

TIK WORKING PAPERS

on

Innovation Studies

No. 20120323

<http://ideas.repec.org/s/tik/inowpp.html>

“But Peter’s in it for the money” – the liminality of entrepreneurial scientists

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Originally published in *VEST Journal for Science and Technology Studies*, 18(1-2):49-75.

Abstract

Entrepreneurial scientists who patent, start spin-off companies and commercialise in other ways are usually seen as occupying a dual role with one leg each in the academic world and another in the entrepreneurial world. This article instead argues that many entrepreneurial scientists should be considered liminal, i.e. at a boundary between these two worlds rather than inside both of them. In statements about research orientations, motivations for entering commercialisation, experiences, co-operation and more, many Norwegian entrepreneurial scientists create a certain distance to other faculty members and private entrepreneurs. The status of liminality or “in-between-ness” allows a flexible networking and commercialisation process. On the other hand, liminal entrepreneurial scientists seem to be locked out of many planning processes for initiatives like technology transfer offices in the wake of a recently changed legislation regarding ownership of research results in Norway.

Introduction: entrepreneurial science and academic identities

The main problem in this article is how we should characterise “entrepreneurial university scientists” or “academic entrepreneurs”. These are researchers that have patented their research results, started a new science/technology-based firm or otherwise contributed to the commercialisation of research-based ideas and knowledge. In the literature, they are often seen as occupying both the world of academic science and the entrepreneurship world, integrating considerations of application and use with fundamental research problems. This article instead argues that many of the entrepreneurial scientists may be considered a *liminal* or “in-between” group – they neither identify with other basic researchers nor the entrepreneurial community.

Although university professors have patented and started companies at least since the end of the 19th century, the term academic entrepreneurship is much newer. Only the last two or three decades has this been used systematically when university scientists have taken a leadership role in ensuring successful commercialisation of research-based knowledge and ideas (cf. e.g. Henrekson & Rosenberg 2001; Zucker *et al.* 1998). It is most commonly used, as I do in this article, for activities like patenting/licensing and forming spin-off companies rather than for “regular” contract work or expert advice for established industry.

Policy-makers have increasingly looked at science as a source of economic growth, industrial restructuring and new jobs – and sought to increase commercialisation of science by changing the research funding structure, establishing support programmes for entrepreneurs and frequently by changing higher education and intellectual property legislation (see e.g. Geuna 2001; Nowotny *et al.* 2003; Slaughter & Leslie 1997). There are also crucial intra-scientific developments towards increasing academic entrepreneurship, not least the growth of generic technology disciplines within universities (most importantly biotechnology, but also ICT,

materials technology etc.). This could lead more researchers than earlier into “Pasteur’s Quadrant” where considerations of use and theoretical/academic considerations go hand in hand (Stokes 1997). In some disciplines, norms of *entrepreneurial science* may already have been established, whereby faculty members view exploitation of research results as a natural academic task next to teaching and fundamental research (Etzkowitz 1998). This is not necessarily easy, however. Academic entrepreneurs need to enrol and utilise a wide range of resources and skills (Mustar 1988), a time-consuming task that may lead to accusations of shirking academic duties. Conflicts of interest can arise when researchers or the companies they have helped create are “in a position to gain an improper advantage from simultaneously occupying two roles” (Etzkowitz 1996:260). Even in situations when the activities of the spin-off firm and the academic programme “are clearly separate, the mere existence of dual roles creates an appearance of conflict” (Etzkowitz 1996:265). In sum, the literature seems to assume that entrepreneurial scientists have “dual roles” or a “dual identity/membership”, even though there may be tensions between the two roles.

Of course, dual membership applies to all professional employees at universities. They are not just highly autonomous university “workers” but members of external disciplinary networks – loosely bound social units that may function as sources of ideas, critique, inspiration and recognition (Allen 1977; Crane 1972; Blau 1973; Mintzberg 1983; Pelz 1963; Zabusky & Barley 1997). For research management, particularly in industry and applied government or private non-profit institutes, dual membership has posed big challenges (Allen 1977; Katz & Allen 1982; Zabusky & Barley 1997). The main challenge is to get the researchers to work towards the organisation’s goals rather than to pursue their own interests, especially in situations with a high degree of loyalty towards a disciplinary network whose goals and reward mechanisms deviate from those of the organisation.

A similar situation is emerging in universities, which now often have a formal goal of contributing to the utilisation of knowledge. However, the researchers are still closely tied to a paradigm of “basic” or “fundamental” research (Gulbrandsen & Langfeldt 2004), which could conflict with the institution’s desire or obligation to commercialise and enforce control over property rights. Some countries have passed laws that grant the universities such obligations, e.g. the Bayh-Dole Act in the U.S. and the recently passed university and college act in Norway. Several European countries have transferred the ownership of research results from the individual researcher to the institution in attempts to increase commercialisation.

Does this mean that there is an increasing gap between university goals and researchers’ personal motivations, leading to strains and role conflict due to faculty member’s dual membership? Or are many basic researchers comfortably placed in Pasteur’s Quadrant, enjoying a dual role with a flexible combination of use-oriented and theoretical studies, in line with the duality of official university missions? Based on a study of the roles and identities of scientists in the European Space Organisation (ESA), Zabusky & Barley (1997) argue that the concept of dual membership is not very well suited to describing scientists’ positions in complex organisations. Rather than being torn between an organisational and a professional identity, the scientists at ESA are described with the term *liminality*. In anthropology, this refers to the condition of being on a boundary, often in a transition state between two more stable memberships in groups, cultures or communities. *Liminal* people do not have a separate status that is institutionalised and codified; a problematic status which may influence behaviour, values and self-image. The terms liminality and liminal are often used to emphasise the “complexities that affect those whose role in society cannot easily be defined” (*ibid.* p. 370). Liminality carries with it disadvantages like marginalisation and psychological stress, but it also “enables freedom of movement and a type of flexibility generally foreclosed to people with firmer identities” (p.371). Entrepreneurial science has been described as a

transitional phase towards a new set of academic norms (Etzkowitz 1998), yet it is difficult to describe without resorting to dichotomies like public/private, for profit/not for profit and property/public good. Initially, it seems appropriate to see academic entrepreneurs as liminal.

A reasonable test would be to look at how academic entrepreneurs define themselves with reference to other academics and with reference to a broader “entrepreneurship community”. I see the latter as mainly a group/network of (other) entrepreneurs/small business owners.

Group membership requires three aspects: identification with the group, expressions of difference from outsiders, and the fact that other members of the group ratify the individual’s belonging (Zabusky & Barley 1997). In interviews with Norwegian university researchers, I have analysed statements about motivations to enter into commercialisation, views on basic research and teaching, characteristics of the interviewees and involvement in the infrastructure for commercialisation.

It should be noted that there are most likely several types of entrepreneurial scientists. Meyer (2003) distinguishes between academic entrepreneurs and entrepreneurial academics, the latter referring to professors who adapt their basic research agendas to new funding climates and new settings, but without a growth motive. Etzkowitz (1998:830) describes three types of entrepreneurial scientists: the “hands-off” ones who leave the matters to the transfer office, the “knowledgeable participants” who are aware of the commercial value and willing to play a significant role in participation, and the “seamless web”, i.e. the integration of campus research groups with company research programmes. Liminality is probably not a relevant characteristic for all of these categories of commercialisation-oriented scientists.

Data and national policy context

The empirical basis of the article is interviews with 20 Norwegian professors and 5 Norwegian commercialisation support personnel (university patent consultant, director of

TTO, science park representative, two university administrators responsible for commercialisation). 15 scientists were selected because their department's annual report or web page listed them as patent-holders, and the rest were chosen after suggestions from the first interviewees. All interviewees had either applied for one or several patents or created a company. 18 of the scientists had patented, while 12 had been involved in forming spin-off companies. Half the interviewees were selected from natural science and traditional technology disciplines (physics, electronics, marine technology, hydraulics), and the other half from, broadly speaking, the health sciences (biotechnology, genetics, pharmaceuticals, molecular biology, medical technology).

Interviews were semi-structured and lasted on average a little more than one hour. The main focus during the conversations was the respondents' personal experiences with commercialisation, including patenting, forming new companies and other types of work oriented at creating economic value. Creative use of language as has been found in other studies of scientists (cf. Gilbert & Mulkay 1994) is also noticeable here. To some extent, successful commercialisation projects were due to "superior technology", "a great entrepreneurial team" etc., while failed projects were blamed on "short-sighted bureaucrats" or simply a lack of funding. I try to avoid this issue by not focusing on success and failure in commercialisation, but rather on the motives and identities of researchers. In addition, the interviewees were generally quite open about mistakes they had done and failed commercialisation attempts.

Finally, several questions were asked about the Norwegian legislation that was changed January 1st, 2003. The Norwegian parliament voted unanimously for altering the "Workers' Invention Act" by removing the so-called "Teacher Exemption Clause" which granted university and college professors the property rights to results emerging from their work. In addition, the "University and College Act" was changed to emphasise that the higher

education institutions have a formal responsibility for ensuring the utilisation of patentable research results. The Ministry for Education and Research later stressed that also non-patentable commercially interesting results constituted a responsibility. So far the response from the higher education institutions has been slow. At the time of writing (summer 2005), an electronic reporting form has been established and the universities all decided to establish technology transfer offices.

The Norwegian policy-makers followed colleagues in Denmark and Germany. In the latter, the “Hochschullehrerprivileg” was abolished in 2002 and patent and exploitation agencies were established (Sellenthin 2004). The Danish changes took place one year earlier, and the Danish reporting forms have been used as templates in Norway. A similar debate has taken place in all these countries – many of the most active entrepreneurial researchers were against removing the teacher exemption clause. The examples of Germany, Denmark and Norway nevertheless show that the universities get more involved in commercialisation and get an incentive to build an infrastructure, possibly unlike countries who have kept the teacher exemption clause (like Sweden, cf. Sellenthin 2004). There is no singular agreement on the effects of legislative changes, but studies of the U.S. Bayh-Dole Act from 1980 seem to agree that it has legitimated and to some extent fuelled the patenting of academic research, not least among universities equipped with a commercialisation unit in 1980 (see e.g. Coupé 2003; Nelson 2001; Mowery & Ziedonis 2002; Sampat et al. 2003). As earlier investigations of patenting/academic entrepreneurship have mostly been from the U.S., there is a need for studies from other countries. The U.S. may be a particular case, not least due to its highly decentralised university structure (Rosenberg & Nelson 1994; Slaughter & Leslie 1997). Compared to the U.S., it also seems that European universities put a relatively stronger emphasis on spin-off companies rather than patenting and licensing (cf. Rasmussen et al. 2005). In Finland, the Ministry of Industry has drafted a proposal that keeps the teacher

exemption clause only for research work that is not funded by external sources. There are still important distinctions between the national legislative contexts; for example, regarding what the law covers (does it include private inventions or books). Although the changes are dissimilar too – Italy has recently introduced a teacher exemption clause while other countries remove it – the intentions are often the same: to give legitimacy to commercialisation and to get more patenting and more spin-off companies.

Analysis

In the following, I have separated my 20 scientific interviewees into two groups. I have labelled 7 of them “basic researchers” or researchers with an “academic” orientation. These expressed moderate interest in commercialisation activities and claimed that their patents were mainly an extension of their academic efforts. They had used consultants for most their entrepreneurial work and spent little time on commercialisation, but were still interested in promoting it and had many opinions about it. The remaining 13 professors have received the label “liminal”. They generally expressed a certain detachment from academic science and from the commercial world. Frequently, they had carried out a lot of entrepreneurial work themselves, and they spent many hours every week on these activities. My classification was based on a number of statements in each interview. Initially, 13 interviewees were easily classified (8 as liminal and 5 as academic). The remaining 7 were slightly more difficult to categorise. 5 of them were finally defined as liminal (they did make a few typical statements of basic research-oriented scientists, however) and 2 as academic (these had a more “dual” identity and saw themselves as both basic researchers and entrepreneurs, but certainly not as liminal). The distinction is sometimes a bit blurred, and the “basic researchers” may still differ from academic colleagues as they do have patents and are definitely interested in commercialisation. Later studies of liminality and/or entrepreneurial scientists may want to

further extend the empirical basis to include those who have not chosen to go in an entrepreneurial direction at all.

It should be mentioned that liminality is, of course, not the only possible or relevant distinction between academic entrepreneurs. In the interview material, there are obvious disciplinary differences – the main boundary is between the life sciences and, broadly speaking, the physical sciences. Patent trials are a good example: most of my life science interviewees stated that they accepted, or even enjoyed, patent trials. As one interviewee said, “I sometimes take my student to the courtroom to listen to the expert witnesses. The students probably learn more about pharmaceuticals from a few hours in the courtroom than from a week in the lecturing hall!” In contrast, the natural scientists and engineers despised patent trials; several had personal experiences as expert witnesses. They saw patent trials as little more than political discussions based on too wide criteria for accepting patent proposals or poor competencies in the patent agencies when it comes to using the criteria. Life scientists did not express these worries. For most of them it seemed that patenting had become an almost integrated part of the research process, and some routinely asked, in every research project, whether the results could be patented.

Personal background and academic identity

There are clear differences between the liminal entrepreneurial scientists and the “basic researchers” when it comes to academic background and identities. All but three of the liminal have work experience from other sectors – applied research institutes and/or industry, which is unusual in the Norwegian academic system. Most expressed that their experiences from applied settings influenced the way they thought about scientific problems, or that it was a source of “scholarly inspiration”. Their broader work experience also influenced how they viewed scientific groups. “There are many highly creative groups in industry in this field, in some cases more creative than in academia,” a pharmaceuticals professor stated.

Surprisingly, their industrial experience and contacts did not seem to be a source of regular contract work. Only three of the thirteen liminal interviewees had had substantial contract work for industry. A few of them took pride in this – “I haven’t sold myself to industry, I’ve made my own applications,” a physics professor exclaimed. Some said they had seen good development projects being stopped for strategic reasons in large companies, meaning that a professor with a desire to see research come to use would be “safer” to do the development work within a spin-off company. An ICT professor who had been through a couple of contracts, offered another explanation: “It’s a big dilemma when you get a good idea during contract work and want to exploit it outside of the particular contract. Because formally the contractor owns the results and might see you as a competitor.” A technology professor said that he concentrated on “low budget R&D; we bought some equipment after a research council grant, and we do quite well without much more external funding”. The three with considerable contract work, had worked mainly with foreign companies. One interpretation is perhaps that the liminal status is at least partially the result of working in “Pasteur’s quadrant” (cf. Stokes 1997) but where national industry and users are virtually non-existent. Many informants complained about the lack of pharmaceutical and medical technology industry in Norway. It should be emphasised that the scientists talked very positively about the benefits of personal contacts with industry.

A few interviewees (none of the basic research-oriented) expressed that they had felt a little “ostracized” at their department for having industrial contacts or patents. A physics professor stated, “It’s seen as acceptable to start a company here, but it’s not something you talk about at all. It’s a non-subject really (...) because some still see it as negative, I think.” This and other interviewees stated that colleagues seemed to fear conflicts of commitment, where the commercialisation activities would take too much time from other obligations. A few also mentioned envy as a typical characteristic of academic departments, and a medical professor

said that “it might have been fun to come to the university parking lot in a new patent-funded Rolls Royce... although who knows, it might be tolerated too.” Others simply stated that in academic life, “one does not talk about money at all”. For these researchers, the academic culture did not offer them opportunities for discussing what they saw as central aspects of their professional work. Still, even the entrepreneurial scientists are sometimes reluctant to talk about commercialisation, at least within the formal organisational unit: “In our group everyone has patents or companies or both. But still we don’t talk about it. We talk about students, the research council, things like that” (physics professor).

The liminal entrepreneurial scientists thus expressed that their work background was a bit different from their colleagues’. This is equally visible when we look at the disciplinary backgrounds of many liminal interviewees. Almost half of them have a cross-disciplinary or otherwise “alternative” background, and they talked at length about this aspect. “I’m really different from everybody else here,” they exclaimed, with a high degree of self-awareness typical of liminal groups. Most common was to have a combination of computer science with something else – one of those who worked in a computer-related field was originally a medical doctor; another had a PhD in nuclear physics. One interviewee saw himself as “a bridge-builder, one of very few at this university who tries to build a bridge between technology and everyday medical practice”.

Many of these interviewees furthermore work in highly specialised sub-disciplines or in scientific fields that are very small in Norway, but large abroad, like medical technology and many sub-disciplines of biotechnology. A common statement was that their group – often just themselves, a colleague (mentor or younger professor) and a few students – was the only one of its kind in Norway, at least in the university sector. On the one hand this contributes to the feeling of marginalisation connected with liminality, but many interviewees also mentioned how working in a small speciality offered large degrees of freedom and flexibility. “The

speciality has just about 200 members internationally, we meet and discuss our field, new problems, our companies, and also our patents when we're allowed to do so," a physics professor said.

Thus, when it comes to academic background and identity, the interviewees I have chosen to call liminal emphasised how their work experience and/or professional background differed from their colleagues'. Many offered long explanations why they had chosen to go to academia rather than remain in industry and/or applied research. Some also mentioned how their considerable entrepreneurial record made them "stand out" in a slightly negative manner from their colleagues, or that they felt suspected of shirking their academic duties (which they denied fervently). This self-definition as individuals (or a collective) that differ from all relevant comparable factions is typical of liminal groups. They have no choice in emphasising membership in one or the other because they are excluded from both.

Motivation to engage in entrepreneurial activities

Every interviewee involved in entrepreneurial activities said that commercialisation was "fun" or professionally stimulating, otherwise it would not be possible to do all the hard work involved in patenting, setting up a company etc. "If I did this just for the money, I could much more easily get a job for a big company," it was claimed. All "basic research-oriented" and seven of the liminal interviewees claimed that they had gotten into commercialisation by "accident" or "chance", not by plan. The remaining six professors had either worked for many years in industry and entered academia late in their career with a spin-off company already in place ("in case we get some good ideas or patents"), or moved consciously into commercialisation since their PhD degree. Some of the technology professors were proud of their commercial achievements, and one said that he found it "enjoyable to have it on my CV that I've actively been involved in commercialisation and been successful at it".

“Accident”/“chance” either meant that the individual’s research interests had gradually moved in a more entrepreneurial direction, or that a project had yielded some unusually relevant results. A medical professor explained, “We worked on molecular mechanisms and got some data that I felt a very strong need to explore more in the utility direction. If you work 30 years in this field, you might get results like that only one or two times. I want what I do to be useful in the end, so I felt I had to ensure that we at least did not mess up the utility value of it.” Some interviewees also explained that the first steps of commercialisation, for example the first investors or patent consultants they had gotten in touch with, had been somewhat arbitrary. Half of the researchers said that one should ideally learn to “become more attentive to commercial prospects”, to e.g. think about patenting systematically and manage to patent broadly yet in incremental steps.

When we move to other motivations there are clear differences between the liminal researchers and the others. Most of the liminal admitted, often after praising the importance of basic research, that they were much more motivated by a mixture of basic and applied work. “I’m interested in both practical and theoretical problems, a physics professor said, while another explained, “My interest is in this speciality [bio-impedance], and we pursue all good ideas that emerge from it. Some are more fundamental, others are more applied; we don’t distinguish much between them.” A biology professor said that he worked with medical problems, but that he at heart was more “an engineer or methodology guy who likes to make things work, see things happen”. This confirms earlier investigations; researchers who become entrepreneurs often have a personal interest in product development but not necessarily in contract work (Siegel *et al.* 2003).

The basic researchers also showed a certain interest in commercialisation; “at least we have a little sideward glance in an applied direction when we get some results”, a genetics professor said. A biology professor said that she had a general interest in molecules and fundamental

research problems; “But when these problems yield new results, I do think about application, which means that I get in touch with people who know application better. I have my name on five patents, but I don’t do the applied bit myself.” The interviewees with a strong basic orientation nevertheless indicated that “Pasteur’s quadrant” may be a relevant term for the field they are in and the motivation they have: “The motivation to work in this field is also to contribute with something practical, to solving a health problem. Everybody internationally thinks about application, even the most academic of research groups patent at least to make sure that they do not hinder a future utility value” (biology professor). But for the seven interviewees I have termed “basic researchers”, patenting (and consultancy) is the last stop on the commercialisation route. The liminal often go one step further, but some sort of takeover or licensing agreement was the final goal for them as well.

When we look at financial motives, the differences seem even clearer. Ten of the liminal, compared to none of the basic researchers, admitted that they had financial gain motives for getting into commercialisation. “It would be wrong not to admit that the possibility of making a good deal of money is a driving force,” a biology professor admitted. He continued: “Of course that’s what I hoped for, that has to be a driving force for everyone who commercialises?” A technology professor talked about this at length: “I’ve worked with basic research and big company contract research all my career and we’ve built up a very good unit here that’s won awards. But I’ve been close to broke all the time.” This technology professor’s involvement in commercialisation was at least partly based on the need to justify his long working hours to his family by raising his income. But he mentioned other motives as well, not least a strong desire to create a successful company in itself after a long publication-focused career.

Still, many entrepreneurial researchers did not have high financial ambitions: “I’ve made a bit of money, perhaps [approx. 12,000 Euro] a year for a few years”, said a technology professor

who was pleased with this amount. Others said they were certain that they would not make any money on being entrepreneurs: “This product we’ve made now is extremely specialised, and not really expensive either, so there’s absolutely no chance that it will make us rich. The total European market is perhaps 100 units.” Many of the researchers had not made any money at all, but still claimed to enjoy the process of patenting and of creating new applications and companies.

For the basic researchers, financial motives were a way of renouncing your identification with the basic research community. A medical professor told, “I was at the annual meeting of my speciality recently, and we sat up much of the night and talked about commercialisation. And everyone said, ‘I’m not in it for the money.’ And it got quiet, and suddenly someone said, ‘But Peter’s in it for the money.’ And everybody laughed, you know, so it might be a bit difficult to talk about these things for us.” Still, the basic scientists accepted “extra licensing income” and were pleased with “hospital-type” agreements where the income from commercialisation goes to research projects rather than into the individual researchers’ pockets. A few stated explicitly that they had entered commercialisation only to get extra research funding for their groups (which is also a monetary motivation, of course). This fits well with the description of “entrepreneurial academics” in Meyer (2003).

The seven interviewees with a strong basic research orientation described, perhaps, a more “idealistic” approach to commercialisation. A biology professor mentioned that she in several cases had given the rights to her results to other actors – a cancer foundation and a spin-off company. She said, “I have this friend in business who says she becomes depressed when she hears about the agreements I sign. But I really don’t think we give away things too cheaply either, and they’re not exactly rich these small biotech companies.” Despite her having no intention of becoming rich, she still had received a fair sum of money on a couple of her patents, more than several of the scientists with higher financial ambitions. Giving away the

rights is also a way of distancing oneself from the liminal researchers or the entrepreneurial community.

It is furthermore interesting that a central driving force for the entrepreneurial scientists is the student interest in commercialisation. This was not mentioned by the “basic researchers”. The liminal scientists described how their entrepreneurial activities become strongly integrated with their teaching duties. They make student assignments based on patents, they go on field trips to small biotech spin-offs, they include commercialisation cases in textbooks, and they call friends in industry, hospitals and elsewhere to see if they have practical problems that are suitable for student work. “The students find [my patents] more interesting than anything else,” a physics professor stated, while a biology professor said that the students were thrilled about everything she said about spin-off companies. A technology interviewee described how “the students now build their own applications at the master’s degree level, it’s very satisfying for them personally and fun to be part of.” Another saw it at the doctoral level as well; the PhDs “want to create companies that produce technology rather than just consultancy firms, because anyone can set up a one-person consultancy.” For the entrepreneurial scientists, commercialisation is thus seen as a fundamental part of the activities of the individual or the research group – and something that should affect both teaching and research.

In this manner, the liminal researchers act as role models to students, and the student interest is perhaps an expression of approval for a broadened academic role. A few mentioned having been influenced by earlier role models who combined basic research with patenting. More traditionally, job opportunity for graduate students was mentioned by a few interviewees. A biology professor said that he had received almost 50 applications for a position “at the PhD student level” in his biotech company, while a PhD scholarship at the department only was met with 5 applications. What we see is perhaps not so much a development of a “seamless web” from basic research to commercialisation (cf. Etzkowitz 1998), but rather that

commercialisation is ever more closely linked with teaching. This may, as some informants argued, mean that the development of entrepreneurial science can be used more actively to recruit students to natural science fields. The status of liminality would then be a generation phenomenon that ceases to exist after Etzkowitz' predicted transformation of basic science. A generation of students, who have worked in the world of commercialisation since their undergraduate level, are less likely to see themselves as outsiders.

When it comes to the increasing political interest in commercialisation, some of the liminal were excited about changes in the funding of university research, especially the technology interviewees. They claimed that in the 1980s and 1990s, you only received funding for publications-oriented basic research or for co-operation with large companies. "Now we have separate funds for commercialisation, separate funds for equipment and for centres of excellence, which we can combine in flexible ways," a hydraulics professor exclaimed. None of the basic research-oriented interviewees talked in a positive way about the changes in research funding.

Finally, the two groups of interviewees reflect different views of innovation. Entrepreneurial scientists often emphasised that the real challenge in commercialisation lies with creating good market linkages, including access to distribution and promotion channels. Interviewees with a traditional academic orientation presented a more linear view of innovation, and many of them described how commercialisable ideas emerge from basic research. In their view, seed funding is just another step of research funding; taking potential or actual patents a small step closer to the marketplace. Although market potential might be a relevant selection criterion for projects warranting seed funding, these interviewees strongly advocated that technical criteria should more or less determine seed funding success. On the other hand, for many of the entrepreneurial scientists, seed funding should involve clear market criteria (size, geography, competitive structure, complementary assets needed) as well as the involvement

of experienced entrepreneurs with market contacts. They still wanted peer review for the technological assessment of commercialisation projects, however. Some saw their patenting as only an indirect influence on innovation: “the real innovation takes place in the companies that have purchased licenses from us” (technology professor).

Summing up, all interviewees embraced scholarly motivations commercialisation – it should be fun, professionally interesting etc., but the entrepreneurial scientists have a stronger motivation for doing applied/development work. They admit that they have financial gain motives, a concession that separates them from the basic research-oriented interviewees. Basic researchers do not talk about money and they are not into commercialisation for the money, although it is seen as acceptable to have side income from licenses. It is interesting that most of the liminal interviewees talked at length about the satisfaction of teaching and the escalating student interest in commercialisation. It may be easier to combine an entrepreneurial career with teaching than with a strong emphasis on basic research.

Basic research and the commercialisation process

All interviewees generally talked very positively about basic research. “It is the fundament of everything, also commercialisation”, was the general claim. A biology professor, who had been active in patenting and started a small company to develop the patents further, asserted, “Most projects that have yielded practical benefits have been of a fundamental nature. Initially, we have not been more applied than basic research groups that are not into commercialisation at all. But when the results arrive, we are different from the other groups here.” Confirming earlier studies, entrepreneurial activities may for some researchers even serve as a “consciousness raising” of not only the importance of basic research, but also “what it is” (see Ylijoki 2003). Many entrepreneurial scientists are eager to convince their colleagues that it is possible to patent, start companies etc. and contribute with scientific

publications at the same time. Some take pride in having a good publication record while having a start-up company.

However, many of the “liminal” interviewees expressed a certain incredulity towards traditional scientific values. They were on the one hand supportive of basic research as a long-term and researcher-controlled activity, on the other hand sceptical about the basic research ideology or the mode of operation in basic research groups they knew of. Many disliked the “publication race” because they did not see number of publications as an indicator of quality: “It’s not very difficult to make lots of publications in medicine. It’s much more difficult to solve actual problems – to start perhaps with an applied problem, maybe try to do something about the side effects of a certain medicine.” (pharmaceutics professor). Two others stated that patents are a better indicator of creativity than publications. One of them argued that patents should count towards tenure: “You need to publish to become a professor, so that’s what people do. And in this field, churning out a lot of publications is not hard. The demands to articles are not very strict, neither to creativity nor problem-solving.” Many informants agreed that the intellectual work in designing a good patent application and defending the patent application is considerable. A biology professor claimed that basic research often was “too descriptive”, and that the commercially oriented research was “more penetrating” and more focused on revealing the fundamental mechanisms of biochemistry – as this is what everyone wants to patent.

Technology interviewees also made critical remarks: “There are a lot of groups in other countries that work with ideal systems only; they work on problems that never will be useful. Only sometimes, perhaps once every 10 or 20 years, they have a breakthrough that changes the fundamental methodology of the discipline. And that’s when the really interesting phase starts, the creative use of this breakthrough for various applications. That is our focus, and we get a lot of publications and recognition for it.” Most of the liminal interviewees from

technology and natural science discipline claimed that commercialisation will strengthen basic research in the long run.

Critical remarks were also made in the other direction. Some of the basic research-oriented interviewees expressed a certain distrust in entrepreneurial scientists (or the liminal expressed they had been met with distrust). When unrestrained, researchers with patents or company ties would act selfishly; they would shirk their regular academic duties or become irresponsibly motivated by financial gain, unlike other researchers at the university. Conflicts of commitment is nevertheless a difficult question, not least since the interviewees work many hours more than regular weekly working hours. Universities in Norway have adopted the 1/5 rule which states that faculty members are allowed to do consultancy etc. one day per week. The liminal researchers often seemed to interpret this to become 4 regular working days of 7.5 hours for academic work, and the rest of an 60-70 hour week (or more) free for any activity. Some of the interviewees felt a bit unfairly treated, that their involvement in a company was enough to warrant suspicions of shirking. The limitations of time and the 1/5 rule nevertheless imply that many of the entrepreneurial scientists find it hard to give priority to their spin-off companies. Many of the academic spin-off companies grow slowly or not at all, as has been found in other countries (see Lindholm Dahlstrand 1997 and 1999).

Still, half of the liminal scientists had left academia for a shorter period (usually 1-2 years) to “get a lot of work done” in a spin-off company. This period has probably strengthened their status of “betweenness”. None of the basic research-oriented interviewees had done so, although several of them had part-time positions (usually as R&D consultant or R&D director) in small companies. One of the liminal medical professors said that leaving the university was “more tidy and with fewer possible conflicts of interest” than having a part-time industry position. There is still a reason for the entrepreneurial scientists to be returning to/working in academia: “I was technical director [small biotech company] for two years, but

that was enough.” (biology professor). This and other entrepreneurial scientists enjoy the mix of teaching, research and commercialisation that their university position allows them. Many seem to find a particular pleasure in teaching and supervision.

Most informants found the patenting process very enjoyable. A medicine professor who did not like patenting very much in principle, nevertheless admitted that she had enjoyed the process a lot. Perhaps a bit surprisingly, several health science informants described the discussions with the professional patent consultants as “something of the most exciting work I’ve done in my career”. Four of the basic researchers made statements similar to this. Few interviewees expressed any doubts about the need to patent: “Sometimes I see a big dilemma: what if [patenting] is just meaningless, that all we do is to make some strange constructions (...) that will never become useful. Maybe the system is extremely naïve, the emperor is naked and someone needs to tell him. Maybe we’re just playing shop and that there is so much else that’s required to really create usefulness” (biology professor). Several of the non-health sciences respondents were critical about current practice at the patent offices, however, particularly in the U.S. The technology interviewees generally wanted to limit what you can patent, not because it may restrain research, but because patenting may restrain innovation and use. In principle, however, these researchers were not against patents.

Starting a company was seen as a “last resort” for many interviewees. Ideally, they wanted a developing agreement or licensing agreement (based on a patent) with an established company, rather than having to start a new company to exploit the knowledge. To get these kinds of agreements, patents were seen as a big advantage: “I took a patent quickly on my present project, because I got a lot of complaints that I did not apply for a patent for an idea I had some years ago.” This physics professor referred to a project that formed the basis of a spin-off company that did not succeed, which, he felt, was partly due to the lack of industrial interest in a non-protected idea. Several interviewees mentioned that companies started

without a basis in concrete patents quickly dissolve if the money runs out, because the personnel find other jobs. When a spin-off company is based on patents, the firm may be reawakened at a later stage after a phase of “hibernation”.

All the liminal interviewees with patents accepted slight delays in publications due to the technicalities of patent applications. “This is not a problem at all,” they claimed, and some told how they had submitted manuscripts for publishing the day after a patent application had been filed. Most accepted delays up to six months, a time period seen as ideal by some of the most active inventors. The basic researchers also accepted delays, although they made much more reluctant statements. As Etzkowitz (1996:275) has noted, the norm of communalism thus has become “limited secrecy”. Research results are kept secret for a few months until the patent consultants agree that the rights have been sufficiently protected.

In total, there is a degree of scepticism between the liminal entrepreneurial scientists and the more basic research-oriented scientists who are involved in patenting and other entrepreneurial activities. Although all embraced the importance of basic research, the liminal frequently made negative statements about the publication race, the quality of scientific publications and the perspectives of some basic research groups. Entrepreneurial scientists were on the other hand sometimes subject to speculations that they spent too much time with their pet commercialisation projects. Although they in many cases had left academia temporarily to work for a spin-off company, this seemed to contribute to the status of liminality more than to remove the accusations of improper behaviour.

Legislative changes and the entrepreneurship infrastructure

The researchers with an academic orientation more or less wholeheartedly embraced the new legislation mentioned earlier, and they did not dispute the principle that the university should own the rights to the research results. “I think the teacher exemption clause was strange, it is

simply not right that as professors we should individually own the rights to the results we make,” an ICT professor stated. A biology professor described the teacher exemption clause as a “weird, Northern European-only arrangement”. Most interviewees warned that the legislation means little compared to the commercialisation support structure (similar to Sweden, cf. Sellenthin 2004).

Although the liminal scientists did not dispute the principles either, some of them expressed a lot more scepticism and uncertainty. “They do remove a benefit of the academic position”, two technology professors pointed out, fearing that the law would give the individuals fewer financial incentives to become entrepreneurs. Many did not believe that the university would be able to offer useful support for entrepreneurial scientists, and that the new technology transfer offices would only contribute with delays. “When you decide to patent everything has to happen very fast, in some cases it may be a matter of days. And we know that the university administration is not quick,” a pharmaceutical professor said. Five made concrete threats (albeit with a smile) that “I’m going to make my future inventions in the garage if the university system’s not working” (biology professor). “And who can really tell,” added a physics professor, “that you got the idea in your working hours or in your spare time working for the company you’ve been allowed to set up?” Others made weaker comments, saying that they expect to be allowed to go on with a commercialisation project that the TTO office is not interested in and to use whatever “helpers” they wanted. A few stated that since they had taken the financial risk themselves (e.g. paying patenting fees), they should also receive the profits. As some of Etzkowitz’ (1996) respondents, some interviewees seemed to view all knowledge as property, meaning that they “own” the rights to their ideas irrespective of funding source or the setting in which the ideas were conceived. If the liminal are allowed continuing to go outside the system, the university TTOs might be left with the mediocre ideas and projects (as other studies have found, cf. Jensen et al. 2003; Sellenthin 2004).

Five interviewees pointed at a principal difficulty; their experiences were that more than 50 percent of the research expenditures were privately funded. In these cases, they did not necessarily see it as “fair” that the universities should own the rights to the results. Many of the interviewees expressed negative views towards what they saw as the *intentions* behind the legislative changes. The general comment was (here from a physics professor): “The politicians and bureaucrats believe they’ll create a lot of new activity with these changes, but it’s not going to happen. Patenting is expensive, as is creating new companies, and few succeed.” There is nevertheless a high degree of double communication. On the one hand, the interviewees claim that outsiders have too high expectations to the outcome of commercialisation. Yet a net positive outcome is also what partly motivates them from becoming involved in such activities.

Some of the liminal interviewees made positive remarks. The new laws force the universities to take commercialisation more seriously, it was argued, down to the very practical level of allowing employees to use their office phone for private purposes. Three individuals used the phrase that “it’s better to have a share of a big cake than the whole of a tiny cake”. Some saw the changes as tidy with respect to getting similar rights for all researchers involved in projects, regardless of whether they worked in hospitals, institutes or higher education institutions. Others indicated that “the old model” allowed for more flexibility with respect to who owns what and who gets involved in what in co-operative projects between researchers from different settings. Finally, many interviewees liked the legislative change because it would lead to changes in the infrastructure for commercialisation.

A few of the liminal scientists were involved in the infrastructure for commercialisation of research. This is more common among the interviewees with a basic research identity. All of them mentioned being board members of science parks, members of steering groups for support programmes, members of university task forces for increasing commercialisation, etc.

In addition, they reported involvement in formal lobbying for public seed funding close to the higher education institutions. At all the Norwegian universities, researcher representatives have been important when planning the institutional response to the legislative changes. My interviews indicate that these scientists are well-respected basic scientists, not the liminal entrepreneurial scientists. The reason is probably that new support mechanisms are more likely to gain acceptance in the wider research community when the mechanisms have been designed partly by “some of their own”.

A similar point can be made when looking at the experiences with the existing support structure. Many of the liminal scientists were highly critical of the science parks, patent consultants etc. Some wanted the science parks removed and replaced with something else, others were pleased that the new TTOs would mean that the “commercialisation monopoly” is dissolved. A more heterogeneous commercialisation infrastructure could take better care of the many different needs of the spin-off companies and the patent applicants. Still, many of the liminal interviewees did not like the idea of creating new TTOs either. These offices will most likely have few market contacts and they will merely administer a patent portfolio with a lottery-like chance of succeeding, it was claimed. “Commercialisation is not for amateurs,” a biology professor commented dryly. Thus, as Selenthin (2004) puts it, the entrepreneurial scientists do not believe the infrastructure will be able to reduce transaction costs. The interviewees with a traditional research orientation generally have a bit more positive experiences, or they simply express a much higher degree of loyalty with the initiatives and programmes of the university. All interviewees were of course pleased with the public seed funding for patenting and spin-off companies that is administered by the science parks (although it was seen as too small). Some were pleased with the science park services but claimed that they were very expensive, and/or that the parks demanded a very high share of company stocks in exchange for seed funding, also when compared to private investors. In

general, several of the liminal preferred private investors to public support programmes; the former were seen as easier to deal with and the latter problematic when science parks and other actors offer “free” public services to entrepreneurs while assuming a fiscal interest in the companies.

The basic researchers want TTOs that employ PhDs, so that decisions to support commercialisation projects will be based on peer review. Some argued that TTOs should make formal agreements with the leading academic groups, a point which the commercialisation personnel agreed to. Many of them furthermore discussed conflicts of interest and wanted clear rules and regulations to avoid accusations of “double dealing”. It seems logical from the argument of liminality that the ones who try to attain or keep dual roles in academia and the world of entrepreneurship, will be the ones who experience conflicts related to roles and interests the most. The liminal interviewees (who avoid dual roles with their status) had noticed few conflicts of interest and wanted flexibility rather than strict rules and guidelines. It is probably challenging to make the rules for distribution of income, not least because many of the projects are inter-institutional and interdisciplinary. In addition, the basic researchers found it hard to enter negotiations with science parks regarding the exchange of support services for shares in a newly formed company. These negotiations are possibly easier for the liminal, who have a much larger network among investors and other people who may give support and advice. To some extent, this is perhaps also a struggle for power and resources – some of the interviewees obviously expect that TTOs will be “less greedy”, more “researcher-controlled” and more “researcher-friendly” than other support programmes.

The entrepreneurial scientists emphasised that they want to use their existing networks of commercialisation. “I can’t understand how a consultant at the TTO office can help me commercialise, how can they possibly have the required competencies? I have my own

external contacts [in industry] who have the necessary expertise,” said a technology professor. A pharmaceuticals professor stated, “I’m sure the science park could have contributed with something if you’re applying for a patent or starting a company, but it’s really the scientist who knows best in many cases – what the technology can do, how it should be presented, what the market is and so on.” He argued that scientists should as far as possible exploit their own contacts or use the best consultants internationally. All the health science interviewees had used a British patent consultancy, a partner everyone talked very highly of.

Some of the liminal interviewees namedropped a number of well-known private investors and other actors that are not necessarily typical for university professors. An ICT professor stated, “You need to be in touch with two groups in particular: the investors with capital and the entrepreneurs who have market contacts. All those other people, the consultants for patents and those who help you write business plans, are not very important.” A few mentioned participation in entrepreneur gatherings and similar arrangements, but most seemed to have built a certain commercialisation network around their own patent or company, but without many further links to or identification with the entrepreneurship community. In addition, many of the liminal interviewees knew each other across disciplinary and departmental boundaries. A medical technology professor had offered a semi-formal course in patenting to some of his colleagues, while several others had contacted entrepreneurial colleagues when in need of advice. The ones with a stricter basic research orientation also had contacts outside of science, not least with the commercialisation infrastructure and with former students.

To sum up, the liminal scientists were somewhat sceptical about the legislative changes. They feared that the removal of the teacher exemption clause and the formalisation of the “third mission” imply that they gain less from entrepreneurship and are forced to use the university’s technology transfer office. Ideally, they want a flexible and non-monopolistic system where they are able to utilise their broad personal networks. The basic researchers were much more

pleased with the legislative changes, and all of them were involved in either the universities' follow-up of the changes or in the existing infrastructure (science parks etc.). They work to get a commercialisation system with a strong emphasis on peer review and with clear rules for all types of conflicts of interests, patenting, licensing and spin-off processes. By default, basic researchers moving into commercialisation should experience more conflicts than liminal scientists with only a weak identification with traditional academic and commercial values.

Conclusion and implications

Academic entrepreneurs have often been assumed to inhabit "Pasteur's quadrant" (Stokes 1997), having a dual membership with an academic identity and an entrepreneurial identity. In this article, based on interviews with university researchers active in commercialisation, it has been argued that many of them rather should be described as *liminal* (see Zabusky & Barley 1997). This means that they do not have strong "group memberships" – neither with academic peers nor non-academic entrepreneurs – but instead distance themselves somewhat from both. In addition, the basic researchers also express a certain distance to the most active entrepreneurs, which contributes to the latter's liminality.

Liminality is partly rooted in alternative backgrounds and career patterns (industry and institute experience, temporary leave), partly in personal choices to work in slightly different ways than other scientists (more interest in applied work in addition to basic research), and partly a result of working in fields with possibly high practical relevance but little advanced industry nationally. Although liminality is not entirely freely chosen, portraying oneself as different has attractions for researchers who need flexibility, freedom of movement and freedom of action, for example to accept untraditional funding. The alternative is probably a kind of dual membership, which could lead to more conflicts of roles and interest, confusion, indecisiveness, stresses and strains. Basic scientists enter patenting as a result of particularly

practically relevant results and a certain “everybody else is doing it, so why can’t we” justification. They still claim to have no financial motives, contrary to the liminal who openly admit that personal economic gain is partly a motivator. This issue seems central to group membership in academia – traditional academics are “not in it for the money”. A development may still be seen where basic scientists readily accept income that is fed back into research activities and even personal licensing income if it does not exceed a certain level.

Central values or norms of “liminal science” are a stronger focus on problem-solving regardless of whether the research can be termed “basic” or “applied”, limited secrecy to ensure patenting and a great emphasis on “creativity” and the ability to follow a project through all phases until a successful innovation has emerged. We may in the future see an even clearer differentiation of norms in various academic groups and an end to liminality. The liminal could move ever more towards “academic capitalism” (Slaughter & Leslie 1997) and train a new generation of students to handle commercialisation, which eventually should complete the transformation into “entrepreneurial science” (Etzkowitz 1998). Both entrepreneurial science and traditional fundamental research can exist within the university, but the interviews indicate that an organisational differentiation might take place. Two of the liminal interviewees represent newly formed centres established in co-operation with research institutes. Both these centres have worked to establish money to take research results through a “proof-of-concept” phase. In addition, new PhD projects are developed in collaboration with venture capitalists, entrepreneurs and other representatives of the commercialisation system. This institutionalisation of academic entrepreneurship will ultimately create a more stable identity for the now liminal academic entrepreneurs.

The categorisation of academic entrepreneurs into liminal scientists and basic scientists with an interest in commercialisation fits well with earlier investigations. In Meyer’s (2003) terms, the basic scientists correspond with the “entrepreneurial academics” who extend fundamental

research interests into a new setting. With Etzkowitz' (1996) distinction in mind, the liminal are the “knowledgeable participants” who believe all ideas belong to the originator, while the basic scientists are the “hands-off” category who leave commercialisation to the technology transfer system. My data indicate that a “seamless web” between university and industry is still far off, but that there is a very strong integration of entrepreneurship with teaching activities among the liminal scientists. And even for the most commercially oriented and financially motivated, business objectives are still claimed to be secondary to professional objectives. Liminality offers a useful alternative distinction to analyse academic entrepreneurship next to profession/non-profession (Rhoades & Slaughter 1991) and broad disciplinary differences (Owen-Smith & Powell 2001). In addition, it provides a nuanced picture of researchers that may inhabit Pasteur's Quadrant (Stokes 1997).

No evidence of increasing tension between university goals and the norms and objectives of basic scientists is found. The universities have enrolled well-known basic researchers into the work on a commercialisation system and are eager to satisfy researchers' demands of a peer review system that is based on extra government funding but where the profits are put back into research. Basic scientists attached a lot of symbolic significance to the term “university”, while the liminal ones attached all their professional identity to the “discipline” or the “speciality”. There is little reason from this small Norwegian data set to fear greedy universities and diminishing “pure” science; the universities are consciously defining the third mission as less important than fundamental research and teaching. Of course, further evidence is required, also from countries with a different legislative history and status.

The distinction put forth in this article has several implications for the support for academic entrepreneurship. First, we have seen that universities have mainly included researchers with a strong basic research identity in the planning of new technology transfer offices and other responses to the legislative changes. The result could be a commercialisation system not

oriented at the researchers who are the most interested in these activities. The need for getting acceptance from the wider research community may create a system that is not very well suited to carrying through complex commercialisation processes. Many liminal interviewees stated that they only have been able to get money from private investors and other “atypical” funding sources because they have developed a long-term trust-based relationship. With the university entering the arena, the liminal fear that they have to give up their hard-earned social capital and use new actors. One result could be that the commercialisation system is not growth-oriented but, as Meyer (2003) has argued, just create another setting for academic research. Another result could be that some of the most innovation-oriented researchers will go outside of the system, and the TTO will be left with mediocre ideas (see also Jensen *et al.* 2003).

Second, the build-up of new entrepreneurship support mechanisms could accentuate self-reinforcing processes of accumulation of advantage or disadvantage. Interviews with the administrative personnel indicate that the TTOs will focus mainly on developing ideas from the “best research groups”. One university director said that the institution would “soon be making special contracts with the formally established Centres of Excellence to gain the rights to all commercialisable results, not just the patentable results.” Of course, several investigations have shown a relationship between high quality basic research and commercialisation (e.g. di Gregorio & Shane 2002; Salter & Martin 2001). If the institutional focus on entrepreneurship implies that more funding will go to the established and relatively wealthy groups, the result could nevertheless be reduced diversity and heterogeneity in the innovative output of the universities. Many of the liminal claimed that the traditional funding structure (public funding for basic research and user funding for contracts) becomes very conservative. The basic researchers saw “seed funding” as an extension of research funding, while the liminal ones saw it as a source to do more alternative and entrepreneurial projects.

Finally, it should be mentioned that liminality is often mistaken for lack of loyalty or lack of gratitude. The liminal interviewees in my study expressed “un-academic” financial gain motives, dissatisfaction or even disloyalty with the university and scepticism towards the new legislation. However, we could also turn this upside-down and view liminality as a source of creativity and effectiveness. These researchers obviously have a very strong commitment to a project, a speciality or set of problems rather than to a more general idea of “basic research” or “the university”. Their output and working hours are often remarkable. On the other hand, as they claim to follow “what’s professionally fun” rather than anything else, they are not necessarily the venture capitalists’ dream. Research managers and policy-makers may find that despite the fact that the liminal scientists are suddenly completely aligned with the formal goals and responsibilities of the universities, these researchers are exceedingly difficult to influence and control.

References

- Allen, T. J. (1977): *Managing the Flow of Technology: Technology transfer and the dissemination of technological information within the research and development organization*. Cambridge, MA: The MIT Press.
- Blau, P. M. (1973): *The Organization of Academic Work*. New York: John Wiley & Sons.
- Coupé, T. (2003), “Science is golden: academic R&D and university patents”, *Journal of Technology Transfer*, 28:31-46.
- Crane, D. (1972): *Invisible Colleges. Diffusion of Knowledge in Scientific Communities*. Chicago, IL: University of Chicago Press.
- Etzkowitz, H. (1996), “Conflicts of interest and commitment in academic science in the United States,” *Minerva*, 34:259-277.
- Etzkowitz, H. (1998), “The norms of entrepreneurial science: cognitive effects of the new university-industry linkages,” *Research Policy*, 27:823-833.
- Geuna, A. (2001), “The changing rationale for European university research funding: are there negative unintended consequences?” *Journal of Economic Issues*, 35:607-632.
- Geuna, A. & L. Nesta (2003), *University Patenting and its Effects on Academic Research*. Brighton: SPRU, SPRU Electronic Working Paper Series No. 99.
- Gilbert, G.N. & M. Mulkay (1984): *Opening Pandora’s box. A Sociological Analysis of Scientists’ Discourse*. Cambridge: Cambridge University Press.
- di Gregorio, D. & S. Shane (2002), “Why do some universities generate more start-ups than others?” *Research Policy*, 32:209-227.

- Gulbrandsen, M. (2003), "Jeg gjør jo ikke dette for å bli rik av det." *Kommersialisering av forskning – en intervjustudie*. ("I'm not doing this to get rich." Commercialisation of research – an interview study.) NIFU, Rapport 6/03.
- Gulbrandsen, M. & L. Langfeldt (2004), "In search of 'Mode 2': the nature of knowledge production in Norway", *Minerva*, 42:237-250.
- Henrekson, M. & N. Rosenberg (2001), "Designing efficient institutions for science-based entrepreneurship: lessons from the U.S. and Sweden", *Journal of Technology Transfer*, 26:207-231.
- Jensen, R., J. Thursby & M. Thursby (2003), "The disclosure and licensing of university inventions: 'the best we can do with the s**t we get to work with'", *International Journal of Industrial Organization*, 21:1271-1300.
- Katz, R. & T. J. Allen (1982): "Investigating the Not Invented Here (NIH) Syndrome: a look at the performance, tenure, and communication patterns of 50 R&D project groups," *R&D Management*, 12:7-19.
- Lindholm Dahlstrand, Å. (1997), "Growth and inventiveness in technology-based spin-off firms", *Research Policy*, 26:331-344.
- Lindholm Dahlstrand, Å. (1999), "Technology-based SMEs in the Göteborg Region: Their origin and interaction with universities and large firms", *Regional Studies*, 33:379-389.
- Meyer, M. (2003), "Academic entrepreneurs or entrepreneurial academics? Research-based ventures and public support mechanisms," *R&D Management*, 33:107-113.
- Mintzberg, H. (1983): *Structure in Fives. Designing Effective Organizations*. Englewood Cliffs, NJ: Prentice-Hall.
- Mowery, D. C. & A. A. Ziedonis (2002), "Academic patent quality and quantity before and after the Bayh-Dole act in the United States", *Research Policy*, 31:399-418.
- Mustar, P. (1998), "Partnerships, configurations and dynamics in the creation and development of SMEs by researchers," *Industry & Higher Education*, 12:217-221.
- Nelson, R. R. (2001), "Observations on the Post-Bayh-Dole rise of patenting at American universities", *Journal of Technology Transfer*, 26:13-19.
- Nowotny, H., P. Scott & M. Gibbons (2003) "Mode 2 revisited: the new production of knowledge", *Minerva* 41:179-194.
- Owen-Smith, J. & W. W. Powell (2001), "To patent or not: faculty decisions and institutional success at technology transfer", *Journal of Technology Transfer*, 26:99-114.
- Pelz, D. C. (1963): "Relationships between Measures of Scientific Performance and Other Variables." In Taylor, C. W. & F. Barron (eds.): *Scientific Creativity: Its Recognition and Development*. New York, NY: John Wiley & Sons, pp. 302-310.
- Rasmussen, E., Ø. Moen & M. Gulbrandsen, "Initiatives to promote commercialization of university knowledge", *Technovation*, forthcoming.
- Rhoades, G. & S. Slaughter (1991), "Professors, administrators, and patents: the negotiation of technology transfer", *Sociology of Education*, 64(2):65-77.
- Rosenberg, N. & R. R. Nelson (1994), "American universities and technical advance in industry", *Research Policy*, 23:323-348.
- Salter, A. J. & B. Martin (2001), "The economic benefits of publicly funded basic research: a critical review", *Research Policy*, 30:509-532.

- Sampat, B. N., D. C. Mowery & A. A. Ziedonis (2003), "Changes in university patent quality after the Bayh-Dole Act: a re-examination", *International Journal of Industrial Organization*, 21:1371-1390.
- Sellenthin, M. (2004), *Who should own university research? An exploratory study of the impact of patent rights regimes in Sweden and Germany on the incentives to patent research results*. Linköping, Swedish Institute for Growth Policy Studies, Report A2004:013.
- Siegel, D. S., D. Waldman & A. Link (2003), "Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy*, 32:27-48.
- Slaughter, S. & G. Rhoades (1996), "The emergence of a competitiveness research and development policy coalition and the commercialization of academic science and technology," *Science, Technology & Human Values*, 21:303-339.
- Slaughter, S. & L. L. Leslie (1997), *Academic Capitalism. Politics, Policies, and the Entrepreneurial University*. Baltimore/London: The John Hopkins University Press.
- Stokes, D. E. (1997), *Pasteur's Quadrant. Basic Science and Technological Innovation*. Washinton, D.C.: The Brookings Institution Press.
- Valentin, F. & R. L. Jensen (2002), "Reaping the fruits of science: comparing exploitations of a scientific breakthrough in European innovation systems", *Economic Systems Research*, 14(4):363-388.
- Ylijoki, O.-H. (2003), "Entangled in academic capitalism? A case-study on changing ideals and practices of university research", *Higher Education*, 45:307-335.
- Zabusky, S. E. & S. R. Barley (1997), "'You can't be a stone if you're cement': Reevaluating the emic identities of scientists in organizations," *Research in Organizational Behavior*, 19:361-404.
- Zucker, L. B., M. R. Darby & M. B. Brewer (1998), "Intellectual human capital and the birth of U.S. biotechnology enterprises", *The American Economic Review*, 88(1):290-306.