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Free patent information as a resource for policy analysis

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Abstract

Patents are generally acknowledged as a rich yet little-used source of information. In recent years, several patent offices made some of their databases publicly available on the Internet. While most likely the promoters of free patent information on the Internet may have inventors as potential users in mind, free access to patents may also further the uptake of patent information by probably unintended user groups, such as researchers and policy analysts. This paper describes how one of the free online databases for patents, together with freely available electronic personnel registries of Finnish universities, can provide valuable data for use as a resource for policy-relevant analysis.

Keywords: Free patent information; Science and technology policy; University patents; USPTO database; Personnel registries; Finnish universities

1. Introduction

Patents are seen as a rich, but often insufficiently utilized source of technical information. Efforts have been undertaken to 'popularize' and promote the use of patent information. A central element of these activities was the launch of freely accessible databases on the Internet [1,2]. The extent to which esp@cenet® and comparative databanks have reached their target groups might be subject to debate (see, e.g., [3]). However, they may reach, probably without ever having intended, a rather esteemed group of novice users—consultants and policy analysts who deal with matters of science, technology, and innovation policy. It should be of interest to practitioners in the patent field how this group of mostly novice users may exploit free patent information on the Internet. This paper does not offer an overview of policy analyses based on free patent information but it presents a case study in which freely available patent data on the Internet served as the basis for the provision of data of relevance for policy-related analysis.

Patent information has been a tool for policy analysis for a long time. Van Steen notes that patents have been used as a science and technology policy indicator since the 1970s [4]. Scherer was the first renowned economist to use patent data [5]. Most notably, Pavitt used patents to establish a sectoral taxonomy of technical change [6,7]. These days, many researchers across the world apply patent data to economic analysis. For instance, earlier issues of World Patent Information included policy-related patent studies by Rozhkov and Ivantcheva [8] and Karki [9]. Francis Narin was the first to study patent data with bibliometric methods—see [10–17] for example. Narin's pioneering work on science–technology linkage has given rise to a considerable number of similar studies—see [18–21] for instance.

However, most of these studies relied on costly patent data. Free patent information broadens the use. This paper will introduce a case study that illustrates what type of analysis is possible free of charge these days. More specifically, it reports on a Finnish study that used only publicly accessible data. Free patent data play a crucial role in this research.

2. Case study: using free patent and personnel registry information to analyse patenting in Finnish universities

2.1. Rationale

This case is based on a patent database of 6800 Finnish US patents (1986–2000) as well as electronic personnel registries of the eight major universities of the

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country. If one analyses science and technology linkages, one relies not only on patent but usually also on scientific publication data. Unlike patent data which has become freely available on certain databases, information on scientific publications is still costly. Depending on the purpose of analysis, however, it is not always necessary to use scientific publication databases to investigate the science/technology linkage. For instance, we were interested in how science contributes to technological development. This question can be explored by using personnel registries of universities. In Finland these data are principally public information.

2.2. Sources and methods

One way of measuring direct connections between science and technology is to investigate which scientists apply for patents. For this type of analysis, not publication data but name lists of university researchers are needed, which in Finland is public information. We obtained electronic listings of the latter from all relevant institutions.

At the same time, we collected patent information using the USPTO online database. Fig. 1 illustrates the procedure. We searched for all patents that were either invented in or assigned to an organization or individual in Finland. The search identified about 6800 records at the time. For each of the records, we downloaded the screen dumps. Using another public-domain tool, the Bibexcel software package, we transformed the data into text fields suitable for further bibliometric analysis. [1]

Based on this data, we carried out matching procedures with Bibexcel. The results of these procedures were name matches which link inventor names in Finnish US patents with the listed names in personnel registries. We had to carry out validation procedures, contacting all potential inventors verifying if they are indeed the individuals who were listed on the patents. In about nine of ten cases, we managed to reach our potential inventors. A total of 655 matches were identified. Often academic inventors collaborated with their university colleagues. So the same patent can be invented by two or more university researchers. If one removes these 'doubles', 530 US patents remain which were invented by individuals working in Finnish universities. These 530 patents were invented by 292 inventors from twelve Finnish universities. Of these 292, seven inventors were working at two universities at the same time. Hence, the total number of inventors is 285. This documents a considerable direct and personal link between Finnish science and technology. Having compiled this type of data, further work concentrated on policy-oriented analysis.

The following section will give a brief overview of how one can use freely available information to identify differences in the specialization of universities with respect to producing patents, identify key inventors and firms that utilize the knowledge base offered by universities. The further analysis of patent data has also identified a significant number of unassigned patents that were co-invented by university researchers. The next paragraphs will present the data in more detail.

2.3. Detailed findings

This section will illustrate that:

- A small group of key inventors are responsible for a considerable share of the patents, i.e. only a small selection of university researchers do patent significantly.
- Inventive activity of researchers is concentrated on a few universities.
- Universities vary considerably in terms of the fields in which their researchers patent and the extent to which the researchers are involved in patenting at all.
- Most of the patents appear to be assigned to established firms and not to be exploited by start-up companies.

2.3.1. Distribution of patents and inventors across Finnish universities

Inventive activity among Finnish university researchers appears to be concentrated on key institutions and key individuals. As shown in Fig. 2, university-associated patents are concentrated on a very small number of institutions. Almost half of the 530 patents can be related to researchers working in only two of all twelve universities. About three quarters are associated with researchers in four universities.

In addition, inventiveness within the universities seems to be related to a relatively small number of researchers only. Fig. 3 shows the concentration of patents for a selected number of Finnish universities. The x-axis describes the accumulated percentage of inventors (in descending order) while the y-axis gives the accumulated percentage of patents. This way one can see how many percent of inventors invented a certain percentage of patents. For instance, for all the universities that are included in this study, one can say that the most active 10% of the inventors in Finnish universities account for more than a third of the university-related patents. About 20% of the inventors accounted for half of the university-related patents.

However, there are considerable differences between the universities. For instance, while the top 10% of the inventors at Oulu University account for more than 40%

[1] The software package was invented by Professor Olle Persson and can be downloaded at the following website: www.umu.se/inforsk.

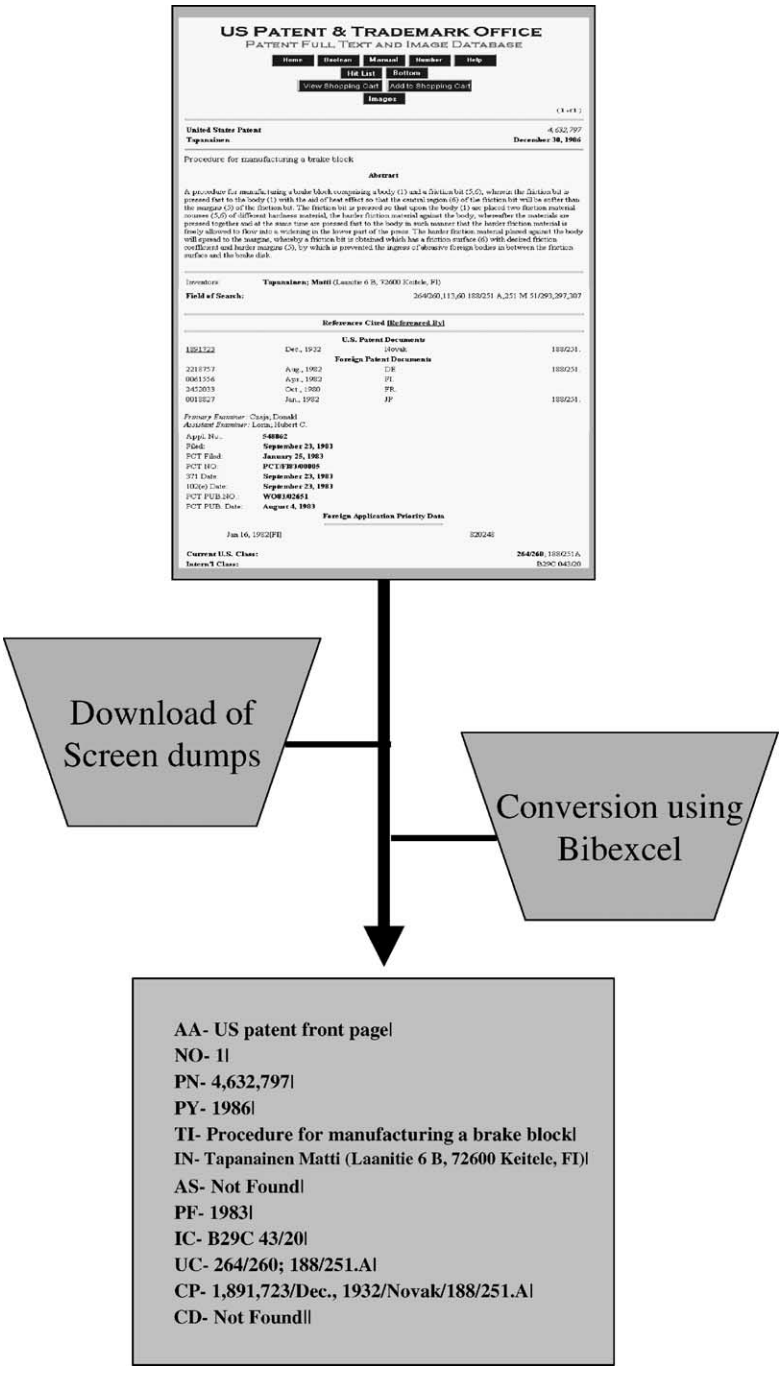

Fig. 1. Utilizing free patent information for bibliometric analysis.

of the patents associated with this university, the top 10% of inventors from Turku University accounted for a quarter of the patents.

2.3.2. Distribution by technological sectors

Telecommunications, instruments, and the life sciences are the areas that are related to university scientists the most. This section presents an overview of the university-related patents by technological sectors. For this purpose, all patents were categorized according a classification scheme that was originally developed by the Fraunhofer Institute in Karlsruhe and the French OST in collaboration with INPI. The scheme is based on the International Patent Classification and provides a more aggregated view of patenting by distinguishing thirty technological sectors. [2]

[2] For more detailed information on how the subclasses of the IPC are categorized in technological sectors, see [22].

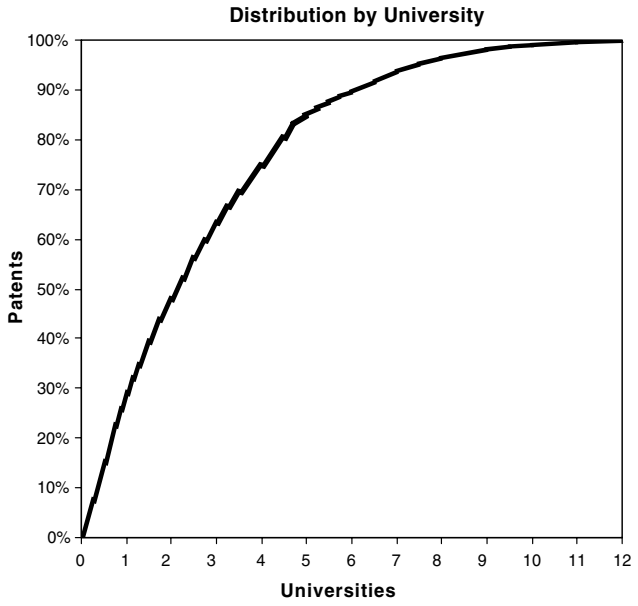

Fig. 2. Inventors and patents in Finnish universities.

Table 1 presents an overview of university-related patents by technological sector. Telecommunications and instrument-related patents are the largest of these thirty technological sectors, with more than 12% respectively. Pharmaceuticals/cosmetics and biotechnology each account for about 9–10% of the university-related patents. The next largest sector is organic, fine chemistry.

2.3.3. Technological profiles of Finnish universities

Finnish universities have different technological profiles. Table 2 provides an overview. The instrumentation-related sector of analysis, measurement, and control is an area where inventive activity is pursued at most of the institutions (nos. 1–6, 10–11). Telecommunications is a domain of applied research that can be related to the two large technical universities as well as a large technically oriented regional university (3, 8, 11) Telecommunications-related inventions play also a role at a smaller regional university (6). Three universities (2, 6, 10) have a strong focus on pharmaceuticals and cosmetics. Organic, fine chemistry is a sector of inventive activity that is prominent field of activity for researchers at five universities (2, 3, 6, 7, 11). Biotechnology patents were invented by researchers working in five universities (2, 6, 8–10). Medical engineering is an important field in 2, 5, 6, 10 and 11.

All in all, the previous examples have illustrated that Finnish universities have developed rather individual technological profiles. One is able to distinguish universities with a focus on life sciences from those that are more concentrated on process technologies and telecommunications.

2.3.4. Top assignees

Most of the university-related patents appear to be assigned to large companies. Table 3 lists the most frequent assignee firms for a selection of Finnish universities as well as for all university-related patents. Mostly large firms are engaged in patent-based collaboration with university researchers. Only in one university, start-up companies appear on the top ranks. A university licensing company is also strong in one instance. However, large firms appear to dominate the picture otherwise.

At the aggregate level for all universities, Nokia is the top assignee with 10.7% of the total amount of patents. Orion Corporation follows with 6.8% of all patents, closely followed by Valmet with 6.6%. The top three assignees account for a share of 24.1% compared to all patents.

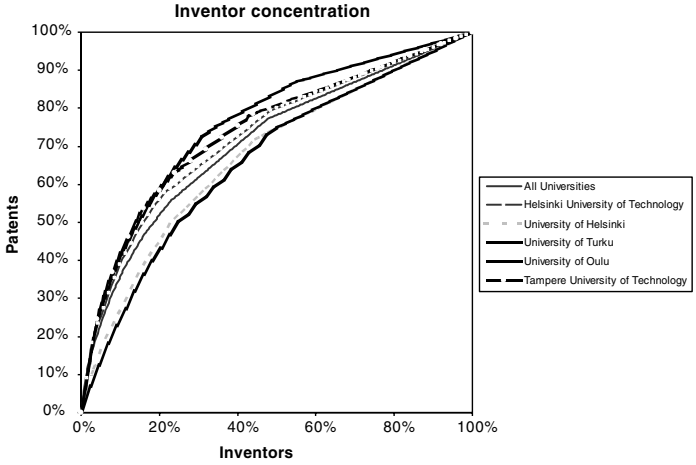

Fig. 3. Concentration of patents on key inventors at selected Finnish universities.

Table 1
University-related patents by technological sector

Technological area	Patents	%
Telecommunications	68	12.8
Analysis, measurement, control	66	12.5
Pharmaceuticals, cosmetics	51	9.6
Biotechnology	50	9.4
Organic, fine chemistry	43	8.1
Medical engineering	37	7.0
Material processing	32	6.0
Electrical devices—electrical engineering	23	4.3
Machine tools	20	3.8
Macromolecular chemistry, polymers	17	3.2
Handling, printing	14	2.6
Surfaces, coating	14	2.6
Information technology	12	2.3
Materials, metallurgy	12	2.3
Chemical industry and petrol industry, basic materials chemistry	11	2.1
Other (10 or less)	60	11.3
Total	530	100

2.3.5. Knowledge map

A map of interrelationships between the affiliation of the academic inventor and the organization to which the patent is assigned can provide a more comprehensive overview. Fig. 4 presents a map of 'knowledge flows' between the organization where the inventors are based and the assignee organizations that own patents. This map illustrates general connections between institutions. It is based on patent-based counts of linkages between inventor and assignee organization. The more patents can be attributed to a university the bigger its 'circle' in the map. The more patents an assignee owns related to university-associated inventors, the bigger the circle of this organization. The more counts of links between a university and an assignee organization the thicker the line that connects these two. However, one should be careful not to over-interpret circle sizes and the thickness of lines. Depending on how one defines the link (university–patent–assignee, as we did in the example, or university–inventor–assignee), the size of institutions can vary considerably on the map. For instance, a university can even catch up to another institution if not overtake it if one counts inventor–assignee links rather than patent–assignee links.

Therefore, the focus should not be on comparing size rather the connections. Here, the maps may be instructive to decision-makers in science, technology or innovation policy. For instance they can indicate where inventive activity of university researchers relates to large firms and where to start-up or spin-off companies. The map also illustrates a cluster of cooperating firms around a university.

2.3.6. Unassigned patents

The share of unassigned patents varies greatly from university to university. About 16.8% of all university-related patents are unassigned, i.e., these patents are owned by the individual inventors themselves. No firm or any other commercial or non-commercial organization has any property rights in the invention, as far as indicated on the granted US patents. This does not mean individual inventors have not licensed the patent to one or several companies for further utilization. However, the data shows where individuals own the patents and a corporate user of the inventions is not immediately visible.

There are considerable variations between the universities. There are a small number of universities with a few patents where all of them were assigned to a company or other organization. In other cases, however, a considerable number of patents are still owned by individual inventors (Fig. 4). In one instance, 45.5% of all patents that were associated with the university were not directly owned by a company. In three other cases, the rate was between a quarter to a third of all patents related to the respective universities. Table 4 provides an overview.

3. Conclusions and outlook

The case illustrated how free patent information can be used as a foundation for policy-related analysis. In summary, the data pointed to a number of interesting developments:

- Inventive activity among Finnish university researchers appears to be concentrated on key institutions and key individuals.
- Telecommunications, instruments, and the life sciences are the areas that are related to university scientists the most.
- Most of the university-related patents appear to be assigned to large companies.

Table 2
Technology profiles of twelve Finnish universities

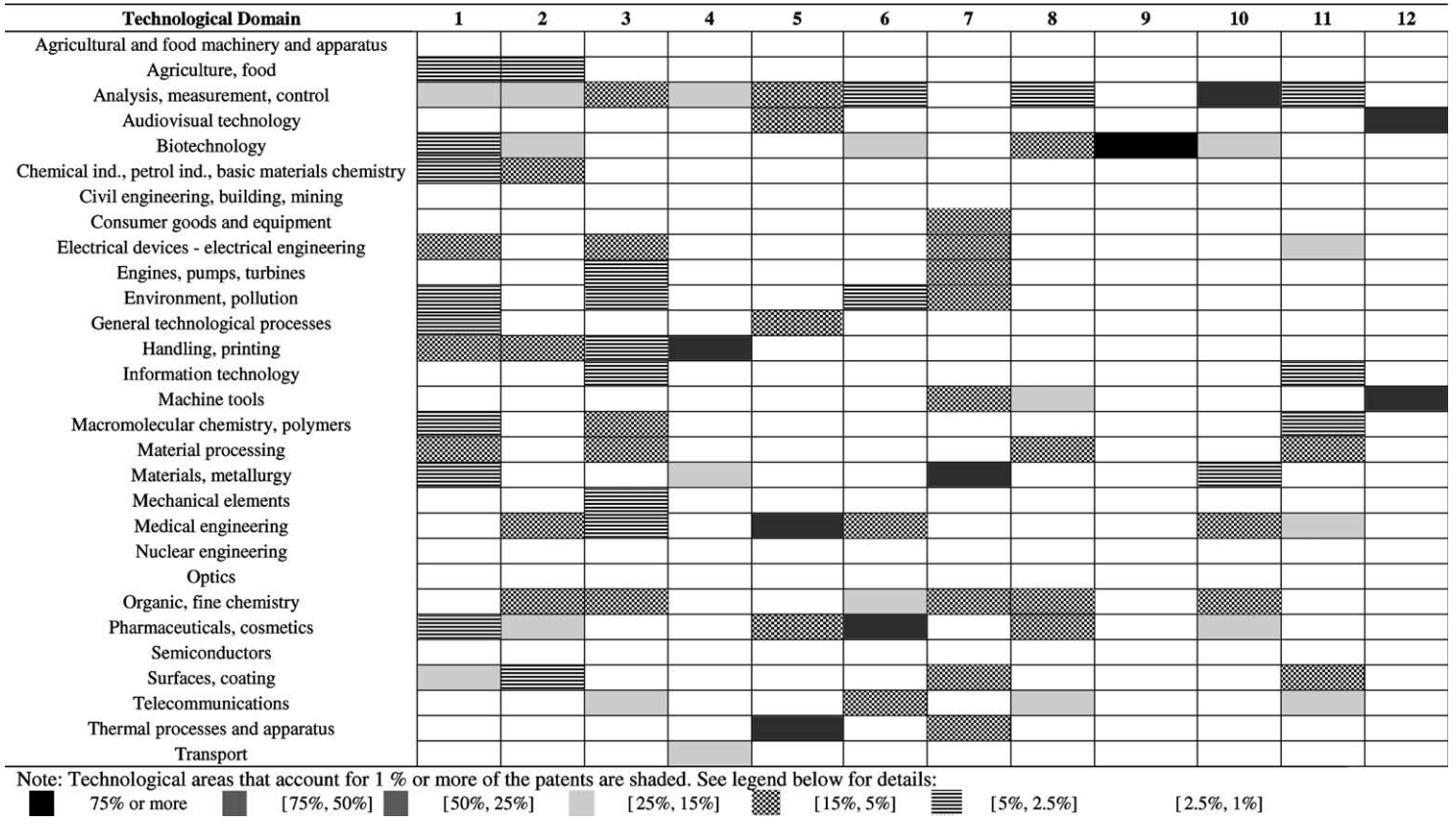

Table 3
Top three assignees for a selection of Finnish university patents

Universities	Top 3 assignee organizations (in alphabetical order)
1	Ahlstrom–Kone–Wartsila
2	Helsinki University Licensing–Orion–Soundek
3	Fortum–Instrumentarium–Nokia
6	Nokia–Orion–Valio
8	Nokia–Orion–Valmet
10	Leiras–Orion–Wallac
11	Biocon–Bionx Implants–Kone
All universities	Nokia (10.7%)–Orion (6.8%)–Valmet (6.6%)

Note: Unassigned patents owned by their individual inventors were not considered here.

- Finnish universities have different technological profiles.
- The share of unassigned patents varies greatly from university to university.

These are only a few initial findings that we have drawn from our database. However, even they are policy-relevant since they are related to a number of policy-relevant questions: Why is the concentration so strong on a small number of key universities and inventors? To what extent can these findings be related to the effectiveness of policy-measures? In which areas of technology can researchers make key contributions to technological development? Why do large firms feature so prominently among the assignees of university-related patents? Why are so many patents not assigned to a company at some universities? What is the extent to which they are utilized in start-up companies of academic entrepreneurs?

The patent data we presented thus raises a number of issues for further analysis. In this sense, free patent information can be seen as a resource that facilitates policy analysis.

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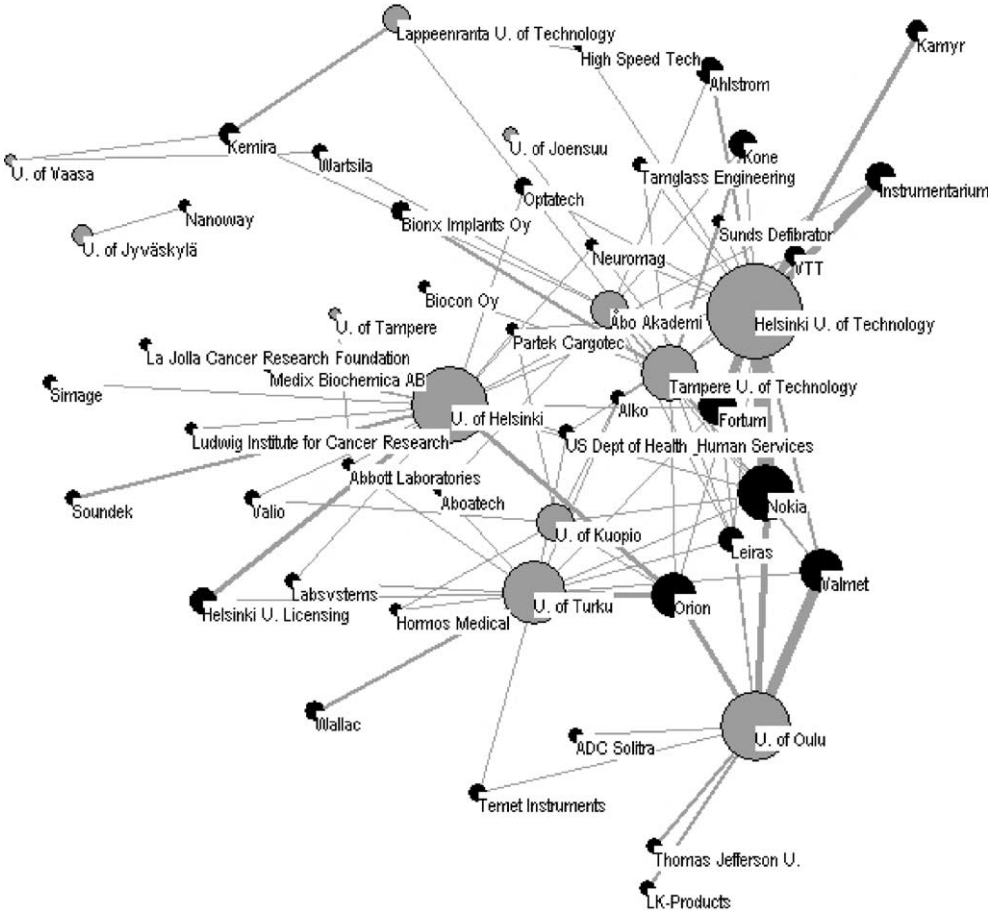
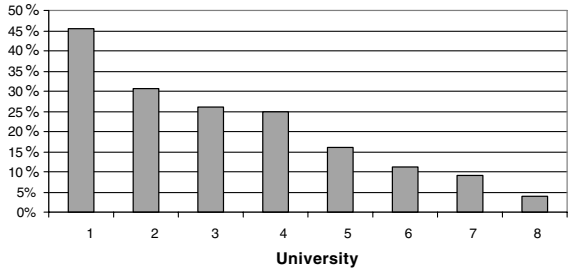


Fig. 4. A network view of university patent–assignee links.

Table 4
Share of unassigned patents by universities



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Appendix A. Finnish universities in this study

Code	University	Description
1	Åbo Akademi	Swedish-language university
2	Helsinki University	Largest Finnish university
3	Helsinki University of Technology	Largest institute of technology in Finland
4	Joensuu University	University in Eastern Finland
5	Jyväskylä University	University in Central Finland
6	Kuopio University	University in Eastern Finland
7	Lappeenranta University of Technology	Institute of technology in Eastern Finland
8	Oulu University	Large university in Northern Finland
9	Tampere University	University with a strong social-science focus
10	Turku University	Large university
11	Tampere University of Technology	Institute of technology
12	Vaasa University	University with a strong management focus

Note: Applies to Tables 2 and 3 only.

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