RESEARCH PAPER

Who commercialises research at Swedish universities and why?

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European universities have been increasingly pressured since the late 1990s to make a more visible contribution to economic development. This policy interest has produced an increasing focus on knowledge transfer generally, and more specifically on measures to promote a research culture which values patenting and firm formation. This paper presents results from an interview study of academic faculty views on knowledge transfer and commercialisation at five public universities in Sweden. Our results show that, despite the retention of inventor ownership at Swedish universities, there is a high degree of knowledge transfer of all kinds. The overriding driver of entrepreneurial behaviour among faculty appears to be the low level of direct funding for research in universities. We find that attitudes to firm formation vary from positive to ambivalent, and that faculty from the humanities and social sciences engage in a higher level of entrepreneurial and policy adaptive behaviour than they report. We conclude that faculty at Swedish universities perceive the role of public servant and entrepreneurial academic as conflicting. This perceived conflict may be one reason for reluctance to report instances of commercialisation of research.

Introduction

Research on research and innovation policy converges on the observation that there has been a shift in the policy perspective on the role of science in society. One of the more persistent manifestations of this shift is the increasing policy focus on changing the institutional context of public science in order to facilitate more collaboration between science and industry and the commercialisation of academic research. This is reflected in the upsurge of research on technology transfer and other issues related to the commercialisation of academic research. Research in this area may be divided into four categories: research on the changing perception of the role of science in society (Gibbons et al., 1994; Guston, 2000); empirical studies on the changing institutional context of science in specific fields or countries (Argyres and Liebeskind, 1998; Whitley et al., 2010); critiques of the impact of the ethos of commercialisation of science on the academy (Jacob, 2009; Kleinman, 2010; Biddle, 2011); and empirical studies of the impact of rule regimes for promoting commercialisation (Mowery et al., 2001; Agarwal and Henderson, 2002; Geuna and Muscio, 2009). The last is an increasingly heterogeneous area in which research on the micro foundations of university entrepreneurship is an emerging sub-specialisation.

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This paper takes its point of departure in this emerging tradition of the micro foundations of entrepreneurship in that it focuses on the factors that motivate individual researchers to commercialise their research results. The paper contributes to the analysis of entrepreneurship in universities by: (i) deepening our understanding of what meanings researchers ascribe to the commercialisation of research and their reasons for engaging in this activity; (ii) improving our knowledge of the variety of ways in which the commercialisation of research results occur; and (iii) providing insight into what types of knowledge transfer and commercialisation activities are undertaken in a context where academics still own the intellectual property derived from their research results. The empirical reference of the study is Sweden, a country with a high level of public and private investment in R&D and a tradition of inventor ownership of intellectual property.

Since the early 1990s, European governments have emphasised that public universities need to make a direct contribution to innovation and that an important goal of innovation policy is to facilitate this contribution. Inventor ownership of intellectual property was identified very early in the debate as an important obstacle to knowledge transfer and the commercialisation of research results from universities. One outcome of this was an upsurge in legislative activity aimed at removing 'professors' privilege'.¹ Germany, Austria, Denmark and Norway changed legislation to make arrangements for universities to own the intellectual property accruing from employees' research.

Sweden is one of the few countries that has retained inventor ownership, within a system that emphasises knowledge transfer and commercialisation of university research. The Swedish university sector is public, which means that state and regional policies that promote university participation in the innovation system are, other things being equal, important factors in shaping expectations of science in society. Taken together, these contextual factors make Sweden an interesting case for understanding the drivers of knowledge transfer and commercialisation from universities in cases where universities do not own the intellectual property of their employees. This information is useful in itself, but may also be of instrumental value to resource-strapped countries intent on promoting commercialisation but for various reasons wishing to forego the legislative route.

Data for this paper were collected through interviews with 88 Swedish university researchers and technology transfer personnel. The interviews allowed researchers to talk about the commercialisation of research results in their own words. The rest of the paper is divided into six sections, the first of which provides a description of the Swedish context in order to give the reader a point of reference for understanding the interview data. The second section features an overview of the literature with particular reference to studies of commercialisation of research results. This is followed by a description of the method used for collecting data for this study. The two following sections present and discuss the results and the final section concludes the paper.

The Swedish context: promoting commercialisation

Sweden spends just under 4% of its gross domestic product on research. Of this, about 65% is private corporate funding and about 28% is public funding.² The rest comes from non-domestic sources, including foreign firms and the European Union. The university sector receives the majority of available public money for research.

The main reason for this is that the university sector is the largest provider of knowledge in Sweden. Competing sources, such as research institutes, are less important than they are in other European countries and the US. The research financing sector is heterogeneous and includes major public research councils, several private charities and large established R&D-intensive companies.

In 1997, the Swedish government amended the university charter to include a third mission (apart from research and teaching) as a core task of universities and university colleges. This amendment was intended to promote faster and easier transfer of knowledge from universities to industry and the public sector. Initially, the third mission comprised three tasks: support of the national innovation system (commercialisation, R&D support to companies, etc.); civil education (promoting democracy, sustainable development and gender equality); and increasing student employability. No special funding was designated for this third mission.³

Higher education is free in Sweden⁴ and the state remunerates universities per student. It is a monopsonic market in that the state is the largest customer and also the regulator. Fees are differentiated according to area of study, not service provider. University budgets are divided into two mutually-exclusive streams, research and teaching. However, students (particularly post-graduate students) are often enrolled in research activities. The bulk (over 60%) of research funding is allocated competitively through the research council system and the recipients are individual academics and research groups. The rest of the research funding goes to universities as a block grant. Since the 1990s, this allocation has increasingly been based on performance (mainly level of income raised in competitive research and publication performance).

Swedish researchers are also required to collaborate and/or seek funding outside the university context. Doctoral students are an important part of the research system in Sweden and the majority of them are funded through grants and projects rather than from institutional funding. Because direct institutional allocation of research funding is low, individual researchers may need to apply for funding to support activities that, in other research systems, are available through institutional allocation; for instance, conference travel and sabbaticals. This means that researchers will, of necessity, be more responsive to research policy signals. A third feature is that the small size of the research institute sector in Sweden, together with the historical struggle over sectoral research, has meant that universities perform a great deal of applied research.

In the wake of legislation on the third mission, many universities began to focus attention on organising their technology and other knowledge transfer activities and created holding companies for assisting faculty with these tasks. The holding company solution was necessary because, as Swedish universities are public authorities, they are not allowed to accumulate capital. For more than a decade now, Sweden has had an on–off debate about the removal of professors' privilege. Despite several commissioned reports on the subject, the state has made no decision on this issue.

Transferring knowledge and commercialising research

Several authors have called attention to the fact that studies of third mission activities at universities have been narrowly focused on technology transfer. This is seen as especially problematic for a number of reasons. Of these, two are significant for this paper. The first is that patents, licences and spin-offs account for a relatively

small part of knowledge transfer from universities (Cohen et al., 2002; Schartinger et al., 2002; Bekkers and Bodas Freitas, 2008). Second, the formal rationale for introducing the third mission is knowledge transfer and while this does not rule out technology transfer, the two are not identical. In fact, technology transfer is only one of several potential mechanisms through which academic inventions diffuse to the rest of society (Litan et al., 2007). Some significant others include collaborative and contract research (Meyer-Krahmer and Schmoch, 1998; Perkman and Walsh, 2007; D'Este and Patel, 2007), personnel exchange (university faculty working in industry and vice versa) (Gübeli and Doloreux, 2005), informal networks and communities of practice (Meyer-Krahmer and Schmoch, 1998; D'Este and Patel, 2007), and paid and unpaid consultancy (Amara et al., 2013). Bekkers and Bodas Freitas (2008) argue that the type of knowledge transfer preferred is dependent on a number of factors. For instance, the more codifiable the form of knowledge, the more dependent knowledge transfer will be on patents, publications and other codified modes. Similarly, informal contacts and networks are more common in areas where knowledge is tacit and uncodified. Given the foregoing, this paper defines knowledge transfer to include all activities in which knowledge from academe diffuses to other actors. Technology transfer is defined as transactions which involve the diffusion of codified knowledge (e.g. patents and licenses). Commercialisation of knowledge is defined as the exchange of knowledge for money. Thus, technology transfer is one type of commercialisation.

Faculty in European public universities have traditionally performed all kinds of knowledge transfer tasks, but not as part of their core obligations. Despite evidence of attitudinal changes, the majority of European researchers still regard teaching and research as their main duties. Knowledge transfer beyond that embodied in education, scientific publication or popularisation is gradually increasing, but the role of academics here is a contentious issue (Foray and Lissoni, 2010; Kyvik, 2013).

European policymakers have therefore seen the primary challenge in innovation policy as one of getting university academics to accept that they have an obligation to make a direct contribution to innovation. A direct contribution to innovation refers primarily to: (i) providing industry/the public sector with services, technical solutions and devices; (ii) providing expertise to actors outside the university (primarily firms); and (iii) doing applied research that contributes to meeting societal challenges. The wide range of activities that is implied by the above definition is one of the reasons it may be useful to use the term 'knowledge' rather than 'technology transfer' to describe these activities.

The effort to promote the above activities in European public universities may be seen as an ideological exercise involving both policy and research. Policy was able to draw on other policies and the example of the Bayh Dole legislation in the United States played an important rhetorical role in legitimating imitative legislation. Policy also drew on research which argued that the linear model was no longer a viable inspirational guide for science policy, and that if science was to contribute to public welfare, it had to collaborate with other actors. The case for collaboration also found resonance in other academic perspectives. Gibbons *et al.* (1994), for instance, argued that academe had already moved towards what they called Mode 2 knowledge production. One of the defining characteristics of Mode 2 is that academics produce knowledge in collaboration with other actors. These and other arguments provided the resources for creating a case that the academy had an obligation to engage in knowledge transfer that would make a direct contribution to innovation. Efforts were made to institutionalise this in universities via incentive schemes that promoted collaboration with industry and pressured universities to include indicators such as the number of patents produced in their performance appraisal routines for academic staff. The focus on patents and collaboration may arguably be said to have taken on an exaggerated importance in relation to other aspects of knowledge transfer, mainly because of the ease with which they could be counted. Regardless of its origin, however, the shift from knowledge to technology transfer challenged the received view that university science is at its best when kept in the public domain and when faculty are not pressured to fashion their research agenda to market factors (Chorafakis and Pontikakis, 2011).

While faculty are not against technology transfer and other types of commercialisation of research results, they do tend to be rather guarded about attempts to promote the commercialisation of research (Martinelli *et al.*, 2008). However, few studies have investigated researchers' reasons for involvement in commercialisation and collaboration with non-university actors (Lam, 2007; Bodas Freitas *et al.*, 2012). A notable exception is Lee (2000), who, in a study of university–industry research collaboration, found that faculty collaborate with non-university actors for a variety of reasons, the most predominant of which include securing funds for research assistants and Ph.D. students, gaining insights into their own academic research, testing/applying theory, and supplementing funds for their own research (see also Duberly *et al.*, 2007). Researchers, particularly those affiliated with technical universities, tend to treat commercialisation as a natural part of their activities (Jacob *et al.*, 2003), while others treat commercialisation as a necessary evil that can increase their revenue flows, especially in the light of reduced block-grant funding to universities (Whitley *et al.*, 2010).

Commercialisation is not a new phenomenon, even for European universities, despite the received view among European policymakers that their universities are far from efficient at commercialisation, at least when compared to their US counterparts. Thus, given the substantial ambiguity about the outputs of commercialisation and the ambivalence that surrounds the activity, there is an increasing interest in ascertaining what are faculty's views of commercialisation and why they engage in it. By treating commercialisation as just one aspect of a broader set of activities – knowledge transfer – we believe that we can provide a nuanced understanding of faculty views on the subject.

Method

We interviewed researchers and staff engaged in technology transfer at five Swedish universities. The five universities chosen reflect the heterogeneity of the national university structure in terms of age, location of the university and range of disciplines. The sample excludes technical universities and business schools that are not part of research universities.

The sample of interviewees includes researchers from all disciplines engaged in knowledge transfer activities and personnel working in this area. We identified and cross checked interview candidates through a number of procedures. First, we asked personnel from the research administration offices at the respective universities to provide an initial list of potential interviewees. This list was checked with university web sites and with the Swedish research councils. We targeted in particular those councils that explicitly profiled themselves as promoting collaboration. In addition, we asked interview candidates to identify other potential interviewees. Our final list of interviewees was 100 divided equally across the five universities. Of these, 88 agreed to be interviewed; 14% of those interviewed were women, the majority of these staff who worked specifically in technology transfer and third mission activities. Senior academics in Sweden are still generally male and male faculty are more likely than female to take risks, such as engaging in commercialisation (Link *et al.*, 2007). The final sample included 64 researchers and 24 administrators. Table 1 shows the distribution across the different disciplines of the researchers interviewed.

We used a structured interview guide, including such questions as 'What do you consider to be commercialisation of research results?' and 'What incentives are there at your university for promoting the commercialisation of research results?'. All interview data were recorded and transcribed. Two people coded the data independently and three dominant themes were identified. The first had to do with the definition of commercialisation and what activities faculty perceived to be included in this category. The second related to the motivation of faculty to commercialise. The third theme is the role of faculty ownership of intellectual property in determining faculty attitude to commercialisation. We grouped the answers into dominant categories and looked for within-group similarities coupled with inter-group differences (Eisenhardt, 1989). We used interviews with technology transfer personnel to check background variables that can differ across universities, such as differences in technology transfer office policies and in the organisation of responsibility for third stream activities.

Results

What is commercialisation?

Several of the interviewees had difficulty defining commercialisation, despite the intensive debate that exists around the subject nationally and despite their own strong views on the subject. We have managed to put their responses into five categories (Table 2). Table 3 shows how these categories are distributed among the various scientific fields.

From Table 2 it is evident that the majority of the interviewees, independent of field affiliation, perceived commercialisation as products, patents and spin-offs. However, there is great variance in the answers; some interviewees emphasise the importance of collaboration with industry while others are rather limited in their definition. One illustrative response is: 'Commercialisation happens in many ways;

Disciplines	Interviewees
Life sciences	9
Science	19
Social sciences and humanities	17
ICT and technology	19
Total	64

Table 1. Distribution of interviewees by discipline

Categories	Definition includes
Technology transfer	Products, patents, licences and spin-offs
Consultancy	Consultancy
Knowledge transfer	Diverse activities, including technology transfer, educational programmes, books
General	Books
Other	Education and 'document effects'

Table 2. Categories and definition of commercialisation

Table 3. Researchers' definition of commercialisation

Fields	Technology transfer	Consultancy	Knowledge transfer	General	Other
Life sciences	4	1	2	2	
Science	9		4	3	3
Social sciences and humanities	8	3	4	2	
ICT and engineering	7		9	3	
Total	28	4	19	10	3

one is through collaboration with industry, and then one can exploit the knowledge gained in the collaboration through commercialisation of products and services'. Another said: 'This must be unique knowledge which can be protected through a patent and then you need a commercialisation strategy', and a third responded that: 'I think it is only spin-offs that can commercialise, to use knowledge and technologies to generate a product'. These quotes are representative of all fields. Faculty that employed technology transfer as a definition of commercialisation tended to regard commercialisation as exchanging knowledge for money. Consultancy was not widespread as a definition of commercialisation, but those who used it employed consultancy as their only definition of commercialisation.

The other major group comprised those who employed a broad definition of commercialisation, which included both codified and tacit knowledge transfer. An illustrative response is:

That is product development, of course, and concept development and consultancy We do sell executive training programmes as well. But for us it is more about knowledge transfer which affects the industry's working methods.

The majority of interviewees in the fields of ICT and engineering are found in this group. One possible explanation may be that researchers in these fields have a tradition of close collaboration with other sectors, such as industry. Only three of the interviewees (all within the field of science) employed a definition of commercialisation that did not correspond at all to the major categories. These three perceived commercialisation as education of students and 'documenting effects', and did not include anything else in their definition. We treat these answers as outliers.

Few of the interviewed faculty were negative towards commercialisation and those who were came from all faculties and had different reasons for their attitude. Some perceived applied research as less academic than other research and some reacted negatively to the term 'commercialisation' itself. However, several of the interviewees in the humanities and the social sciences groups were reluctant to define their own work as commercialisation – even though they performed activities that they had defined as commercialisation. In general, academics in the humanities and social sciences shared the view that commercialisation and third mission activities were easier for natural scientists as they could protect their work. This view was held by the natural scientists as well. According to one respondent:

 \dots [commercialisation] is necessary so that the knowledge will have a continued life. If not, you will end up in some sort of humanistic faculty that will die slowly. And this is the strength of the natural sciences – that it has been possible and still is, to commercialise large portions of the knowledge.

Generally, faculty from outside the humanities perceived their colleagues in the humanities to be uninterested in, and negative towards, commercialisation. Many held the view that faculty from the humanities do not participate in third mission activities or knowledge transfer activities, and that research in the humanities is very specialised, narrow and of little interest to society at large.

Incentives and motivations for commercialisation

The general consensus among faculty was that there were few incentives for university researchers to participate in third mission activities. Some interviewees at one regional university claimed that third mission activities were integrated in the evaluation of candidates for professorships, but this appears to be the exception rather than the rule. The general view is that the university is rather poor at handling commercialisation, as the incentive mechanisms are more or less absent.

Some faculty perceived a change in the attitude of their peers, who had become more positive towards non-university actors. One quote is illustrative:

When I started working here, if I went to one colleague and said, 'Can you work with a report?', I got the response, 'Why should I do that?' Today they meet me more often with a 'Yes, that is interesting'. Well, first you have to see how you might exploit this in your daily work. You'll get living examples for teaching or you might use the empirical data in your own research, and I think that is great. ... More and more share this perception.

Almost all of the interviewees had contacts with non-academic organisations. The majority of those in the humanities and social sciences had networks consisting of public organisations and research councils. Less than half of these interviewees had industry contacts, and of these, all maintained that the contacts were important for obtaining projects for Ph.D. students. The major motivations for contacts with public organisations and industry were obtaining data and feedback into ongoing research, and identifying new research areas and research questions. However, many faculty members from the humanities and social sciences had companies which they used for consultancy. These companies and the activities associated with them were seen as separate from their research at the university. Natural scientists shared the need to get access to other environments to fund or provide research problems for their students. They reported theory testing and documentation of effect as

additional reasons for collaboration. Those working in the applied sciences and engineering often reported that without collaboration with industry, they would be unable to perform research at all.

Intellectual property and spin-offs

All the researchers interviewed approved of Sweden's arrangements for intellectual property rights in universities. However, those working with technology transfer in an administrative capacity cared little for a legal regime which gives researchers the right to intellectual property arising from their research. The rationale for this position was that academics should not be treated differently from employees in other sectors of working life and should not have the opportunity to earn revenue at the expense of the tax payers. Researchers cite the professors' privilege as the single most important incentive to engage in commercialisation of their research: 'If the university should own the IPR, commercialisation of research would be of no interest for the individual researcher, if so it would be better to pursue the academic road'. However, pursuing research that might have commercial potential is both risky and time consuming:

You have the Swedish problem in that we get too little technology transfer out of the research. But, there is a simple reason for this; there are too many risks in spinning out research You might lose your job, your income, and you will put yourself in a situation where your income will be insecure even though you succeed in getting external financing from day one, and you lose the prestige within the career which you originally chose.

The general view was that firm formation and commercialisation are not for everyone and was best left to risk takers. Some entrepreneurial researchers were actually criticised by their peers: 'You should not be doing extracurricular activities that compete with ordinary activities'. There were further dangers: 'What is research and what is commercialisation? You might get suspected for doing product development, when you are supposed to be devoted to research'. Nevertheless, many reported higher credibility in the university and in industry as a result of having been successful in establishing firms.

Discussion

Our initial concern in this paper has been to establish how researchers define commercialisation and what motivates their participation in commercialisation. Our results show that faculty from the humanities, social sciences and natural sciences tend to define commercialisation as technology transfer, but there are important differences beyond this shared definition. The difference is first and foremost related to the significance attributed to intellectual property rights in faculty understanding of commercialisation and what is desirable commercialisation. The coupling of commercialisation with intellectual property rights poses more problems for those in the humanities than it does for researchers in the social sciences, natural sciences, medicine and engineering. Much of the commercialisation activity associated with knowledge transfer in the humanities is so well integrated into the everyday work of researchers and their students that it would be difficult to distinguish between knowledge with a commercial purpose and knowledge that is fundamental in teaching and research. This is certainly not to say that knowledge creation in the humanities has no commercial relevance; researchers in the humanities do a great deal more consultancy and other types of commercially-oriented knowledge transfer than is commonly believed.

Researchers from all areas give disproportionate attention to patents in defining commercialisation of research. This may reflect the fact that policy signals and incentives give considerable weight to patents. Or it may be that arguments advanced by researchers about commercialisation are deliberately crafted to position the researcher and third mission activities in a space that is protected from the problems associated with commercialisation. This may be for a number of reasons that go beyond identity issues, such as the grey zone in which commercialisation of research exists in a context where researchers are themselves public servants.

Why commercialise research results?

While the official policy arguments for commercialisation in Sweden are linked to growth and dissemination of knowledge, universities and their faculty have other reasons for engaging in knowledge transfer and commercialisation. The most common reason advanced by faculty, regardless of subject area, is that they need funding for their research and their students. This is a consequence of the national research policy in Sweden, which favours competitive project or programme-based funding to the individual researcher or research group rather than block allocation to the university. A second reason is that commercialisation is simply an artefact of collaboration, which is necessary for access to problems, data and so on in some research fields. While this situation is more common in the biological sciences. engineering and nanoscience, it is also evident in areas of the social sciences and humanities. A third explanation may be found in the public R&D structure of Sweden, and this is that Sweden is an R&D-intensive country with a high level of corporate and public R&D expenditure. The university is seen as the main provider of knowledge, and there is much interest in collaboration with universities. The fact that all doctoral students have to be fully financed in order to gain admission to doctoral programmes also provides strong incentive for collaboration.

Faculty ownership of intellectual property and commercialisation

The debate in Europe about the university's role in society gives a great deal of attention to intellectual property rights and firm formation. Sweden conforms strongly to this norm with one exception and this is its retention of the right of researchers to own the intellectual property that accrues from their research. Our results show that this is a contested issue. The main difference of opinion is between technology transfer personnel (who are convinced that the incidence of firm formation would increase were universities rather than individual faculty to own intellectual property accruing from research) and researchers (who see their continued ownership as an important incentive for engaging in commercialisation activities).

The ambivalence reflected in researchers' accounts of firm formation in particular may be attributed to such issues as the conflict between the ethos of open science and the personal income that may accrue from firm formation. This ambivalence is also related to faculty ownership of property derived from public investments and is the retention of professors' privilege. However, this is only a small part of the picture, as both our research and that from other Nordic countries show that a host of other conflicts arise from attempts to establish spin-offs from university research (see Tuunainen, 2005). This is understandable given that the financial model for university research in Sweden transfers a significant percentage of the costs of doing research to the research group. Faculty may thus perceive research materials that are collectively owned as not belonging to the employer *per se*, but to the research group because of the large overhead costs that are levied on research grants. Spin-off creation separates the group which forms the company from the wider research community and this may spark disputes over who has rights to what in a way that other types of commercialisation may not.

Second, there is a tension between the researcher and the university. The majority perceived the university as positive to commercialisation in general, but recognition of commercialisation as part of the role of a researcher was not uniform. Some departments provide explicit, though few, incentives (such as temporary leave of absence and credit within the merit system), but not all. There are similar variations among universities. Further, it is unclear what kind of weighting this factor is given *vis-à-vis* the more traditional outputs (such as number of Ph.D. students supervised and publications) when one is applying for new jobs. Third, tension arises because policy favours spin-off creation primarily for its potential positive externalities (e.g. developing the regional and national economy). Personal and career risks involved in firm formation do not figure in such policy considerations.

Conclusions

In summary, this paper has sought to deepen understanding of what meanings researchers ascribe to the commercialisation of research and why they engage in this activity; to improve our knowledge of the variety of ways in which the commercialisation of research results occurs; and to provide insight into what types of knowledge transfer and commercialisation activities are undertaken when academics own the intellectual property derived from their research results.

Our results confirm existing research in so far as they show that there is a variety of different reasons for university faculty to engage in commercialisation. In the Swedish case, although inventor ownership is cited by researchers as an important incentive to engage in the commercialisation of research, it seems that the peculiarities of the funding system are an overriding determinant of researcher behaviour. The policy implications of this finding are difficult to ascertain without further research. However, there is reason to believe that the structure of the Swedish R&D system may be another determinant of significance at this level.

We found that researchers engage in a diverse range of knowledge transfer activities, many of which are so deeply embedded in their everyday work that they have difficulty retrieving them when reconstructing what they do. This embeddedness may go some way towards accounting for another finding, which is that of all knowledge transfer activities, it is technology transfer (and, more specifically, creating firms) that appears to be the most difficult activity to integrate into the everyday lives and practices of researchers. These perceptions appear to be independent of who owns the intellectual property arising from research. Swedish researchers cite inventor ownership as the only incentive for engaging in firm creation. An important caveat in this regard however is that faculty perceive the personal risks involved in firm formation to offset the potential benefits that may be derived from ownership. Further research is needed here to determine what aspects of these risks may be amenable to policy intervention.

We have given particular attention to the views of researchers from the social sciences and humanities in our sample because of the general perception that they have been ignored by the body of research on university entrepreneurship. Our data show that faculty from the social sciences and humanities are perceived by their colleagues in other faculties to be largely irrelevant to the knowledge transfer debate because the knowledge they produce is of little relevance to the economy. Further, faculty from the humanities and social sciences are assumed to be particularly negative towards the commercialisation of research results. Our findings in this regard are significant, given that our sample was of researchers who do engage in knowledge transfer activities. Faculty from the social sciences and humanities were not overly positive, but they were not negative towards commercialisation activities. In fact, many of their reservations about commercialisation were to a great extent echoed by interviewees from the natural sciences. These researchers confirmed the view that starting firms was not a relevant form of knowledge transfer in the humanities and social sciences, though we found instances of researchers from these areas who had started firms on the basis of their research. Faculty from the social sciences and humanities generally under-reported their engagement with commercial activities or were unwilling to characterise their activities in these terms, even when allowed the opportunity to define commercialisation broadly to include all types of market-based knowledge transfer. This may be explained by the fact that it is still unclear in the university generally, but particularly in these knowledge areas, how colleagues will perceive commercial behaviour. Another potential explanatory factor is that Swedish researchers belong to the public service; thus, in addition to the reputational issues actualised by commercial activity, there are formal problems arising from the dual role of the public servant as private entrepreneur.

Finally, we found that there was a high level of knowledge transfer from Swedish universities and that researchers were engaged in diverse forms of knowledge transfer. Firm formation appeared to be the type of knowledge transfer and commercialisation of research that presents most challenge to academic life. Our study found that this challenge was, in part, grounded in substantive structural aspects of university life, such as who owns what in a publicly-funded system. Two aspects of the conflict observed may be explained by factors internal to the university as an institution and its attempt to grapple with the changing demands of society. One is the tension produced as a result of the creation of a new cadre of administrative staff charged with promoting technology transfer. This group sees inventor ownership as a significant obstacle to its work. This, together with the fact that Sweden is an outlier in this respect, makes it difficult for technology transfer personnel to compare their practices with those of counterparts outside Sweden.

A second aspect of the conflict lies in the identity conflict experienced by researchers. On the one hand, pressure from society and changes in science itself introduce commercial considerations in more and more aspects of science. On the other hand, researchers, particularly those from the humanities and the social sciences, feel that their identity and the tradition of science as open-ended would be undermined if they admitted the extent of their engagement with the more commercial aspects of academic life. Despite these tensions, we observe a general tendency towards a changing understanding of the content of the core missions of teaching and research to include knowledge transfer. This may suggest a gradual mainstreaming of third mission activities and may be explained in the Swedish case by the combined effects of national funding practices, the structure of the public R&D system and adaptations to global changes in research practices.

Notes

- Professors' privilege is a legal arrangement by which academics at public universities in Europe were allowed ownership of intellectual property arising from their research results. This is a practice that has its roots in the German university system of the 1800s. It is also sometimes referred to as professors' exemption because it gives academics rights that other employees do not possess.
- 2. These figures are based on 2011 data on R&D spending from Statistics Sweden.
- 3. This has changed incrementally as funding for infrastructure for technology transfer was made available to universities via a competitive open call, starting in 2000. Later the third stream ruling was revised to focus almost exclusively on innovation support.
- 4. Students from non-EU countries have had to pay tuition fees since 2011.

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