Knowledge Transfer And Intellectual Property Rights In Scandinavia

By Charlotta Dahlborg and Lilian Wikström

Introduction

The foundation of a successful knowledge-based economy is an effective educational system and research environment. Many international examples of valuable companies and intellectual property rights (IPR) originating from university researchers are available to exemplify this (Hvide and Jones 2018). There is general agreement on the value of university-based innovation, but countries have chosen different legislative paths, as there is no common view on how best to facilitate the transfer of university-based innovations to society. Many European countries have followed the example set by the US in 1980 when changing the law from researcher-owned (sometimes called Professor's privilege or Teacher's exemption) to university-owned IPR through the Bayh-Dole Act, with the aim to enhance technology transfer.

We aim to outline the landscape for university knowledge transfer in Scandinavia with a focus on Sweden. Using Karolinska Institutet and Lund University as examples, we will discuss how IPR of academic origin is contributing to the development of industry. There are many similarities between the Scandinavian countries Sweden, Norway and Denmark as well as Finland, in terms of culture, legal systems, welfare and mainly public funding of research. The prerequisites for technology transfer, however, became significantly different when Denmark abandoned the model of researcher-owned IPR in 1999, Norway in 2003 and Finland in 2007, while the inventions in Sweden remain owned by the researchers. These countries thus constitute an excellent opportunity to compare effects, which we will discuss.

Strong university research as a foundation. When universities were ranked in 2018 using the Shanghai Ranking (ARWU 2018), three Swedish universities were among the global top 100. One of the underlying explanations for strong university performance is the consistent and significant funding of research and development. Sweden is committing over 3 percent of its growth domestic product (GDP) to research and development, which is and has been for many years, well above the average spending in the USA and the EU countries (Legatum Institute 2018). Sweden is also considered one of the most innovative countries and generally receives top positions in international innovation rankings. For example, in the 2018 European Innovation score board ranking (European Commission 2018), Sweden was ranked first and also ranked third in the Global Innovation Index 2018 regarding both innovation and innovation efficiency (WIPO 2018). Thus, it can seem surprising that when Reuters ranked the world's top 100 innovative universities in 2018 (Reuters 2018), no Swedish university was on the list. An explanation to this seemingly contradictory finding is that in Sweden, researchers own and file for IPR protection and not the universities. Rankings where the number of university-owned patent filings are considered measures of innovativeness, Swedish universities are bound to fall short for these structural reasons. A different approach is needed to investigate this, as will be discussed below.

The contribution of universities to innovation production. The Swedish higher education system consists of about 50 university colleges, universities and independent higher education providers, employing approximately 75,000 persons. Most of these institutions are publicly operated (UKÄ 2019). Swedish universities have three main missions; to educate, to perform research, and to disseminate knowledge to society, through, for example, various collaboration and innovation activities.

There is a multitude of channels of interaction between university and industry (Bekkers and Freitas 2008). A commonly used measure of technology transfer and commercialisation are the number of university patent filings and academic start-ups (Perkmann *et al*. 2013). A consequence of the researcher-owned IPR model and the change to university-owned IPR in some countries over the last 10-year period is that there is no comprehensive statistics of patented inventions or start-ups stemming from universities in the Nordic countries (Geuna and Nesta 2006). Nor do the universities themselves have any systematic insight into their own researchers´ inventive productivity. To remedy this gap, a couple of initiatives have been taken to track the inventive productivity. Through individual studies discussed below, often spanning limited time periods and made on either university, regional, national or international level, it is possible, however, to get an estimation of the overall status and impact of university patenting.

On an international level, several studies have reviewed the research field of academic patenting (Agrawal 2001; Mowery and Sampat 2005; Baldini 2006; Thursby, Fuller, and Thursby 2009b; Lissoni 2012). Academic patents are defined as patents with at least one inventor affiliated to a university, regardless of owner (Meyer 2006; Ljungberg, Bourelos, and McKelvey 2013), while university patents are patents owned by the university. For example, in Sweden, Italy and France, it has been shown that between four percent and five percent of academic researchers have filed a patent, and that these levels are comparable to U.S universities (Balconi, Breschi, and Lissoni 2004; Lissoni *et al.* 2008).

A common pattern in countries with researcher-owned IPR is that the patent ownership cannot easily be linked to the university. For example, In Finland, Meyer *et al.* (2003) found that between 1986 and 2000 universities owned only a minor part of the overall patents (see Table 1).

One example of the proportion of academic patents to the total domestic production of patents is that 8-12 percent of all Norwegian domestic patents were invented by researchers at universities and Public Research Organisations between 1998 and 2000 (Rapmund, Gulbrandsen, and Iversen 2005). Lissoni *et al.* (2006) found that during 1978-2002 Swedish university-owned patents were less than 1 percent of the total domestic patents, while the researcher-owned patents were over 6 percent. This indicates that the Swedish level of university patenting is well in line with U.S. levels, which are also around 6 percent. See Table 1.

Two examples from Sweden. We will showcase academic patenting from two university cases, Karolinska Institutet (KI) and Lund University (LU). KI is a single-faculty medical university, and LU is a traditional multi-faculty university.

Since 1995, at KI, there has been an increased emphasis on the creation of an innovation support infrastructure, including the establishment of a technology transfer office. In addition, in 2009, KI was one of eight universities selected for government funding to establish "Innovation Offices" with the aim to support researchers in their commercialisation efforts. One important finding from the Karolinska Institutet Intellectual Property Project is that 6.1 percent of the faculty had at least one invention in a study period of 15 years (Dahlborg, Lewensohn, and Sundberg 2013). This is well above the national Swedish average, which has been shown to be 4.1 percent (Lissoni *et al*. 2008). The two results are not directly comparable, since Lissoni *et al*. (2008) included only professors in their study, while Dahlborg *et al* (2013) include all levels of faculty.

Transfer of university innovation to industry. Swedish industry and universities have a strong tradition of collaboration and interaction. However, it is hard to find any direct measures of the amount of collaboration. A survey from 2018 from the Swedish governmental agency "Statistics Sweden" of innovation activities in Swedish enterprises that covers the period 2014–2016 shows that 46 percent of the enterprises conducted innovation activities (Statistics Sweden 2014-2016). Of those involved in activities in the areas of product and/or process, 29 percent cooperated with other organisations, of which 18 percent responded that they collaborate with a university or other higher education institution. The most common partners were suppliers, followed by customers or clients, which accounted for 80 percent and 68 percent, respectively (Statistics Sweden 2014-2016).

The CWTS Leiden Ranking offers insights into the scientific performance and proportion of industry collaboration of almost 1,000 major universities worldwide. In the 2018 ranking it can be concluded that of the top 20 countries with the highest proportion of university collaboration worldwide, five are Nordic (CWTS Leiden Ranking 2018). This can probably be explained by a tradition of strong university-industry linkages in the Nordic countries and a general need for collaboration since all Nordic countries are relatively small. Sweden has a large proportion of industry-owned academic patents (Thursby, Fuller, and Thursby 2009a, Lissoni *et al*. 2008; Lissoni *et al*. 2009).

Going back to KI, a study by Dahlborg *et al*. (2016) examined the transfer of academic patent ownership over time and showed that just above half of the patents were transferred to a small or medium sized company and only eight percent to large multinational companies. The University had ownership of about 12 percent. It was also shown that the ownership proportion of industrial actors of the studied patents increased over time, indicating an ongoing commercialization process and interaction with industry.

In contrast to KI, a different pattern was seen at LU, where large firms such as Ericsson and AstraZeneca rather than SMEs, were owners of a larger proportion of the academic patents (Göktepe 2008; Göktepe 2007). This also shows that the industry ownership distribution varies between universities within a country. Both technological and local environmental differences are likely to affect such differences. In this case, KI is a single-faculty university in the medical field and the presence of small SMEs mirror logic of the pharmaceutical industry, while LU is a multi-faculty university with many strong links with large multinational companies in the region.

The influence of IPR ownership on the volume of patenting. The volume of patenting and entrepreneurship from universities in Norway (Hvide and Jones 2018) and Finland (Ejermo and Toivanen 2018) before and after changing ownership policy has been compared. In Norway, a 50 percent decline in entrepreneurship and patenting is reported by Hvide and Jones (2018). The study furthermore shows a decline in quality, as the growth of university start-ups is decreased and patents are less cited after the reform. The Finnish transfer of IPR ownership rights to the universities was implemented after a pre-announcement period. If this period is included in the analysis, the drop in patent applications was 46 percent (Ejermo and Toivanen 2018) after 2007. This is in line with findings by Valentin and Jensen (2007) who show a significant reduction in the contribution of Danish academic inventors, combined with an increase of non-Danish academic inventors. Moreover, the contribution of university-generated patents that were transferred to companies decreased substantially (Valentin and Jensen 2007). There is, to our knowledge, no indication of a comparable decline in technology transfer in Sweden.

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Discussion. One of the parameters thought to most impact the success of technology transfer is the IPR ownership, with the underlying idea that university ownership would secure the necessary skills and funding. Interestingly, the recent study by Bengtsson (2017) indicates that technology transfer capacity (well-developed and funded technology transfer support system) has increased in all three Scandinavian countries during the period studied 2004-2013). The reported increase is seen

Table 1. Academic IPR Studies Exemplified

Country & University	Time Period Database	# Of University-Invented Patents	# Of University-Owned Patents	Author
Finland, All Universities	1986-2000 USPTO	530 Patents 285 Inventors	36	(Meyer 2003)
Norway, All Universities Colleges	1998-2000 (Norwegian Patents)	307 Patents	N/A	(Rapmund, Gulbrandsen, and Iversen 2005)
Sweden, Chalmers University Of Technology	1943-1994 Swedish Patents Or EPO	417 68 Inventors	N/A	(Wallmark 1997)
Sweden, Linköping University, Technical Faculties	1980-1996 (Swedish-PCT Filings FromEast Gothia)	88 (Swedish-PCT Filings From East Gothia) 82 Inventors	N/A	(Schild 1999)
Lund University	1990-2004 EPO	458 EPO-Patent 250 Inventors	1	(Göktepe 2008)
Sweden Karolinska Institutet	1995-2010 All Markets	703 Patent Families, 437 Inventors	82 (12%)	(Dahlborg, Lewensohn, and Sundberg 2013)

in Sweden as well as in Denmark and Norway, suggesting that increased technology transfer capacity does not appear to be dependent on ownership of the IPR and concludes that it may be related more to how the national and university-specific policies are designed, the nature of government funding, incentives and key performance indicators.

While the study by Bengtsson (2017) found that maintaining or abolishing researcher-owned IPR paradigm did not influence technology transfer capacity in the countries studied, recent striking and unexpected findings on its impact on innovation productivity were made by studying the situation in Finland (Ejermo and Toivanen 2018) and Norway (Hvide and Jones 2018). The immediate outcome of transferring the researcher-owned IPR to the universities in Denmark, Norway and Finland is opposite from what was expected by policymakers: a substantial decline in university-based technology transfer. Additional analysis is needed to understand the complex landscape of underlying reasons and mechanisms and possible ways forward. ■

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