

Title: Light in the empirical shadow: Base-lining the impact of academic patenting legislation in Norway

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Abstract

As the commercialization of academic research has risen as a target area in many countries, the need for better empirical data collection to evaluate policy changes on this front has increasingly been recognized. When new legislation went into effect in Norway on 1 January 2003 with the objective of changing the way researchers in the large university and college sector approach the potential for commercializing their research output, little preparation was made for monitoring the success of the controversial policy change. This paper presents results from a project designed to provide necessary empirical basis on which to analyze changes in extent and focus of academic patents while enabling future comparisons. The purpose is to describe the project's empirical approach and results, while also providing insight into the changes in Norwegian policy on this front and their context.

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1. Introduction

The commercialization of academic research is an important area of innovation policy in Norway as it is in a rash of other countries. Although changes in this policy area are by no means new to the country, recent developments in this policy area arguably have made it the most significant area of the country's formative innovation policy, generating more active public discussion than the "integrated innovation policy" of which it forms a part. This legislation, which recently went into effect, is expected to substantially change the basis for commercializing academic research. This new legislation makes the question of the new role of academic research substantially a question of academic patenting. An expressed objective is to increase the rate and degree of exploitation of the science base in Norway, thereby improving the basis for economic growth.

The policy change is highly ambitious and it involves an attempt to foment change not least in the attitude that academic and other public sector researchers may or may not have towards commercialization, which is generally assumed to be antipathetic to patenting. The changes also have far-reaching implications, for example affecting the institutional set-up of universities in Norway. Despite the expectations of this high-profile policy change, despite the explicit obligation to monitor the effects of the change, and despite the importance ascribed to monitoring effort in relevant analysis no evident way to assess the effect of the new measures against their expressed aims was envisioned when the new regulations went into effect in January 2003.

1.1. Project ambition and paper aims

This paper reports on results from a project to provide light in this empirical shadow. The project addresses the patenting of academic and other public sector researchers (hereafter *the UIH Sector*)¹ in two stages. The first stage of the project involves designing and executing an empirical approach to identify and analyze academic patenting in Norway. This approach links registry data covering all researchers in Norway with concurrent domestic patent data. This step allows us to identify and analyze the involvement of academic researchers in patenting. Furthermore it will lay the basis for a targeted survey to explore qualitative aspects of commercialization, including attitudes, motivations to patent, the role of support services, etc. Stage two of the project surveys researchers identified in stage one. The second stage serves both to provide qualitative interpretative information about academic patenting as well as to help verify (and revise) the accurateness of the identification exercise. The overall objective is that the identification and the complementary survey can then provide a baseline against which to monitor and analyze Norwegian developments in academic patenting.

The paper is mainly descriptive and will predominantly showcase the approach and the results from the identification of academic patents. First the paper touches on some issues and perspectives and briefly surveys some relevant institutional and regulatory aspects of the Norwegian case. In the main section the paper presents some features of the approach before presenting some of our results.

¹ The UIH Sector includes personnel at Norwegian universities (U) and colleges (H=Høgskoler). In addition, the patenting activities of the publicly supported research institution (I) sector are included for comparison.

2. Issues and perspective

It is well documented that the climate and the practice academic patenting have changed dramatically during the past couple of decades. At the same time we recognize that the division between academic research, associated with ‘open science’ and the ideal of ‘communalism’, and the patent system, characterized by a technological focus and a commercial focus, has perhaps never been very clean cut. Some basic dimensions of academic patenting is worthwhile reviewing before we proceed to identify its recent history in Norway.

2.1. Schematic dimensions

The commercial logic of applying for a patent—as well as a certain cultural factor—has traditionally made patenting the domain of industry. Patenting is typically biased towards the applied nature of new technical knowledge². On its side, it can be said that ‘basic research’ is typically biased against the idea manifest in the patent regime, that knowledge can be owned by someone and that others can be excluded from using it. Thus a more fundamental obstacle dividing university-research from patenting has been cultural. Such attitudes contributed to a situation in which patent-protection has not been carefully considered in all but special cases.

But even in cases where the basic science of university research do meet patentability requirements, an economic incentive is needed to outweigh the costs associated with patent protection. Since, “the outputs of basic research rarely possess intrinsic economic value,” (David, Steinmueller & Mowery, 1995) and since the traditional research university is not geared to developing and marketing any technological innovation that might arise, patenting has not been considered generally relevant for the fundamental research of universities and other nonprofit R&D institutes.

On top of these two fundamental factors, a practical set of reasons has kept academic research from seriously considering patent-protection as an option. A lack of clear guidelines for university patenting combined with a lack of practical support in effectively managing ‘intellectual property’ (applying for and capitalizing on patented inventions) has made the prospects of recouping the investment in the patenting process remote indeed for university research.

2.2. Growth of academic patenting

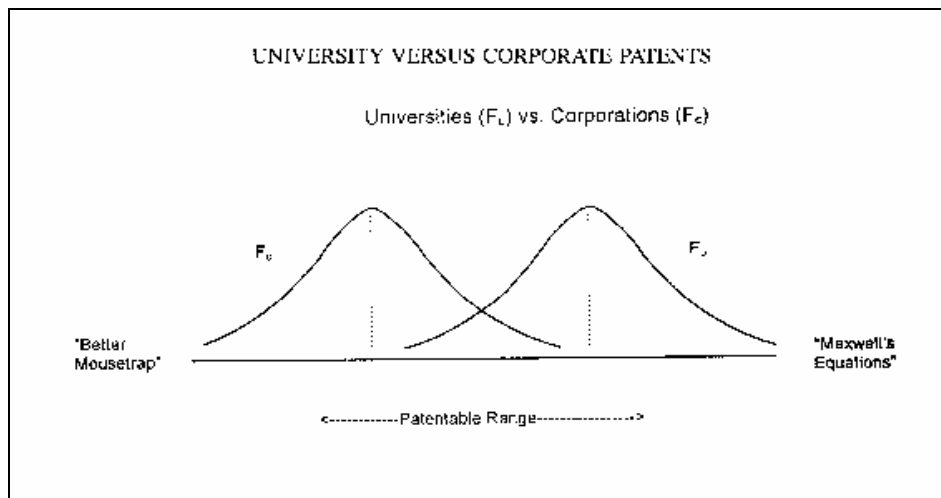
This schematic division between patenting and academic research has of course never really been accurate. Instead academic research has long been associated with increasing innovation in the economy. Internationally, patenting of academic knowledge and concerted measures designed to promote commercialization of academic research both trace back to the early part of last century. (Mowery et al, 2004) In Norway, there is also a legacy that substantially predates the new legislation.³

² A patent can be granted for devices or process which demonstrate an ‘inventive step’ while discoveries and phenomena of nature cannot be patented. In this, it seems that the patent-regimes of the US or the UK type especially intended for entrepreneurial and industrial R&D and not academic science. In extension to its technology focus, patentability requires that an invention not only prove novelty and non-obviousness but also demonstrate ‘utility’. The concept of utility implies that the invention has a potential for commercial application. Further, this potential is expected to be ‘exercised’ or actively pursued in order to maintain protection. In a typical case, the ‘exercise’ of an invention means active development of a product.

³ The birth of SINTEF in the fifties is a good example to be returned to in the institutional section. It was substantially meant to promote the commercialization of results from technical university in Trondheim.

Nonetheless the intensity of academic patenting has by all accounts changed in the course of the past decade or two. Qualitatively, the base-line of what is being patented is widening. With reference to figure 1, corporate and university patenting is each stretching what is patentable both in the direction of the applied and basic. In the middle, there is growing overlapping of university and corporate patenting, increasingly through collaborations between them. Simultaneously, the fringes spread, apparently allowing increased patenting into the realm of basic science (incidentally, where both universities and corporations are active, often in tandem) but also in the other direction through an apparent weakening of the non-obviousness criterion (cf. Jaffe and Lerner, 2004).

Figure 1 : Schematic portrayal of university vs. industry patenting, from M. Tratjenberg, Henderson, Jaffe (1996)



Source: M. Tratjenberg, Henderson, Jaffe (1996)

Quantitatively, a gathering set of studies have shown the increase of academic patenting especially in the US: Henderson et al. (1995) showed that academic patents increased 15-fold between 1965 and 1988.⁴ This increase in intensity is recognized to involve a set of interlinking changes, including changes in the roles of universities (Gibbons et al (1994); Webster, (1999); Etzkowitz (1998)), changes in technology, and, relatedly, changes in the patent-system (cf. Jaffe and Lerner, 2004). Legal, regulatory and, not least, institutional elements all contribute to a climate for better interaction between academic knowledge bases and those in the economy otherwise.

3. Regulatory and institutional context

Academic research makes up a large component of national research efforts in countries like Norway. Policy interest in quickening the return to society this component is however by no means new. Policymakers began to see it as “an underutilized resource” in the 1980s, for which there was a rising tendency to ‘adopt appropriate policies’. (Stankiewicz, 1986) Since then, more and more countries have been occupied by concerns to (continue to) improve the climate for commercializing university research, and by concerns to improve links between public research institutions and industry.

⁴ The explosion of university patents however has accompanied a peaking of this quality-measure during the mid-80s, suggesting, “that the rate of increase of important patents from universities is much less than the overall rate of increase of university patenting in the period” (Henderson et al., 1995)

New legislation⁵ recently went into effect in Norway that substantially changes the basis for commercializing academic research. The measure effectively removes the ‘teacher’s exception’/‘professor’s privilege’ from the legal corpus and places the responsibility for commercialization of academic research on the universities. It explicitly follows developments in other countries. (e.g. Denmark, Germany, as well as the US)

The linchpin of the formative Norwegian policy takes the form of two amendments. The general objective to increase the rate and degree of exploitation of the science base, in order to improve the basis for economic growth

- Proposition No. 40 to the Odelsting (2001–2002) § 2 nr. 4.: Amendment to expand the societal responsibilities of universities and colleges to include promoting the practical application of research methods and results, not least in industry
- Proposition No. 67 to the Odelsting (2001–2002). Amendment to increase the commercial exploitation of inventions by revoking the ‘professor’s privilege’ (<<lærerunntaket>>)
- Adaption of the institutional framework (TTOs, new seed-funding, adjustments of funding mechanisms, etc)

The legal amendments hope to increase commercial utilization of academy-based inventions. An important point is that it intends to do so while maintaining the academy’s traditional goals, namely free-research and higher education. In fact, the expressed intention is to strengthen the traditional goal of universities in spreading research results to society. To do so, the amendment substantially readdresses the role of academic research. It widens the interpretation of the university sector’s obligation to disseminate research results⁶ to include commercialization as a channel for such dissemination. In order to do this the amendment changes the right to industrial application/commercialization of ‘inventions’ formally from the researcher to the university sector institution.

The change introduces new obligations on the researcher and the university sector institution. In the new environment, researchers are obligated to orient the university about results with potential industrial application. (‘notification obligation’) An obligation has been created at university sector institutions for active engagement in commercialization.

The changing regime raises new questions and challenges. These include:

- The question of the right to publish, and who has responsibility in cases where more than one researcher is involved.
- The need to develop strategies whereby the researcher is able/encouraged to participate in commercializing (‘working’) the invention.
- How to introduce the obligation to notify on researchers who are not principally aware of, nor sensitized to what is patentable etc.
- The importance of introducing necessity that it act as the researcher’s partner not opponent
- The need to better understand the empirical effect of the changing regime.

The recent international spread of initiatives that focus on increasing the rate and degree of

⁵ Amendment to increase the commercial exploitation of inventions: Proposition No. 67 to the Odelsting (2001–2002). This amendment changes the ‘teacher’s exception’ (lærerunntaket) of Act No. 21 of 17 April 1970 relating to the right to inventions made by employees.

⁶ Universitets og høyskolelov: §2.

exploitation of the science base brings with it a recognized need for better empirical tools to evaluate. The need for a robust and reliable empirical basis on which to assess commercialization practices over time and across countries was indeed the basis for recent OECD work on the licensing and patenting of public research organizations⁷; the need for continued work in this direction was also one of the major recommendations to countries following this trend (OECD, 2003; 19). The international policy environment continues to be characterized by a state of flux in spite of the experience already amassed and in spite of attempts to coordinate the direction of policies. In this setting, there is no doubt that there is pronounced, “need for timely and accurate information on the nature and extent of research collaboration between universities and industry, and on how it varies across discipline, type of university, sector, firm-ownership and time” (Calvert & Patel, 2002).

4. Approach and methodology

The methodological aim presented in this paper addresses this need. It is designed to identify and analyze the involvement of academic researchers in patenting with an eye to creating a baseline which will allow comparisons over time, and potentially, across the Nordic area. This empirical analysis will be instrumental to informing the future development of this important innovation policy area.

The approach identifies the involvement of academic researchers in domestic patenting by linking researcher- registry data with concurrent domestic patent data. This creates the basis for a targeted survey to then explore qualitative aspects of commercialization, including attitudes, motivations to patent, the role of support services, etc. The principle objective is to develop empirical tools to better analyze the changing role of public R&D in economic growth in Norway.

4.1. The two tier approach

The reliable identification of patents stemming from the research of public-sector institutions, especially universities, poses a set of distinct challenges. In a ‘professor’s privilege’ environment, the patent record will generally not provide the indication of the inventor’s institutional affiliation: the academic patent will tend to reside in the name of the researcher and/or a sponsor. In this situation patented results of academic research will initially remain invisible in the patent data.

Absent special circumstances⁸, running the names of ‘academic’ researchers against inventors in the patent record forms the only route towards identification. This approach provides the benefit of full information about the patenting activity (frequency, technological orientation, collaborators etc). However it of course assumes the availability and reliability of name lists (preferably linked to institutional affiliation and other information) over a substantial period of time. This temporal dimension is important since the patenting event and the researching event are sequential, with the former activity tending to extend considerably backwards in time. Moreover, the name-link approach risks generating large numbers of false-positives and of false-negatives for example due to the same-name problem (e.g. John Smith) or due to propensity for orthographic problems. These problems are compounded in countries like Norway which have standard name-forms (such as Hansen, Iversen, Gulbrandsen...) and

⁷ OECD (2003) Turning Science into Business: Patenting and Licensing at Public Research Organizations. DSTI/STP(2003)/22.

⁸ Such as the existence of periodic reporting (e.g. through national surveys) efforts which includes relevant questions.

atypical character sets (æ, å, ø) which may be error-prone in database programs.

The main alternative strategy is to systematically survey academic researchers on their patenting activities. (cf.) This approach where successful can provide contextual information that is valuable to understanding the purpose, orientation and context of the researchers' patenting activity. On the other hand it relies on the researcher's own account of the patent particulars (such as the patent numbers, IPC classes, etc) which opens up some initial difficulties. Furthermore, it again assumes current addresses of researcher that preferably includes additional information to avoid overburdening the respondent. Securing reliable responses for a representative set of researchers poses many challenges especially in larger countries with large and diverse researcher populations. Moreover, there are a set of daunting trade-offs. These include the trade-off between selection criteria and representativity and between the amount of information in the questionnaire and the critical question of response-rates.

4.2. Matching the two-registries

The approach of the paper is essentially to combine the two basic approaches in such a way as to exploit strengths while avoiding inherent weaknesses. There are two-tiers to the approach, which is basically the reverse of that of Balconi, Breschi, Lissoni, 2004. Here we pursue a name-match strategy which links the identity of researchers at public research organization (universities, colleges and other public research organizations) with domestic patent applications.

The approach involves two types of registry-data:

1. Inventors in domestic patents, 1998-2003. Includes full-first page information.
2. Register covering all researchers in universities, colleges, and institutions receiving public funding: including information of institutional affiliation and position.

Tier1: Name-match strategy based on registry-data:

- Inventors in domestic patents, (1998-2003). Includes full-first page information.
- Register covering all researchers in universities, colleges, and institutions receiving public funding: including information of institutional affiliation and position.
- Relax some criteria to reduce false-negatives

Tier 2: Conduct survey targeting linked inventors. (forthcoming paper)

- Use survey to verify results of the registry link:

The patent dataset consists of all patents applied for and/or granted domestically (the Norwegian Patent Office) between 1998-2003. The link will be made via a controlled joining procedure which will join the names and addresses of the researcher with the names and addresses (zip-codes) of patent inventors/assignees⁹. The primary IPC classes of the patent applications were associated to Technological Areas by a widely-used Correspondence Key: the INPI/OST/ISI Key, Version 3.

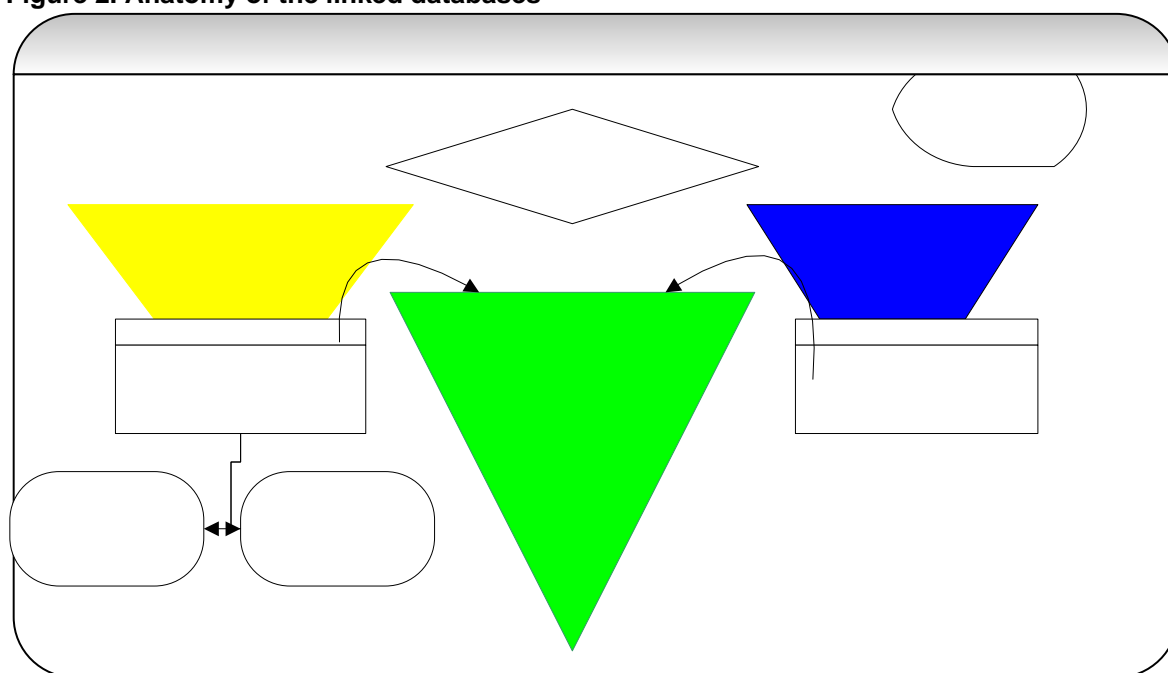
5. Results

⁹ The postcodes were associated to county and district-levels via the Norwegian Post's database.

This section presents the (first) results from the database analysis. It is informed by the responses of the survey inasmuch as these help to correct the population (ie. Remove false positives). However, the results of the survey will be presented in a separate paper. The focus here is on the position of academic inventors in the total patenting activity of the country. In this frame special attention is given to relative technological orientation of invention, to development from period 1 (1998-2000) to period2 (2001-2003), and to the relative activity of the three main constituents of the UIH sector, namely the universities (U), the colleges (H) and the large research institute sector (I).

The researcher registry reflects a yearly average of 25,728 researchers in positions at the various UIH institutions. The composite picture based on 1997, 1999, 2001, and 2003 runs to 51,000 separate observations, since it captures turnover both in terms of researchers and the positions and institutions they are employed at. Twenty-one percent (10,615) of these observations were in the institute sector and the rest (39881) were in the University and College sector. The patent register is based on 7780 domestic patents (P)¹⁰, involving a total of 6684 different inventors (INV). All in all, these 6700 individuals were involved 11889 times (Pinv) in the 7800 domestic applications. Figure 1 illustrates the link between this inventive activity (in terms of P, INV, and Pinv) and the researchers in the UIH organizations.

Figure 2. Anatomy of the linked databases



The link is conducted in two iterations as discussed above. In the first round of name-matching, 800 individual inventors were identified 1800 times in 1500 separate patents. The second round of verification by survey provided the basis to deflate the false-positives towards a more accurate population. The negative responses allowed us to remove 73 inventors, while 307 positive responses provided a lower end value for academic inventors.

The approach however still does not provide completely unambiguous results. We are especially left with the question of what to do with non-responses. Since the survey responses

¹⁰ These are applications with a Norwegian address in the inventors and/or the applicant fields. These applications make up twenty percent of the total volume of patent-application (38,225) received by the Norwegian Patent Office during the six-year period (1998-2003).

are not perfectly binary there is also the question of what to do with inconclusive responses. The responses can be divided into seven categories in order to verify the link between researcher and patenting activity. Table 1 shows the breakdown of these categories by inventor, by patents (Discrete patents), and by the number of times the inventors appear on patents (Frequency).

Table 1. Breakdown of responses

	Inventors	Patents ¹¹	Frequency	Pat/inventor
1 Positive response	307	550	724	2,4
2 Other affiliation	35	59	60	1,7
3 Moved	90	235	246	2,7
4 Neg response	73	133	144	2,0
5 Unknown	21	42	46	2,2
6 No response	270	483	618	2,3
7 Non UIH (not surveyed)	5788	6279	10061	1,7
	6584	7781	11899	1,8

This breakdown provides the basis to reclassify into three categories: (Guardedly) Positive, Unresolved and Negative.

1. **Guardedly Positive** includes 1. Positive responses (N=307) as well as the ambiguous category 2 (N= 35) which confirms patenting, but disputes UIH affiliation . Cases include institute sector researchers who see their work to be private sector. Researchers who changed jobs in the period are also included here. Since these researchers did patent and did work in the UIH in our period, they qualify as positive responses here.
2. **Unresolved** includes 3. Researcher moved (n=90) as well as 6. No response (n=270) where we have no verification.
3. **Negative** includes 4. Correct name, wrong person (n=73), 5. Researcher unknown (n=21), as well as the large category 7. with no link to the UIH (n=5788)

This revision yields the following basic categories which will now be used to present the general results. Table 2 indicates that at least 5.2%¹² of the inventors have definite UIH affiliations.

Table 2. Revised categories: percentages

	Inventors	%	Patents	%	Frequency	%
POSITIVE	342	5,2 %	609	7,8 %	784	6,6 %
UNRESOLVED	360	5,5 %	718	9,2 %	864	7,3 %
NEGATIVE	5882	89,3 %	6454	82,9 %	10251	86,2 %
Total	6584	100,0 %	7781	100,0 %	11899	100,0 %

3.1. What proportion of Norwegian (patentable) inventions involves UIH researchers

The following figures explore general dimensions of UIH patenting. The purpose is to lay the basis for further analysis of main dimensions of this activity. This explorative exercise will into the breakdown of academic patenting by technological area and by the subcategories of the UIC sector. In addition the grant-records will be briefly considered.

¹¹ Counting Saksnr (checked) for each category (unchecked)

¹² 4.7% of these are Positive responses.

The narrow definition of verified links indicates that UIH patenting accounts for about 7% of the inventive activity in the patent record (ie frequency). This however varies strongly from technological area to technological. Figure 3 breaks down UIH patenting as a proportion of the patenting activity of five technological sectors. This reveals that Norwegian UIH researchers hold a particularly strong position in chemistry and pharmaceuticals (17% of domestic patenting) and in instruments, including medical instruments (12%). For purposes of presentation, the figure also includes the population of category of respondents for whom we do not have a decisive basis on which to include or exclude. If included, the intensity of UIH patenting rises to 30% for the chemistry and pharmaceutical area. In reality the level is likely to be nearer the twenty percent range.

Figure 3. Relative proportion of the two populations of academic patenting (Positive and Unresolved) by technological area. (N=11, 884)

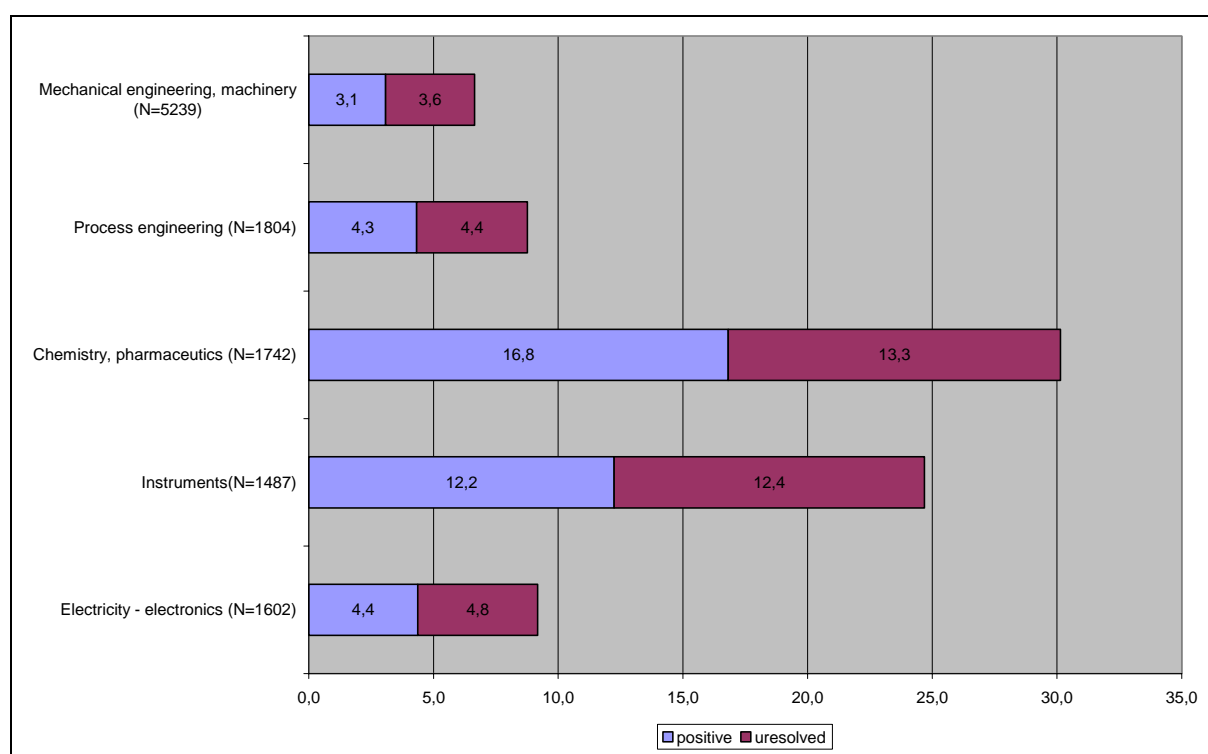
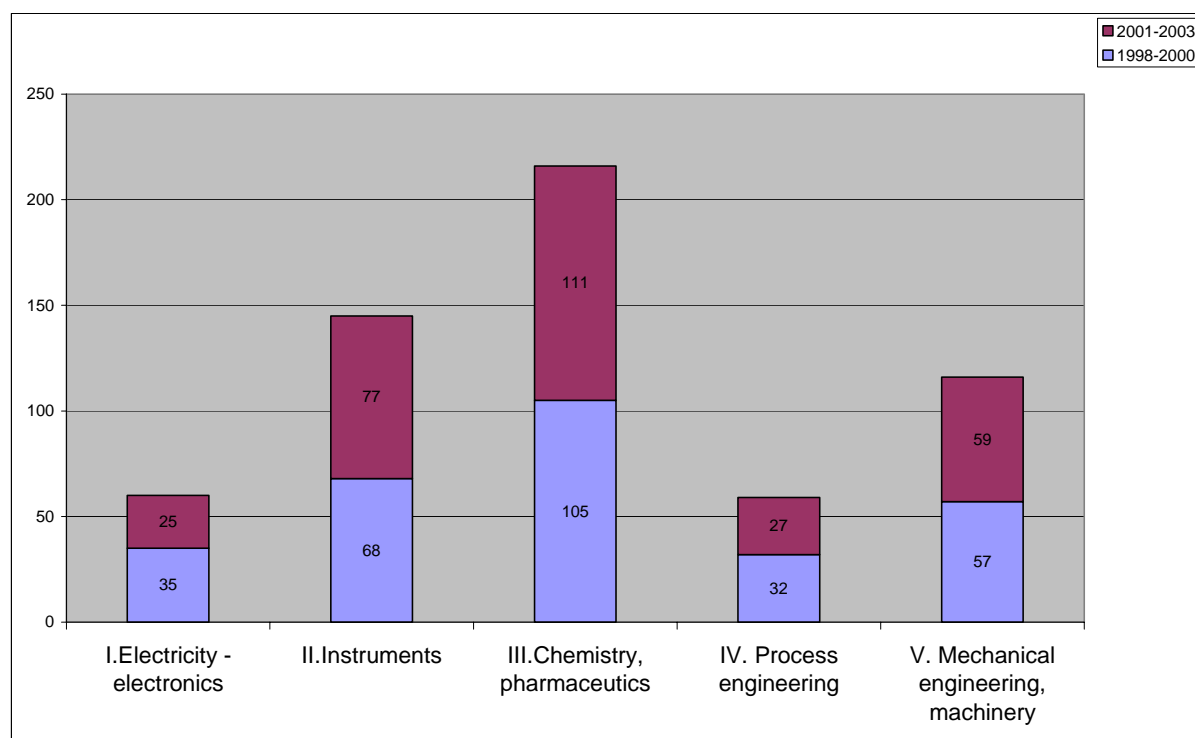


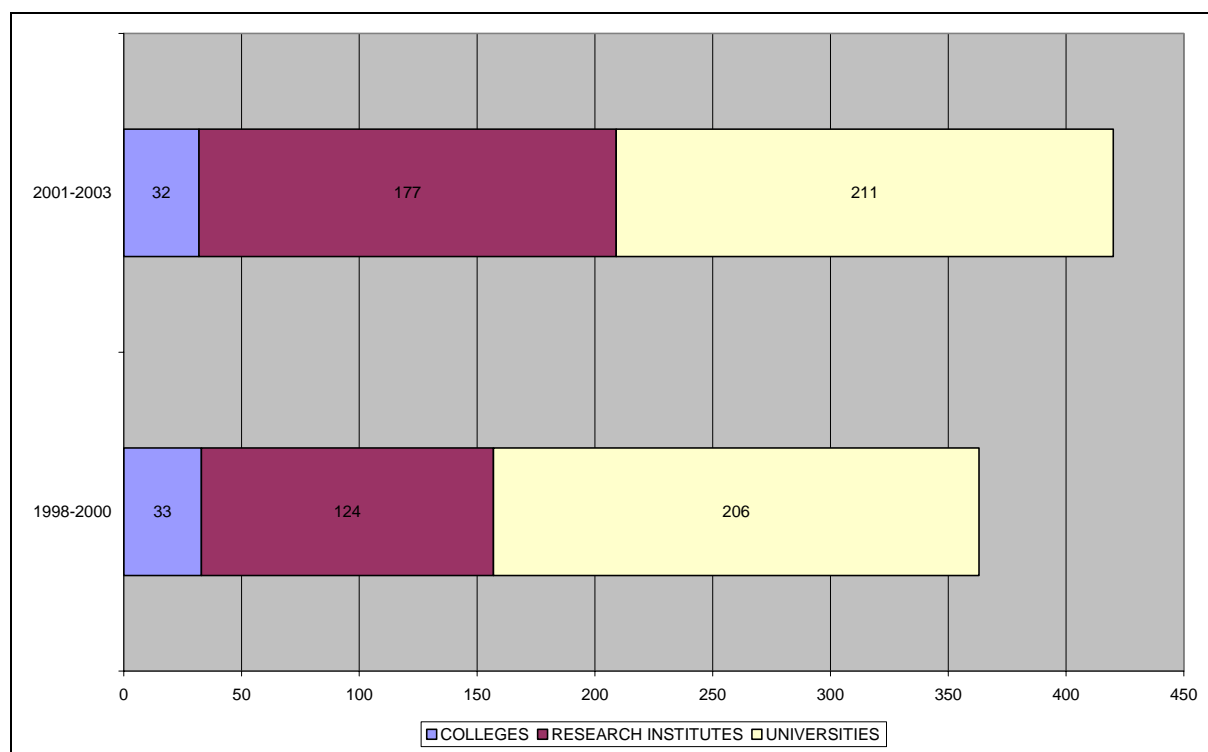
Figure 4 focuses on the narrow interpretation of the population on the basis of positive responses. It depicts the development over two three-year periods (1998-2000) to (2001-2003). It illustrates the largest technological areas are also those where there is most growth over time.

Figure 4. Narrow population of positives over time. Conservative interpretation: UHI researchers involved (780 times) in at least 7.8%(600) of domestic patents



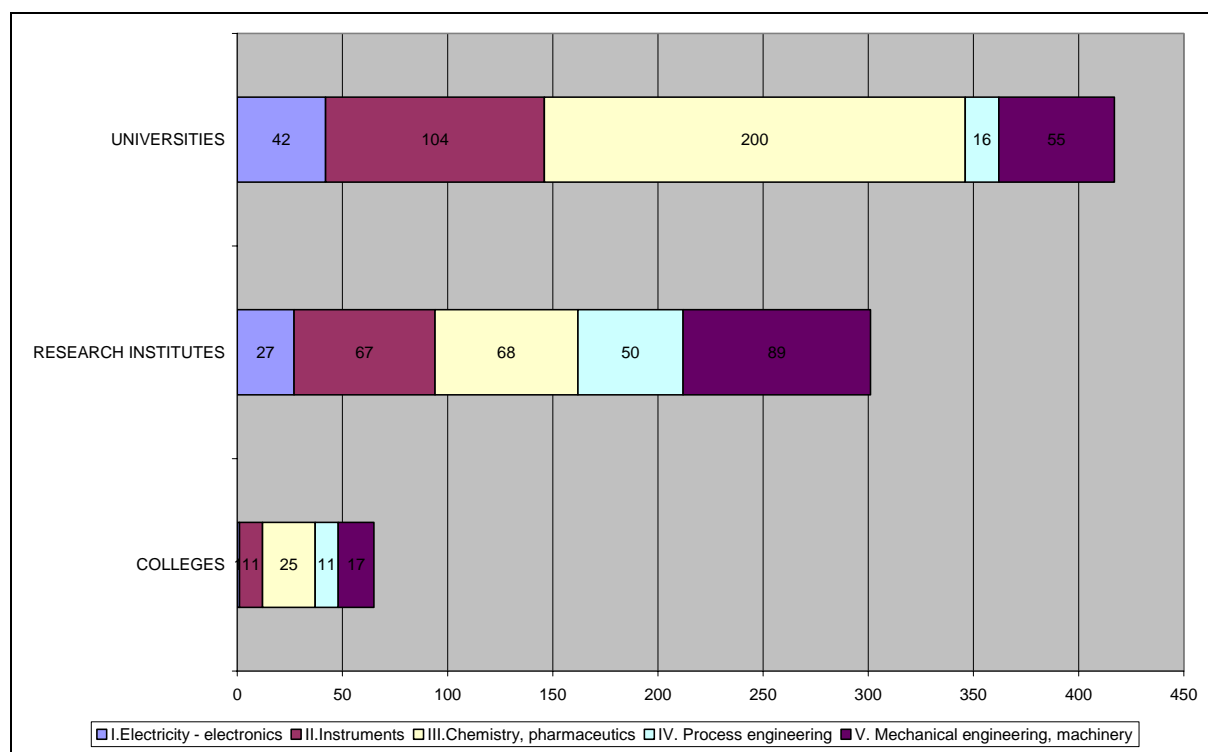
UIH patenting is growing even as patenting more generally has stabilized in the time frame. Figure 5 the breakdown the UIH patenting into constituent parts: the patenting of universities, that of colleges, and that of research institutions. The resulting picture illustrates the dominance of university patenting in the picture. However it also shows that the patenting activity of research institutions has strengthened considerably in the period. That of colleges has remained stable at a fairly low level.

Figure 5. Development of UIH Sector patenting (Positives) by sub-sector



Technological profiles are reflected in the patenting of the different types of research organizations. The profiles of colleges and of research institutes are each rather evenly distributed across technological areas. Colleges however do not figure in electronics patenting, while the institute sector is slightly more inclined towards participation in engineering patents. Universities, meanwhile, account for much of the activity in the large fields of chemistry/pharmaceuticals and of instruments.

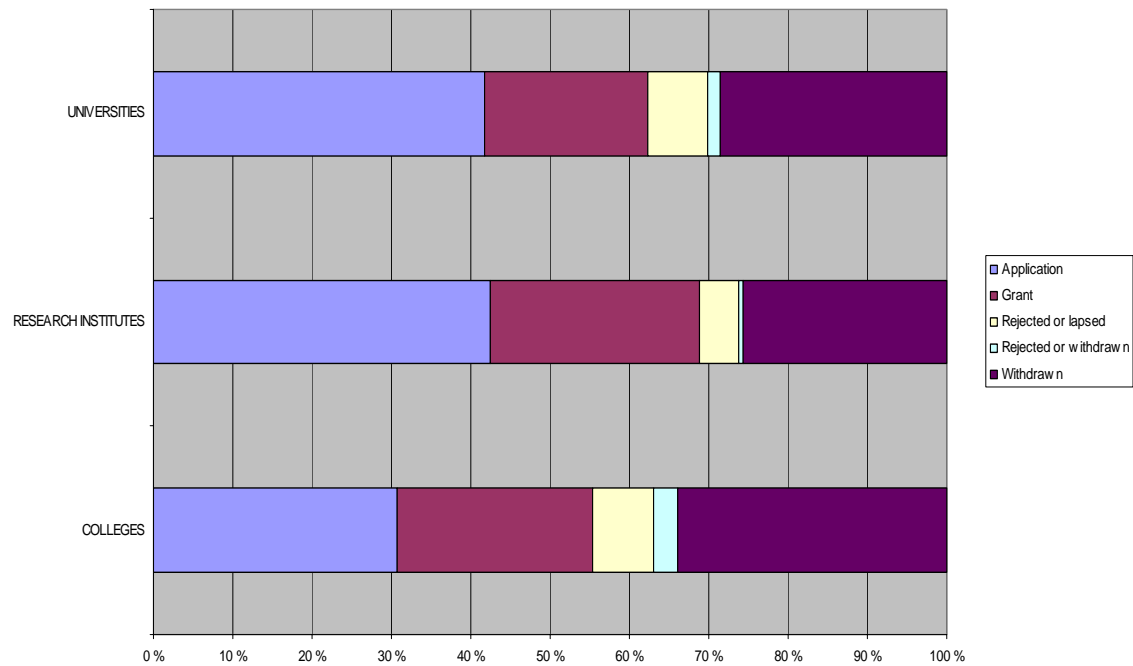
Figure 6. UIH Sector patenting (conservative) by technological area



The final figure in this explorative paper takes a preliminary look at what happens to the applications from UIH inventors. In many cases, especially in cases of complicated applications from later years, the applications will not have been processed. So the proportion of grants must be approached with caution since a lower percentage might simply mean that the sector is increasingly patenting in areas where examination takes longer.

Of more interest is the proportion of patenting that is withdrawn (purple) or otherwise not pursued (lapsed or rejected). These patents might indicate that the researchers could use more support in deciding what to try to patent and how to apply, and thus would benefit from the TTOs helping them here. Indeed figure 7 indicates that colleges tend to withdraw their applications to a larger degree than universities and research institutions, some of which have been linked to TTOs. No immediate conclusions can be drawn on this basis however.

Figure 7. Grant versus withdrawal of UIH Sector patenting (Positives)



6. (preliminary conclusions)

- Considerable academic patenting precedes the regulatory change
- Between 8-12 percent of Norwegian domestic patenting ascribable to UIH researchers (1998-2003): likely nearer the lower bound
- Substantial growth in the proportion of UIH patenting (especially the research institution researchers)
- Distinct institutional profiles of patenting activity:
- life-sciences and instruments dominant in the university sector,
- mechanical engineering more pronounced in the institute sector.
- What do the higher levels of withdrawn patents (Colleges) and lower level of grants (universities) tell us?
- Artefact of processing cycles or indication that UoH researchers face problems in filing own applications?

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