B 2-1 Transfer of knowledge and technology

Transfer goals and problems

Knowledge and new technologies generated by the science sector are an essential source of job-creating innovations, economic growth, as well as societal and cultural developments.[92] If transfers are to succeed, findings need to be transmitted from research to a wide range of applications and then utilised economically or socio-culturally. The mechanisms of knowledge and technology transfer vary considerably in this context (cf. Box B 2-1-1).

However, different types of market failure are inherent in knowledge and technology transfer that justify state support for transfer and utilisation processes (cf. also Box B 2-1-1). Furthermore, the transfer is hampered by the fact that incentive systems and cultures differ between research institutions and knowledge users. While in science success is measured primarily according to whether a finding is really new and publishable, society's interest lies in using this knowledge for the benefit of the general public. The criteria that are decisive for knowledge users are often not so much novelty, but, for example, practical applicability, reliability and the cost of use.

Particularly serious problems occur when knowledge is transferred to the economy. Companies involved in transfer aim to generate economic returns by applying the knowledge. In the science system, by contrast, there are often still reservations against the economic exploitation of research results. The 'culture of commercialising knowledge' at universities and non-university research organisations is often poorly developed, or else existing structures – for example transfer offices or patent utilisation agencies – have not yet been correspondingly professionalised. This requires setting up corresponding framework conditions and taking targeted measures (such as start-up funding) to intervene.

Measures and general framework

Various measures have been introduced to overcome market failures and support cultural change in the academic field, combined with a professionalisation of commercialisation processes.[93] In this context, different phases and mechanisms are used in the transfer and commercialisation process, and different actors in science and business are targeted (cf. Infochart at the beginning of the chapter on selected measures and initiatives over the last decade). The BMBF (Federal Ministry for Education and Research) focuses in particular on transfer processes involving tertiary education institutions, universities of applied sciences and non-university research organisations; the BMWi (Federal Ministry for Economic Affairs and Energy) concentrates on transfers to SMEs, commercialisation management and start-up activities in science.

The innovation and commercialisation efforts of universities and universities of applied sciences are comprehensively supported by the BMBF programmes 'Innovative University'[94] and 'Research at Universities of Applied Sciences'. In addition to these measures by the Federal Government, institutional promotion of non-university research organisations by Federal and Länder funds encourages the transfer of knowledge and technologies, inter alia by appropriate structures to promote commercialisation and spin-offs.[95] Furthermore, the agreements between the Federal Government and the science and research organisations in the context of the continuation of the Pact for Research and Innovation allow for a stronger role for knowledge transfer by 2020.[96]

The BMWi programme called 'EXIST – University-Based Business Start-Ups' offers comprehensive support for start-up activities at research institutions

Box B 2-1-1

Mechanisms and problems of knowledge and technology transfer

The transfer of knowledge and new technologies from science to economic and socio-cultural applications takes place via various mechanisms. These can involve considerable uncertainty and market failures, making the transfer difficult or even preventing it.[97]

Start-ups:
Start-ups are a direct way of transferring findings from research to commercial application. However, there is great uncertainty as to whether a finding is practically applicable, whether it is marketable at all, and ultimately whether there is market demand. This uncertainty leads to substantial financial risks for the founders, as well as for the venture-capital investors that finance such type of start-up.

Exploitation of property rights:
New knowledge and technologies can be protected by patents. These rights can be commercialized in different ways; however, to do so involves search and transaction costs as well as considerable uncertainty with respect to usability due to information asymmetries between the parties involved in commercializing the patent.

Research collaborations:
Research collaborations enable research institutions and companies to work together on a research topic and to benefit from knowledge externalities. Ideally, the findings and the economic exploitation are shared. Information asymmetries can lead to coordination problems with respect to the identification and selection of suitable partners and to jointly exploiting research results.

Contract research:
Contract research enables companies to use the expertise and infrastructure of research institutions to obtain research results for specific problems.

Scientific exchange:
A direct transfer of knowledge takes place via scientific publications, congresses and informal contacts. Transfer problems occur when the corresponding recipients are unable to understand and process the knowledge.

Education and training:
Tertiary education institutions and non-university research organisations are important training centres for scientific, technical and creative staff that transfers new research and methodological knowledge into companies or finds employment there.

and is attempting to establish a start-up culture.[98] The BMBF's measure entitled 'Validation of the Technological and Societal Innovative Potential of Scientific Research – VIP+', which provides funds for the transition from the orientation phase to the utilisation phase, is meant to reduce uncertainty regarding the potential commercialisation of scientific findings. To support the reduction of information asymmetries, a variety of measures have been introduced, for example the BMBF's funding initiative called 'Research Campus – Public-Private Partnership for Innovation'. Science and business cooperate here 'under a shared roof' and 'on an equal footing' in research, development and innovation, and jointly develop utilisation strategies. The BMWi has bundled several measures under the title 'Transfer of Knowledge and Technology through Patents and Standards (WIPANO)' with the aim of encouraging and facilitating the codification and commercialisation of research results.[99]

The legal framework plays an important role in the success of a transfer. It is especially important for an accelerated exchange of knowledge when it comes to initiating or further strengthening the targeted cultural change among all participants. A legal paradigm shift to this effect took place in 2002 with the abolition of the 'university lecturers' privilege' in the course of the amendment to section 42 of the Employee Inventions Act (Arbeitnehmererfindungsgesetz, ArbErfG). As a result, the rights to commercialise inventions passed from the professors to the tertiary education institutions.

A further improvement in the framework conditions governing the transfer of knowledge could be achieved by introducing a grace period[100] in patent law. Such a regulation could make it easier for scientists to mitigate conflicting goals relating, on the one hand, to the reputation-based publication of new knowledge and, on the other, to the commercialisa-

tion of these findings. International experience with a grace period indicates that such a scheme has a predominantly positive effect on scientists' freedom of action. At the same time, the intellectual property rights of established actors in the business sector can be adequately protected.[101]

In 2016, the BMBF presented an open-access strategy. This provides for an open-access clause for all projects funded by the BMBF. As a result, research findings are to be published in a way that is freely accessible.[102] Furthermore, in the past the Commission of Experts has called for the introduction of a general exemption from copyright for scientific and education purposes.[103] Such a measure was included in the coalition agreement for the current legislative period. Both measures can lead to an improved circulation of knowledge and current research findings both inside and outside the science system.

Impact and effectiveness of policy measures

The list of measures in the field of knowledge and technology transfer has been further developed and expanded over the past ten to fifteen years (cf. Infochart at the beginning of this chapter), and evaluation studies are available for some of these measures.[104] Up to now, not all the measures carried out in the field of knowledge and technology transfer have been evaluated in a way that is in line with scientific standards, e.g. with the aid of control groups. Reliable statements on their effectiveness and efficiency are therefore only possible to a limited extent.

Conclusions can be drawn, for example, from the evaluations on the introduction of the 'Research Campus' and the abolition of the university lecturers' privilege. The evaluation of the 'Research Campus' confirms that having companies and research institutions operating under one roof has positive regional economic effects, establishes and strengthens research collaborations, and benefits young scientists.[105] However, long-term effects cannot yet be assessed.

Various studies show that the abolition of the university lecturers' privilege in 2002 led to a significant decrease in the patenting activities of scientists at German tertiary education institutions.[106] The new regulation has not yet had the desired success.

In view of the wide range of funding measures in the field of knowledge and technology transfer, the term 'subsidy jungle' has come up – at least from the point of view of the target groups.[107] However, closer inspection shows that there is very little redundancy in funding.[108] Only in a few cases has the funding portfolio been adjusted and consolidated. Overall, a closer examination of the different mechanisms and phases of knowledge and technology transfer reveals a consistent mix of instruments.

Yet there is still little involvement in the funding programmes on the part of the sciences that are not patent-relevant. At present, it is still too early to conclude whether the current measures, e.g. 'VIP+', which also attribute a greater role to knowledge transfer, will lead to a corresponding interest and increased participation from the humanities and social sciences.[109]