Chapter 1

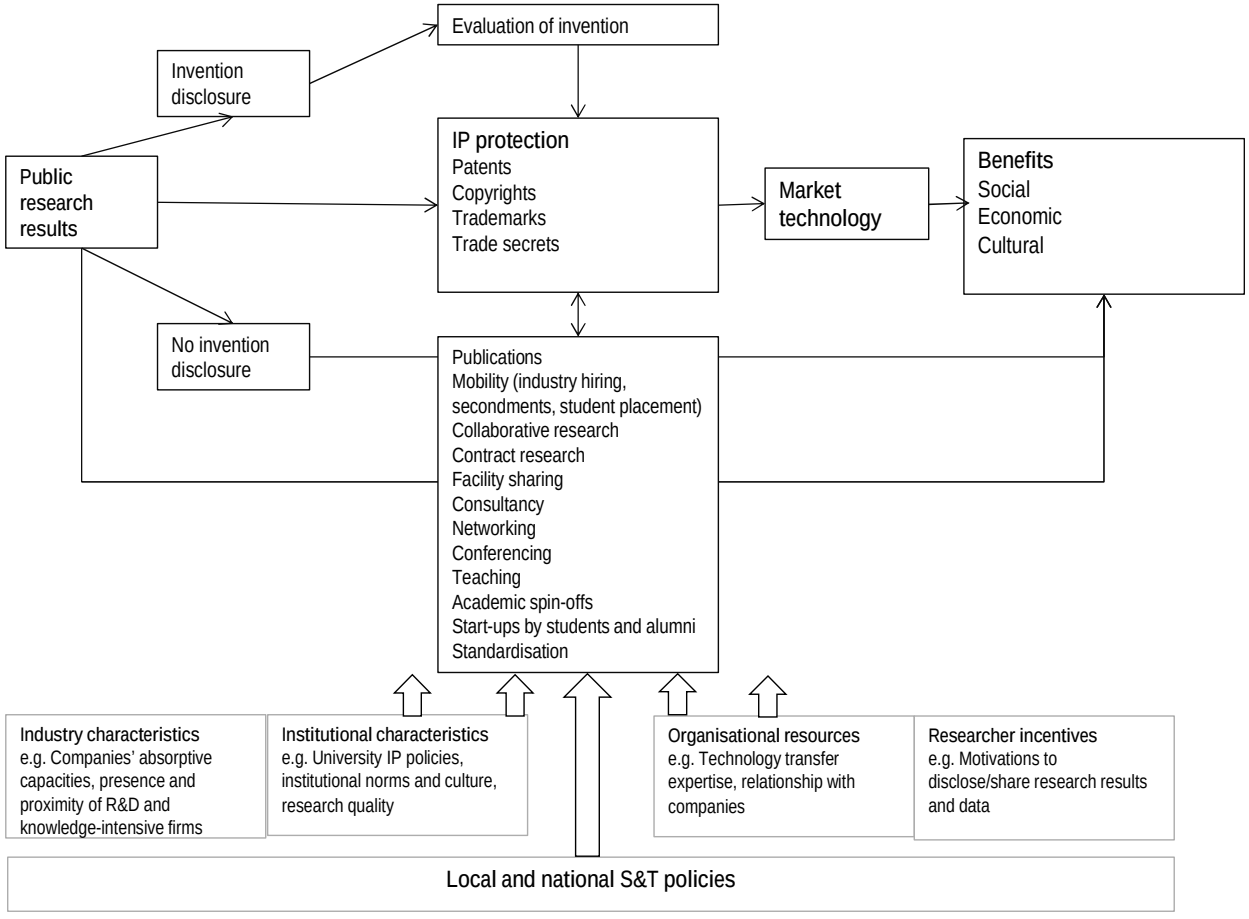
Knowledge transfer channels and the commercialisation of public research

This chapter describes the main channels of knowledge transfer and commercialisation and discusses their "relational intensity" (i.e. the degree of interaction between knowledge creators and receivers), their significance to industry, the type of knowledge involved, and their degree of formality. It shows that there are multiple ways in which public research knowledge can be transferred, exploited and commercialised that go beyond patents, licenses and spin-offs. For example, personal contacts and labour mobility are important channels for knowledge transfer and commercialisation.

Knowledge transfer and commercialisation of public research refer in a broader sense to the multiple ways in which knowledge from universities and public research institutions (PRIs) can be exploited by firms and researchers themselves so as to generate economic and social value and industrial development.[1] It is a multi-stage process involving different actors and a variety of channels (Figure 1.1). This understanding is in line with modern views of innovation as mostly interactive learning processes. It implies both the generation of new knowledge (i.e. supply of knowledge) and the integration of knowledge from external sources (i.e. demand for knowledge) (Brisson et al., 2010).

There are both structural factors and policy actions that characterise the structure of a country's or institution's system for the generation, transfer and commercialisation of knowledge. These range from funding structures and research activities to the institution's legal environment, the institutional setting, proximity to high-tech firms, the expertise and experience of intermediaries such as technology transfer offices (TTOs), and the presence of national and local science and technology (S&T) policies, among others.

Figure 1.1. Knowledge transfer and commercialisation system (simplified)



Typology of channels

There are many ways to characterise and categorise channels for knowledge transfer and commercialisation. Ponomariov and Boardman (2012) distinguish between four dimensions:

- **Extent of direct personal involvement (relational intensity).** Knowledge transfer tends to be associated with tacit and explicit knowledge. Tacit knowledge can be hardly codified and communicated. The transfer of knowledge requires close interaction between knowledge creators and users (i.e. researchers and/or industry). For example, a publication is associated with low relational intensity, while joint research would have a high relational intensity.
- **Significance to industry.** When seen from the perspective of industry, the relative importance of channels varies. Business surveys show that publications and collaborative research are rated highly significant, while patent and licensing-based channels are rated low.
- **Degree of knowledge finalisation.** Knowledge finalisation refers to the degree to which a research project provides a specific goal or can be contained in deliverables (e.g. contract research), as opposed to producing public sector knowledge and/or enlarging the stock of knowledge whose outcomes are difficult to measure/anticipate (e.g. conferencing).
- **Degree of formalisation.** Channels for knowledge transfer can be categorised as either informal channels – such as staff exchange or networks (involving tacit flows) – and formal channels that involve a contract between the public research organisation (PRO) and the firm, a license, a joint patent, or participation in a university spin-off. Channel formalisation refers to the extent to which the interaction is institutionalised and/or guided by formal rules and procedures.

Table 1.1 outlines the channels of transfer according to their relational intensity, industry significance, degree of finalisation and their formalisation. This differentiation is crucial as it provides policy makers with a more nuanced view of the diversity and the potential impact of knowledge transfer and commercialisation channels, and shows that there are multiple ways in which public research knowledge can be transferred, exploited and commercialised beyond patents, licenses and spin-offs.

It should be noted that knowledge transfer and commercialisation channels are not unidirectional. Channels often operate simultaneously or in a complementary fashion, underscoring the interaction between tacit and codified flows of knowledge as well as the multidirectional nature of flows. Knowledge flows not only from university to industry, but also in the other direction. For example, consulting services to industry may result in a more persistent and longer-term relationship between industry and science. This could lead to a longer-term collaboration in terms of ideas, funds, contract research and joint publications or joint patenting.

PROs exchange and use a variety of different forms of intellectual property rights (IPRs), not limited to patents but extending to copyrights and trade secrets. These other forms of IPRs have an important impact on how other channels, such as contract and collaborative research, operate and function. For example, most student start-ups are based on computer software or software-related inventions (e.g. mobile applications), which are copyright protected. In addition, an institution's ability to negotiate research and collaborative contracts with firms relies on IPR-related clauses in agreements (e.g. protection of proprietary data [trade secrets]). Hence, IPRs form the foundation ("grammar") on which other channels and modes of transfer and commercialisation function.

Table 1.1. Summary of selected knowledge transfer and commercialisation channels

Channels	Description	Characteristics			
		Degree of formalisation	Degree of finalisation	Relational intensity	Significance for industry
Publishing	Most traditional and widespread mode of transmission of knowledge; mostly limited to published papers	Low	High	Low	High
Conferencing, networking	Professional conferences, informal relations, casual contact and conversations are among the channels ranked as most important by industry; important across sectors	Low	Low	Medium	High
Collaborative research and research partnerships	Situations where scientists and private companies jointly commit resources and research efforts to projects; research carried out jointly and may be co-funded (in relation to contract research); great variations (individual or institutional level); these range from small-scale projects to strategic partnerships with multiple members and stakeholders (i.e. public-private partnerships [P/PPs])	Medium	Low	High	High
Contract research	Commissioned by a private firm to pursue a solution to a problem of interest; distinct from most types of consulting; involves creating new knowledge per the specifications or goals of client; usually more applied than collaborative research	High	High	High	High
Academic consulting	Research or advisory services provided by researchers to industry clients; most widespread activities – yet least institutionalised – in which industry and academics engage; three different types: research-, opportunity- and commercialisation-driven consulting; important to industry, which usually does not compromise university missions	Medium	High	High	High
Industry hiring, student placement	Major motivations for firms to engage in industry-science linkages with main benefit for universities; occurs through (e.g.) joint supervision of theses, internships, or collaborative research	Medium	Low	Medium	Medium
Patenting and Licensing	Ranked among the least important channels by both industry and researchers; substantial attention both in academic literature and among policy makers; little transfer of tacit knowledge	High	High	Low	Low
Public research spin-offs	Received substantial attention, although a rare form of "entrepreneurship" compared to alumni and student start-ups	High	High	Low	Low
Personnel exchanges/inter-sectoral mobility	May take many forms; usually university or industry researchers spending time in the alternate settings; most important form of "personnel mobility" is employment by industry	High	Low	Medium	Low
Standards (Box 1.1)	Documents based on various degrees of consensus; at least as important as patents as a knowledge transfer channel	High	High	Low	Medium

Source: Based on Ponomariov, B. and C. Boardman (2012), "Organizational behavior and human resources management for public to private knowledge transfer: An analytic review of the literature", *OECD Science, Technology and Industry Working Papers*, No. 2012/01, OECD Publishing, Paris; and adapted from Cohen, W.M., R.R. Nelson and J.P. Walsh (2002), "Links and impacts: The influence of public research on industrial R&D", *Management Science*, Vol. 48, pp. 1-23; Perkmann, M. and K. Walsh (2007), "University–industry relationships and open innovation: Towards a research agenda", *International Journal of Management Reviews*, Vol. 9, pp. 259-280 and others.

Box 1.1. Standards and standardisation as a knowledge transfer channel

At their root standards are documents, based on various degrees of consensus, that set forth rules, practices, metrics or conventions used in technology, trade and society at large (OECD, 2011). Standards can be categorised in many ways; the driving forces include network effects, switching costs, government policy and IPRs, as well as other environmental factors (Blind, 2004; Narayanan and Chen, 2012 for an overview). Even if they are developed for a single purpose, they often serve several.

The setting of standards is mainly the responsibility of different types of standard setting organisations (SSOs): industry bodies (private) and governmental (public) and non-profit technical bodies (hybrid) (Funk and Methe, 2001; Blind and Gauch, 2008). Governments can act as facilitators and co-ordinators while industry bodies must be supported by firms as well as by governments. Standards may be developed by technical experts working in government agencies, but in most cases governments adopt standards developed by industry bodies for reasons of expediency and because of a lack of technical expertise.

According to Blind and Gauch (2009), various standards along the innovation chain – such as terminology, measurement, testing and interface standards – can be identified as knowledge transfer channels. Depending on the current research stage, the standardisation activities are initiated by the various stakeholders involved – i.e. researchers in PROs in defining the terminology, and industry in the later phases of the technology development.

Anecdotal evidence based on survey data from German researchers working on nanotechnology suggests that technical standards are considered as important as patents as a transfer channel, while publications were ranked as the most important (Blind and Gauch, 2009). Adding to the complexity of standards and standardisation, there is also an interplay between standards and patents and between PROs, industry and government (Berger, Blind and Thumm, 2012). The phenomenon of patents in standards occurs in those areas where standards relate to innovative technologies, e.g. in ICTs. Patent pools may mitigate the potential conflicts between the different parties involved, as the example of the MP3 standard shows (Blind, 2003).

There are also interdisciplinary differences in the intensity of transfer and commercialisation channels used. Empirical evidence shows that patents and licensing, publications, industry hiring, students' placements, and contract research are the most important channels for R&D-intensive sectors such as biomedical and chemical engineering. Patenting and licensing are very important for researchers working in the material sciences, whereas these channels are less relevant for computer scientists. The most relevant channels in the social sciences and humanities are personal contacts and labour mobility (Bekkers and Bodas Freitas, 2008). As engineering sciences (or the so-called "transfer sciences" – i.e. computer, aeronautical, mechanical engineering) and the social sciences support gradual and tacit transformation due to the characteristics of knowledge in question, tensions over proprietary rights are expected to be weaker than in the sphere of natural and physical sciences.

The available evidence and data on knowledge transfer and commercialisation via different channels provide valuable information about the supply and demand of knowledge flows. Evidence on the amount and type (Chapter 2) is an important input when considering the rationales for government intervention or changes in policy approaches.

Note

1. Due to the breadth of knowledge channels, the text will refer to "knowledge transfer and commercialisation". In recent years the term "knowledge exchange" has emerged, and is sometimes used in preference to "transfer". Terms as "research mobilisation", "public engagement", "research utilisation", "valorisation activities" and "knowledge exploitation" have been used synonymously (Kitagawa and Lightowler, 2013).

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