BOX 03

Impact of the Technische Universität Berlin on the city's economy

A recent study[10] estimates the direct, indirect and induced effects of the entire expenditure of the Technische Universität Berlin (about 370 million euros) on the Berlin economy. The result is that the overall financial impact is considerably greater than the annual expenditure of the TU Berlin and in particular more than the funds that Land Berlin provides as basic funding (some 275 million euros in 2006). In all, there is additional annual value-creation of about 550 million euros, and furthermore demand effects of about 450 million euros are generated in Berlin, more than 11 500 jobs are created or secured in the region, and almost 21.5 million euros tax receipts are generated for Berlin.

At the same time the venture capital sector should be provided with sound framework conditions which would make it internationally competitive – to the benefit of German businesses and their innovative potential.

This is particularly important because other countries are continuing to make progress. In the annual benchmark study of the European Private Equity & Venture Capital Association (EVCA),[11] Germany fell back further in 2008 and is now only ranked 22nd in its list of 27 countries, two places down on the previous year.

The tax system must offer businesses in Germany with better conditions for research and innovation. Without the necessary reorientation, the tax system will counteract the efforts of direct and indirect support and lead to a waste of funds.

B 2 THE SCIENCE EMPLOYMENT MARKET

Lost opportunities due to inadequate investment in research and development

It is now almost a cliché that investments in research and innovation pay off. But they can also be of benefit for the development of the entire region, as is shown by the example of the Technical University Berlin (Box 03). Its importance for the Berlin region is based on a number of effects. Firstly, as a teaching institution it contributes to the education of human resources in the region. Human capital is important for businesses in the region – whether for new enterprises, spin-offs or the development of local businesses. Universities and research institutions also boost demand for goods, services and personnel and thus promote growth. More difficult to measure, but no less important, are the "soft" location factors generated by the image effect of universities and research institutions. The debate about the Creative Class (Box 04) has shown how important a creative climate can be when it comes to attracting "Talents". Universities and research institutions are therefore extremely important for the scientific and economic development of regions and countries.

This only makes it all the more regrettable that Germany invests less in research and development than other countries. The level of three percent of GDP remains an objective, but it will not be reached in the near future.

No strengthening of innovative potential without an educational offensive

Germany needs both finances and well trained personnel. The shortage of academics is already apparent and it will grow worse – in relative and absolute numbers. It is estimated that by 2020 the demand for graduates could exceed the numbers available by well over a million (Fig. 01).[12] This is due above all to the fact that a well-trained and numerically strong generation will be gradually reaching retirement age over the coming years. The labour force potential will sink so much that even immigration and increasing numbers of women in employment will not be able to compensate fully for this demographic effect.[13]

Germany is not a special case here. In the USA, Japan, and other European countries the demand for highly-qualified professionals[14] has risen disproportionately. Between 1997 and 2007, the growth in employment of graduates in general and natural scientists and engineers in particular has been above the German level almost throughout the remaining EU-15 countries.[15]

Against this background there is little cause for optimism. The proportion of school-leavers who are qualified for higher education has been rising much slower since the 1990s and the long-term rise in the rate of higher education enrolments has been restricted since 2003. It is only recently that Germany has shown small signs of progress. The rates of enrolment in higher education rose between 2006 and 2007 and reached a peak in 2008. However, it is too early to interpret this as a turnaround, because the shortening of upper secondary education by one year is leading to double cohorts in various places as this is introduced. The international comparison also shows that the proportion of German students accessing tertiary education is below the OECD average and there has been a trend for this gap to increase considerably since 1995.[16] In contrast, the proportion of students failing to graduate is declining and is below the OECD average.[17] But at 21 percent it is still high and the student potential is not being exploited to the full.[18] Problematic are the particularly high 30 percent drop out rates in natural sciences and engineering and the increasing numbers of drop-outs in physics, computer sciences, mechanical engineering, electrical engineering, chemistry, and mathematics.[19]

It is pleasing that the numbers of first degree graduates in Germany reached a new high in 2006 of almost 221 000, which is an increase of nearly 30 percent since 2001. However, an international comparison in this case shows once again that despite the increase in the proportion of graduates, Germany is still lagging behind OECD countries such as Finland, Sweden or Switzerland.[20]

In order to meet the future needs for replacement graduates in Germany, at least 35 percent of a cohort would have to obtain a higher education degree. Taking dropout rates into account, this would mean that 40 percent of a cohort would have to enrol for higher education, and at least 50 percent of each cohort would need to qualify for tertiary education, given that not all school-leavers will go on to higher education.[21] Already today it is an ambitious target to want to replace the highly-qualified professionals who will be retiring from the employment market in the near future. The imminent additional need for graduates calls for corresponding efforts from policy-makers. There are likely to be shortages in particular in economics and the social sciences, followed by the educational sciences, teaching, and engineering.[23] The lowest need for expansion is in agriculture, forestry and food sciences, in architecture, and in civil engineering.[24]

If Germany wishes to strengthen its potential for innovation, the education system must necessarily be expanded and improved. This will have to include better tutor-student provisions and better teaching, as well as increased investments in further education.

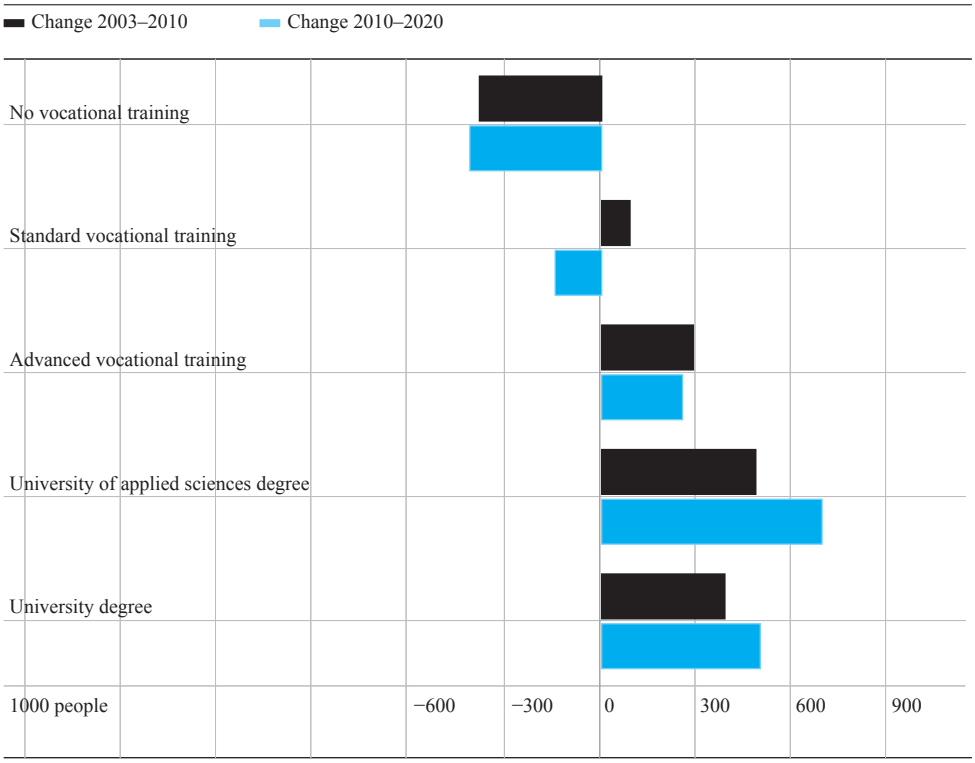
Creative Class BOX 04

The scientific and political debate about the creative class has its origins in a publication by the urban planner Richard Florida "The Rise of the Creative Class".[22] According to Florida, the creative people in a society and the innovations they generate are essential for the economic growth of regions. He claims that societies have a particularly promising future if the "creative class" is able to transfer existing knowledge into new, competitive products and services. An environment in which this creative class can thrive is characterised by the three "Ts": Talent, Technology and Tolerance. Florida's idea has influenced regional development strategies world-wide, and these now address the promotion of the three T-factors. However, there is still disagreement about whether investments intended to serve the public's quality of life (such as inter-cultural meeting centres, parks and museums), do actually generate innovations and economic growth.
There are also disputes about whether it is acceptable and legitimate to concentrate public investments on attracting intellectual elites and in turn then to reduce expenditure in social sectors and for "classic" economic support.

The time is running out: Germany needs an active immigration policy for highly-qualified professionals

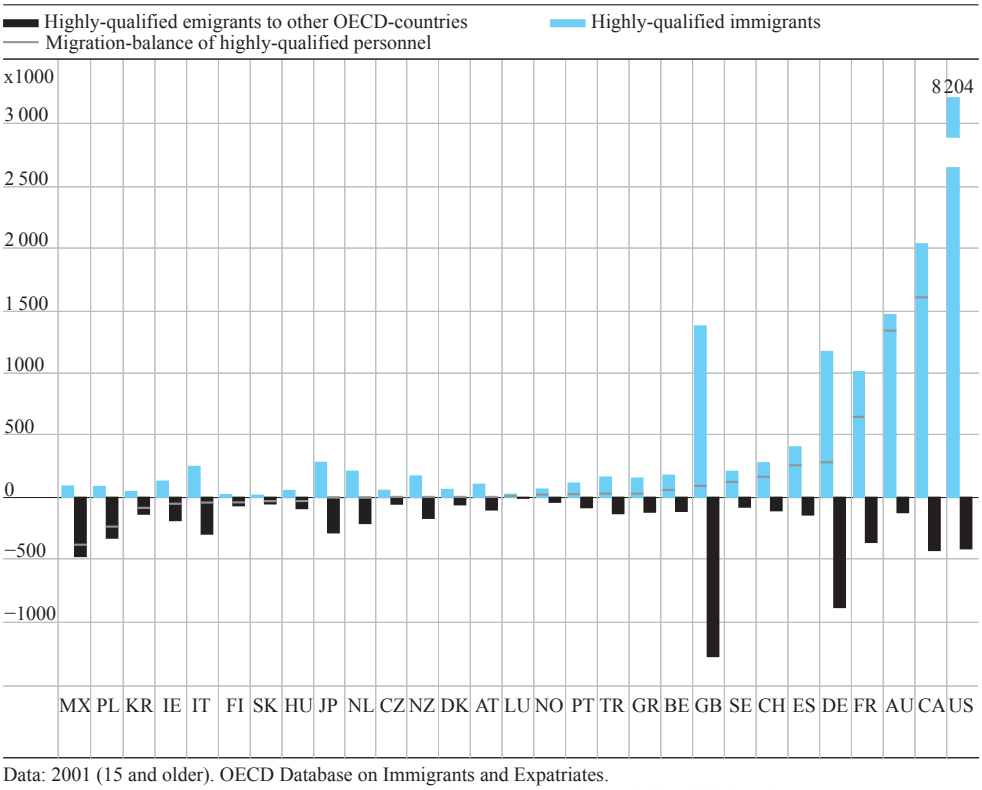
Like most OECD countries, Germany attracts more highly-qualified professionals than it loses (Fig. 02). But Germany has one of the highest numbers of emigrating highly-qualified professionals OECD-

ABB 01 **Demand for personnel in Germany according to level of qualification 2003–2020**



Source: Bonin et al. (2007: 81).

ABB 02 **Highly-qualified immigrants and emigrants for OECD countries**



Data: 2001 (15 and older). OECD Database on Immigrants and Expatriates.
Source: OECD (2008b): The Global Competition for Talent: Mobility of the Highly Skilled, Paris.

BOX 05

Immigration conditions for highly-qualified professionals in Germany

According to the Immigration Act of 2005, specialists and managers with special professional experience from non-EU states could only receive an unlimited visa to stay in Germany if they earn at least twice the limit for payments to the statutory health insurance system – currently 86 400 euros per annum. This income limit has recently been lowered by the Federal Government in the Labour Migration Control Act to the limit level for general pension contributions (West). Since January 2009, this has been 64 800 euros. The average gross salary of a graduate in Germany is 50 700 euros, so that this reduction has hardly affected the restrictive access to the labour market. If the income is below the limit, then the Federal Employment Agency (BA) can judge whether to grant a work permit, but priority must be given to domestic candidates for the position.
Since January 2009, this situation has been improved for non-EU foreigners who have completed their studies in Germany, who no longer have to submit to the BA priority examination.[25]

wide and one of the lowest numbers of highly-qualified immigrants.[26] The most important OECD destinations for highly-qualified professionals are the USA, which attracts some 45 percent of highly-qualified professional immigrants worldwide, ahead of Canada (11 percent), and Australia (8 percent). In contrast, only approx. 6 percent come to Germany, which is also low in comparison with other European countries such as Great Britain (nearly 8 percent – Fig. 03).[27]

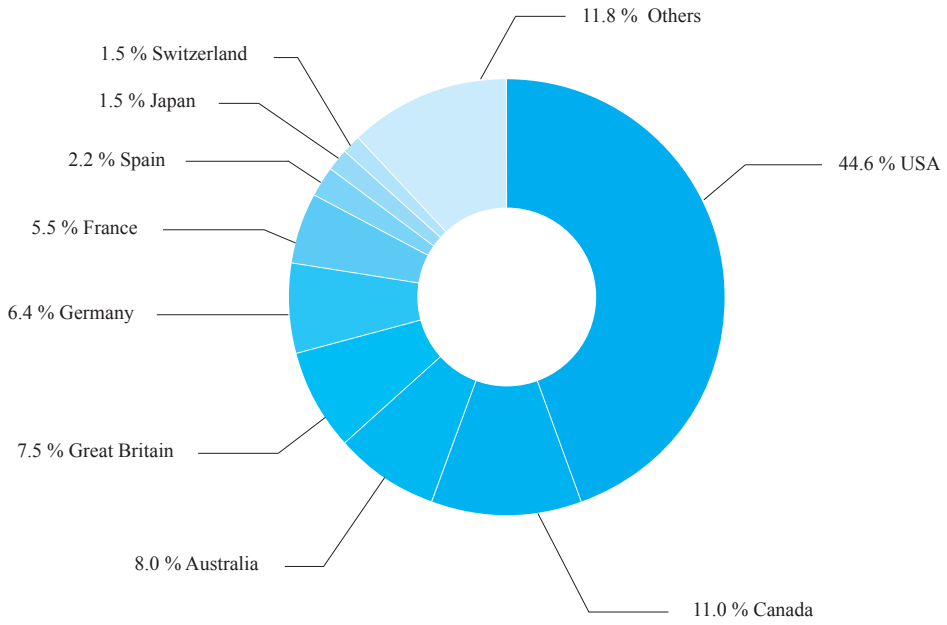
But there are signs of success. The number of graduates from other countries in 2006 rose once again to about 20 000, which is more than double the figure in 2000. A third of these students come Asia and Eastern Europe and the majority obtain their first degree in Germany, above-average numbers in the natural sciences and engineering.

If it could be ensured that foreign scientists who graduated in Germany would also have career prospects here, this would be an important contribution to meeting the demands for qualified personnel[28] in Germany.[29] This was not the case in the past.

Germany needs an immigration and science policy which is aimed at attracting qualified personnel from abroad. Within the EU, the free labour movement is guaranteed and the exceptions which have restricted the entry of job seekers from Estonia, Latvia, Lithuania, Poland, Slovakia, the Czech Republic, Hungary, Bulgaria, and Romania, have no longer been in force since January 2009.[30] However, the majority of migrants to Germany come from countries outside the European Union – and the proportion will continue to increase in future. Previously, the access to the German labour market was extremely difficult for academics from countries outside the EU due to the high income threshold and the priority examination of the Bundesagentur für Arbeit (Box 05). The underlying logic was the wish to avoid displacement effects on the job market due to foreign employees. However, because highly-qualified foreigners can also increase productivity and create jobs, the German immigration policies sacrifice important potential here.

Other countries have policies aimed at actively attracting skilled and qualified immigrants, and they are successful with this. The assessment of prospective immigrants on the basis of a points system like those used by Australia and Canada is a practical and tested instrument which raises the qualification levels of immigrants, reduces their risk of unemployment, and also reduces possible negative effects on the labour market, or reductions in the income for the local population. By systematic monitoring, the immigration criteria can continuously be adapted to current requirements.[31] The positive effects of such policies are also highlighted by recent findings which indicate that the productivity of regions and their rate of investments increase with the degree of cultural diversity, and particularly so if the immigrants have a high level of qualification.[32] In addition to the recruitment of highly-qualified professionals from other countries, Germany should also try to hold on to its own talent, or to persuade them to come back. Because here too important potential remains unexploited. Germans living in other countries and emigrating Germans have above-average qualifications.[33] The labour mobility of those with higher levels of education will presumably continue to increase, but this does not represent a brain drain. Graduates do not usually emigrate permanently, and most find their way back to Germany.[34]

ABB 03 **OECD-target countries for highly-skilled migrants**



Data: 2001 (15 years and older). OECD Database on Immigrants and Expatriates.
Source: OECD (2008b): The Global Competition for Talent: Mobility of the Highly Skilled, Paris.

A study of young scientists in the USA in 2001 found 5 000 to 6 000 German scientists in the USA, which would represent an immigration of about 14 percent.[35] Compared with the brain drain of some Asian and Latin American countries in the direction of the USA, this is a modest percentage, which is sometimes overlooked in the political debate. And since they return enriched by international contacts and their experience, the mobility of German academics is generally to be welcomed. Nevertheless, as a rule it is the most successful German scientists who receive the grants which enable them to go to the USA. And of these, the most successful obtain an attractive position on their return as an assistant professor with tenure track (Box 06). In addition, the young scientists who go to the USA have research interests in future-oriented sectors and interdisciplinary fields of application (such as molecular genetics, biophysics, bio-process technology, bio-informatics, neuro-sciences, or medical imaging systems). In the structurally conservative German science system they see few opportunities for development.[36]

The setting must be right: No improvements possible without an attractive science labour market

For this reason, Germany needs to provide attractive conditions for the science employment market. A survey of German scientists in other countries and foreign scientists in Germany shows what these might look like.[37] Important factors are the scientific standing, the graduate employment market, and the working conditions for professional scientists.

German science and research have a good standing in an international comparison, and in particular within Europe. This image is mainly determined by non-university research. The universities are rated as good in general, but the leading universities are given rather weak ratings – above all in comparison with the USA and Great Britain.[38]

The respondents see in particular the German university academic job market as rigid and restrictive. They criticise the shortages of personnel, the inadequate employment opportunities, the strict acceptance requirements, the inflexible career structures in the public sector, and the rigid adherence to staffing plans. University administrations and institute committees

BOX 06

Tenure Track

The tenure track relates to a teaching or research position, such as a junior professorship at a college or university, that can lead to a tenured position. However, the universities have so far been slow to adopt this. A study has shown that only 18 percent of junior professors are offered tenure and the criteria for a successful evaluation are frequently felt to lack transparency.[39]

are hardly in a position to make job offers to leading scientists in a non-bureaucratic fashion.

Unattractive for German respondents in other countries are also the provisions for access to academic careers, career planning, and further professional development possibilities. The procedures for working together in German institutions are quite unattractive. The lack of cooperative decision-making structures and of interdisciplinary cooperation are criticised particularly frequently. Foreign scientists in Germany, in contrast, criticise the difficulties in accessing research funding. They point out the need for investments in innovative areas of knowledge and in the research infrastructure for all sub-disciplines which require expensive apparatus. They also feel it is necessary to intensify international cooperation.

In addition, 80 percent of married German scientists working in foreign countries make their decision to return to Germany dependent on their partner also receiving a satisfactory job offer.[40] In an international comparison, German research institutions are very reticent in this respect and rarely create satisfactory working and living conditions for the families of the researcher, for example with Dual-Career programmes.

Some of these points have already been picked up on by political initiatives and projects. Career promotion was strengthened by the Federal Ministry of Education and Research and other institutions by means of independent young researcher groups and junior professorships (Box 07). In addition, post-graduates can work on research programmes in so-called post-graduate schools, with the support of a number of university teachers. The new "Strategy for Modern Departmental Research" also envisages a more active role for Federal Government department research institutions in the encouragement of young scientists.

Internationally attractive programmes include the "PhD-Net" of DAAD, which intensifies the cooperation of German universities with foreign universities and research institutions. The professorships funded by the Alexander von Humboldt Foundation make it possible for universities and research institutions to recruit up to ten leading foreign scientists from all disciplines every year.

In the framework of a Joint Initiative on Research and Innovation, the Federal Government and the *laender* have undertaken to make strenuous efforts to give financial planning security to the science and research organisations[41] and to increase the annual allocations by at least 3 percent by 2010. The agreement is intended to ensure that it will then be possible to enrol at least 90 000 additional students at the institutions of higher education and to provide funds for more young researchers. The Excellence Initiative also provides universities and research institutions with additional funds for young scientists. So far, 39 post-graduate schools have been supported with a million euros annually. In addition funding was provided for junior professorships and independent young researcher groups.

BOX 07

Junior professors and heads of young researcher groups

In 2002, junior professorships were introduced in Germany. Since the mid-1990s, research funders and non-universities institutions have been appointing heads of groups of young researchers. The aim was to develop alternatives to the conventional route to a Chair. Junior professors and independent heads of young research groups must have completed a doctorate, and these positions offer promising young scientists an opportunity at an early stage in their career with more scope to assume responsibility.
Independent groups of young researchers are now receiving funds from DFG (Emmy-Noether Programme) and from the Volkswagen Foundation (Schumpeter Fellowships). The Max Planck Society has also set up independent groups for young researchers.

BOX 08

"Initiative Freedom of Science Law"

In Summer 2008, the Federal Government agreed on the key points on the "Initiative Freedom of Science Law". Non-university research institutions should be allowed steadily increasing scope for the management of their own finances, including the sections personnel, cooperation, construction, and contracting. Increased flexibility has been provided in the 2009 budget by the allocation of funds for self-management, and which therefore do not have to spent within the financial year, as well as extending the spread of funds to cover personnel, fixed assets and investments. The more flexible funding framework, the elimination of the requirements for approval in the so-called "W"-payment principles for professors, together with improvements to the appointment conditions are intended to allow institutions to make more attractive offers to scientists. Further measures are aimed at improving the networking between science and business, and the acceleration of construction projects and the acquisition of goods and services. The measures came into force in the 2009 budget year, and will be tested before being finally formulated in legislation. The recent debate about the Second Recovery Package of the Federal Government has once again highlighted the effects of the various degrees of freedom of research institutions with respect to construction and maintenance work. Private educational institutions are much more flexible than public in-stitutions when it comes to awarding such contracts, and they will probably spend the available funds much more quickly.

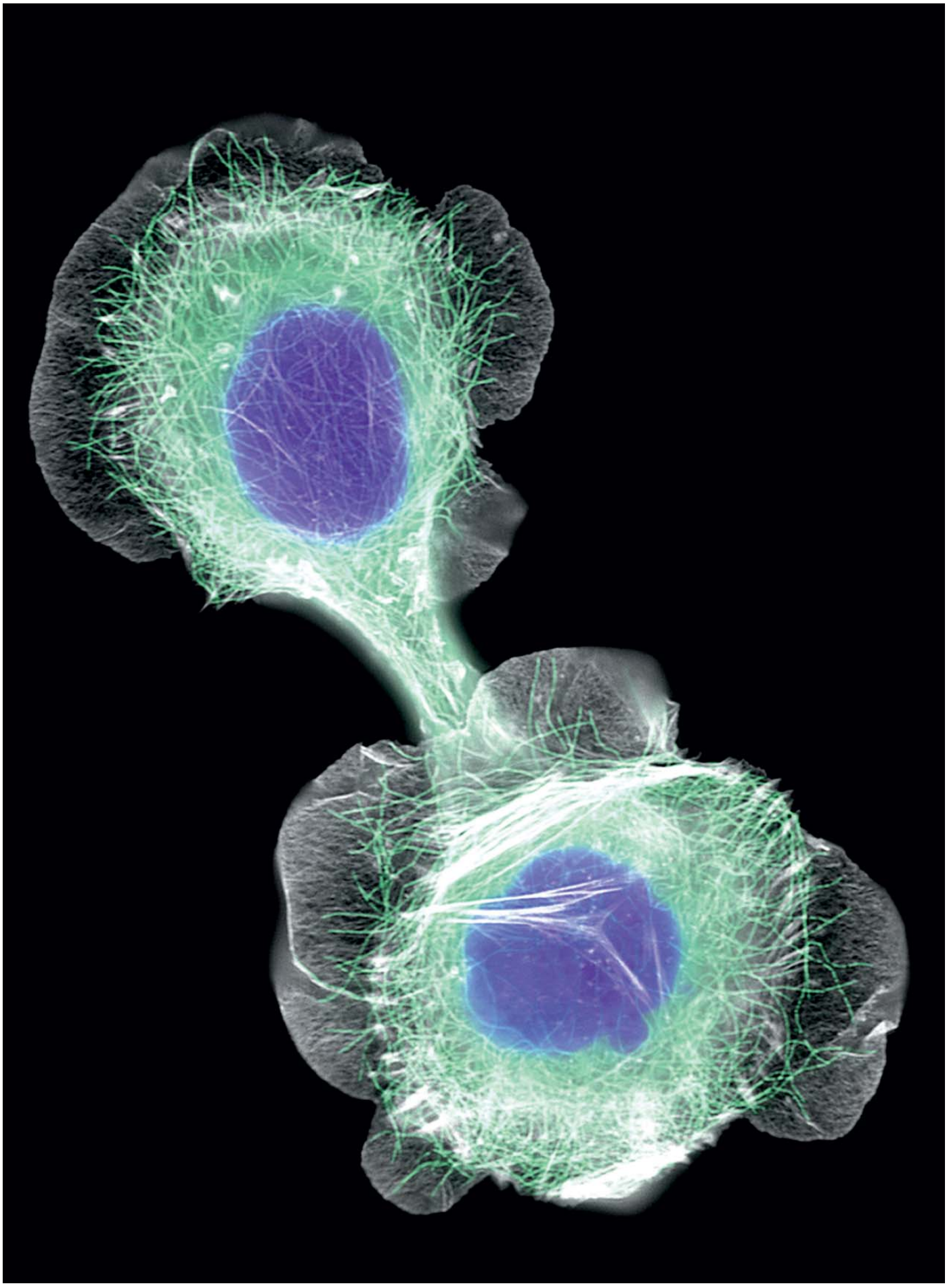
The Federal Government has shown the way with the key points formulated in the draft "Freedom of Science Act" (Box 08). Scientific institutions funded predominantly by the Federal Government shall be enabled to offer improved working conditions to young researchers which are adapted to their specific situation. It is hoped that the federal states will also introduce corresponding legislation for the universities and research institutions for which they are responsible.[42]

All these initiatives are aimed in the same direction. However, the reforms will have to be supported by various actors and institutions in order to improve the competitive situation of Germany as a science location.

Neither the Federal Government nor the *laender* can act alone – the universities and research institutions are also called on to take action.

The Expert Commission gives the following recommendations:

- The autonomy of universities and research institutions is to be strengthened. Scientific institutions must be in the position to develop their own goals, staffing plans and financial strategies. Budget responsibility is a necessary pre-condition.
- The laws on public servants make it hard for researchers to move between university, business, and society. Nor do they aid the international mobility of scientists. It is also places restrictions on performance-based salaries. The Expert Commission recommends that public service law should no longer be applicable for scientists.
- Fixed and inflexible teaching obligations can impede research. Teaching requirements should be a topic for contract negotiations and professors should be able to concentrate more or less on teaching or research in various phases of their career. In principle, the Expert Commission supports the unity of teaching and research.
- Whereas the Federal Government should continue to support young researchers (by means of excellence initiatives, post-graduate schools, etc.), the federal states should also provide additional funds for their universities and research institutions, so that these will be able to cope with the expected rise in the numbers of students. The *laender* university legislation should be adapted so that staffing regulation can be reformed, and research cooperation between the universities and with other research institutions, companies, associations and ministries is supported.
- Post-doctorate researchers should be given the greatest possible scope for their scientific work. A first step has been taken with the introduction of junior professorships and independent young researcher groups. Further steps should follow, based on the implementation of the tenure principle. Permanent employment contracts at universities should be awarded on the basis of clear and transparent evaluation procedures. If there is no prospect of continuous employment, contracts should be awarded for a short period. Insecurity in this respect can often lead excellent young scientists to leave the science employment



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market or not to consider it in the first place. Research institutions, which are rarely able to offer a tenure track, should try to cooperate with universities here.
– The career goals of young scientists are very varied. Many staff members in research institutions do not intend to stay working in science indefinitely. Their careers outside science must also be supported effectively. Permanent employment options are not always relevant in such cases.
– The best possible support should be provided to prepare young scientists for a career in research. This includes offering opportunities to gain teaching experience, to spend time in other countries, and to apply for research grants and funds to set up research networks. Generally, young scientists should be systematically involved in decision-making processes within the institutes.
– A regular evaluation of working conditions for scientists in Germany is important, and the first Federal Report on the Promotion of Young Scientists (BuWiN) is welcomed. It should appear at regular intervals. A positive aspect is the intention to extend the report to include key areas such as promoting young researchers in the private sector or the analysis of special groups in addition to gender comparisons.

B 3 KNOWLEDGE AND TECHNOLOGY TRANSFER

In recent decades, publicly-funded research institutions in all industrialised countries and in emerging economies have become very important for the dynamics of innovation.[43] The EFI Report 2008 already drew attention to this important development. In particular under difficult financial circumstances, research and innovation policies should aim to intensify knowledge and technology transfer, because science can make a considerable contribution to commercially-successful innovations.[44]

But attention should not be directed solely to engineering and natural science disciplines. With services also becoming increasingly important in Germany, it is necessary to view knowledge in a broader sense. Service innovations are often knowledge-intensive, but frequently they are characterised by a low technology intensity.

Key forms of knowledge and technology transfer BOX 09

– Education and further training
– Research contracts and consultancy
– Strategic cooperation
– Licensing and rights exploitation
– Spin-off companies

Statistical analyses[45] show that the contribution of such innovations to increased productivity and welfare can be just as significant as the contribution of technologically-driven innovations. Engineering and natural sciences are immensely important, but not the only sources of innovations; the humanities, cultural and social sciences can also create innovations and must receive specific consideration in the R&I policies.

Supporting the entire breadth of knowledge and technology transfer

Knowledge and technology can be transferred in various ways (Box 09). The most important way is through teaching at universities and research institutions. Elite universities do more than produce Nobel Prize winners – the vast majority of their graduates will be doing practical work. The curricula must take this into account. Research institutions also offer intensive preparation for subsequent innovation-oriented activities in companies. New research findings and methods are transferred very effectively by graduates from universities and research institutions who move into the business sector. Therefore in particular in the course of the Bologna Reforms, close coordination is required between businesses and institutions of higher education. There should not be excessive political intervention concerning course structures and contents. The institutions of higher education would then be able to adapt their curricula to the employment market situation and the requirements of the subject. Personal technology transfer can be even more effective if all students have an opportunity to gain knowledge about business management in the course of their studies.

A further form of knowledge and technology transfer is through external research contracts and consultancy