion: university's future; society's benefit

It can be predicted that in the near future the European and US academic entrepreneurial formats will converge as each adopts the innovations of the other. Europe will experience an increase in faculty start-ups. The USA will see more firms organized by students emerging from an educational process, with incubators integrated into departments and research centres. Academic entrepreneurship is becoming an academic mission, equal with teaching and research, on both sides of the Atlantic. The 'European' non-linear/lateral and 'American' linear/vertical models of academic entrepreneurship can be combined. Indeed, this syncretism has taken place in Brazil, where entrepreneurship is spreading throughout academia, presaging a Latin American entrepreneurial university.

Even as universities in various countries perform their traditional tasks, they are also taking on new roles, such as that of the organizational entrepreneur. University entrepreneurship takes various forms, including establishing organizational mechanisms such as technology transfer offices, incubator facilities or student companies, to offer consulting advice to micro-firms who are at the beginnings of raising their level of expertise. As the university takes on the mission of promoting innovation, it puts academic knowledge to use in new ways. Universities and other knowledge-producing institutions play an enhanced role in inter-institutional collaborations, not only in training students and conducting research, but also in developing knowledge-based firms. When they do so as part of a 'triple helix' of university–industry–government relations, society is transformed as well.

We are moving towards a new model of the use of knowledge in society, and away from the assumption that there is a single starting point of research and an end point of the economy: a linear model in which things happen by themselves. It is also necessary to start from the standpoint of problems in society and thus identify how knowledge can be used to address them. Industrial firms, for example, need to apply advanced knowledge to improve their production processes, but it cannot be expected that entrepreneurs can do this by themselves. Various cooperative programmes among university, industry and government point the way to link academia and industry reflexively (Senker, Senker and Hall, 1993).

Institutional spheres must interact more intensively in a knowledge-based society. As firms take on their new role in continually adapting and raising their technological level, they become closer to what a university does in creating and disseminating knowledge. As government

plays a role as public entrepreneur it becomes more like the industrial and academic spheres in capitalizing knowledge. Government programmes have an important role to play, not only at the national level, top-down, but also from the local level, bottom-up. When top-down policies meet bottom-up initiatives, a most dynamic and fruitful regime is established.

Notes

¹Another distinctive European academic–industry relations model is the connection of large firms to industry through science parks. Science parks have been criticized as an ineffective method of encouraging start-ups, often their public and publicized image. In reality science parks have often successfully served as sites for large firms to locate research units so that they can collaborate with their counterparts in academic research groups. The ‘bluetooth’ innovation in wireless is an example of such academic–industry collaboration at the Ideon Science Park in Lund, Sweden. Science parks also serve as a recruitment mechanism for large firms whose research units may provide a home for students seeking to carry out projects in collaboration with an industry sponsor.

²These interviews were supplemented by the collection of documents and participation in EU conferences and workshops. A parallel set of interviews with members of universities, academic research institutes and spin-off firms was carried out in the ‘transition countries’ Bulgaria, Romania, Poland and Hungary. Some of the results from these interviews have been reported in Etzkowitz (1996) and in a special issue of *Science and Public Policy* (‘The Eastern European Transition,’ Vol 27, No 4, August 2000). This paper focuses on the Western European scene.

³See <http://www.entrepreneur.chalmers.se/>

⁴www.astp.net.

⁵Indeed, some observers have defined the European entrepreneurial university primarily on this dimension and its precursor, the ability to formulate a strategic direction for the organization – see Clark, 1998. For other international perspectives on the entrepreneurial university, see Etzkowitz, Webster and Healey, 1998. For an analysis of academic variation, see Martin and Etzkowitz, 2000.

⁶Bringing in the case of Northwest Russia raises the intricate question of whether regions characterized by a centralized top-down model may “jump” (or at least speed up) the Mode 2 phase in order to reach the mode of ‘triple helix’ cooperation (Mode 3): (Ylinenpää, 2001)

⁷European high-tech clusters are following a very different model from Silicon Valley, and they seem to be the better for it. Silicon Valley has been characterized by an overabundance of capital, a dynamic environment, and a large domestic market...’ <http://www.acm.org/technews/articles/2002-4/0118f.html#item3>.

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