

## Recommendations

Public research provides important impulses for innovations in business companies. Universities and research institutions in Germany are very active in this respect, and many German companies have been working successfully with them for a long time. However, in the opinion of the Expert Commission, the knowledge created in the public sector could be put to better use. In particular the German *mittelstand* does not utilise these sources of information often enough. Policy-makers have more possibilities to support the transfer of knowledge and technology:

- Knowledge- and technology transfer can be organised in many ways. Universities and research institutions have to find the solutions which are best for them. R&I policies should provide incentives and initiate independent evaluations, but not demand specific processes and structures.
- R&I policies for the organisation of knowledge and technology transfer can identify and communicate good examples.
- Public Private Partnerships should be promoted energetically.
- The Expert Commission urges the introduction of a “Grace period” in patent law.
- The Expert Commission recommends the development and regular evaluation of further instruments to validate the commercial applicability of research results.
- Germany needs to catch up in particular with research-based new enterprises. The involvement of universities and research institutions in spin-off companies should be made easier by the Federal Government and the relevant *laender* ministries.
- Entrepreneurial training should be offered at all universities and research institutions.

## RESEARCH AND INNOVATION IN SMALL BUSINESSES

B 4

Small and medium-sized enterprises (SMEs)<sup>54</sup> play a key role in the German economy. According to an estimate of the Institut für Mittelstandsforschung Bonn (IfM Bonn), some 70 percent of the total workforce of German companies in 2007 were working for these smaller businesses.<sup>55</sup> In the commercial services sector, about 75 percent of the workforce were employed in SMEs, and about 60 percent in the manufacturing sector.<sup>56</sup>

Smaller businesses are particularly prevalent in the services sector. There almost half of the employees registered for social security payments are working in small- and micro-enterprises with up to 49 employees. The proportion of the total work force in Germany working in the services sector rose from 54 percent in 1980 to 72 percent in 2007. Changes in productivity and demand are favouring the growth in services, and the trend to tertiarisation is coupled with the growth in significance of smaller businesses.

Since the begin of the 1990s, employment in the manufacturing sector has been declining, while it has been increasing in the services sector.<sup>57</sup> Under this aspect, among others, the small and medium-sized enterprises are a pillar for the economy. Therefore the conditions provided for them are equally as important as those for the large companies and under no circumstances should they be neglected.

### Types of smaller businesses

85 percent of small and medium-sized businesses are active in the services sector, and 15 percent in the manufacturing sector. Of the smaller businesses in the services sector, 25 percent are in turn active in knowledge-intensive sectors. Five types of SMEs can be distinguished, each with specific functions for the economy.<sup>58</sup>

Type 1: Regularly researching small and medium-sized businesses have a high R&D-intensity,<sup>59</sup> and particularly high in the case of small- and micro-enterprises of this type (Box 13). This group of companies is therefore very significant for the dynamics of innovation.

BOX 13

**Example of a regularly researching company**

CAS Software AG in Karlsruhe was founded in 1986 and it currently has 300 employees. It specialises in software for Customer Relationship Management (CRM) for medium-sized companies, and is one of the leading companies in Europe in this sector. The research concentrates on product-related topics such as speech analysis, methods for data storage and recovery as well as the development of wireless applications. Through strategic partnerships with established companies, CAS Software AG is represented in many European countries.

Type 2: Innovators without regular R&D are constantly launching new products or processes on the market, but only research intermittently, if at all (Box 14). They also make a key contribution to the competitiveness of the German economy. For this group of companies, access to external knowledge, e.g. from research institutions and universities, is vital.

BOX 14

**Example of an innovative company without regular research and development**

Topstar was founded in 1976 and it currently has 450 employees. It produces office furniture, in particular top-segment office chairs, in a highly competitive market. Although the company does not itself carry out any research and development, it keeps track of innovations in the organisation of production and deliveries, so that it can achieve extremely short delivery times. The company is also constantly working to improve the technical basis for office furniture, the materials, and the design, and cooperates with a research institute and leading designers worldwide.

Type 3: Non-innovators do not carry out R&D or innovation activities. These companies also have very specific expertise which enables them to compete internationally, including against companies from emerging economies with much lower wage levels. It is also very important that these companies are reached by knowledge and technology transfer measures, find access to sources of knowledge, and utilise external knowledge.

Type 4: R&D- and knowledge-intensive new enterprises form a numerically small group (Box 15), but above all in cutting-edge technology sectors such as pharmaceuticals, medical technology, instrument technology, or computer engineering they can provide crucial impulses for radical innovations. These companies also play a key role for research and innovation in new sectors and markets, e.g. biotechnology, nanotechnology or sustainable energy technologies, because they can react more flexibly to new demands in growing markets than established companies. Finally, they also represent an important potential for structural change, because they contribute to new forms of value-creation.<sup>60</sup>

These new enterprises often require external funds (venture capital) for their consolidation and growth.

**Example of a research-intensive new enterprise**

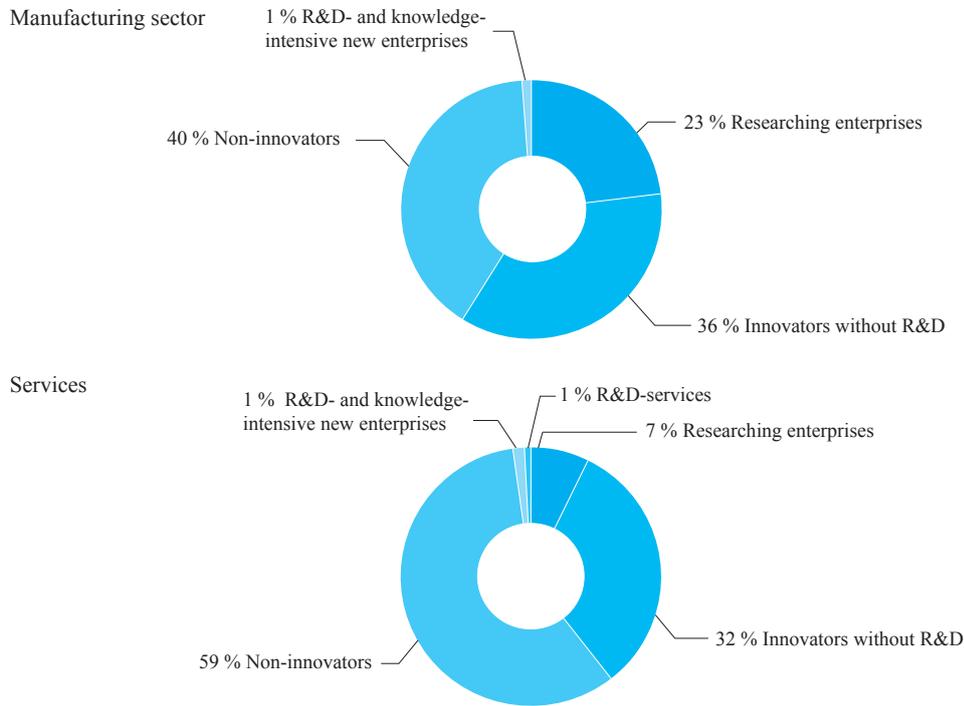
BOX 15

Concentrix Solar GmbH was established in 2005 as a spin-off company from the Fraunhofer Institute for Solar Energy Systems. In 2006, the company received a first round of venture capital from a Swiss investor. It now has 60 employees and is planning to expand further in the near future. The Freiburg-based company has developed an innovative photovoltaic technology from the laboratory setting to series production, and today it runs one of the most modern production lines for so-called Concentrator Photovoltaic Modules. In comparison with conventional silicon technology, which achieve a module efficiency of 13–14 percent, the concentrator technology of Concentrix Solar produces a module efficiency of 27 percent.

Type 5: Service providers in the research and development sector carry out R&D work on behalf of other companies (Box 16). This allows specialisation, with the company concentrating on its core competence, and outsourcing specific questions outside this area. R&D service providers contribute to new developments and support their customer's position relative to international competitors.

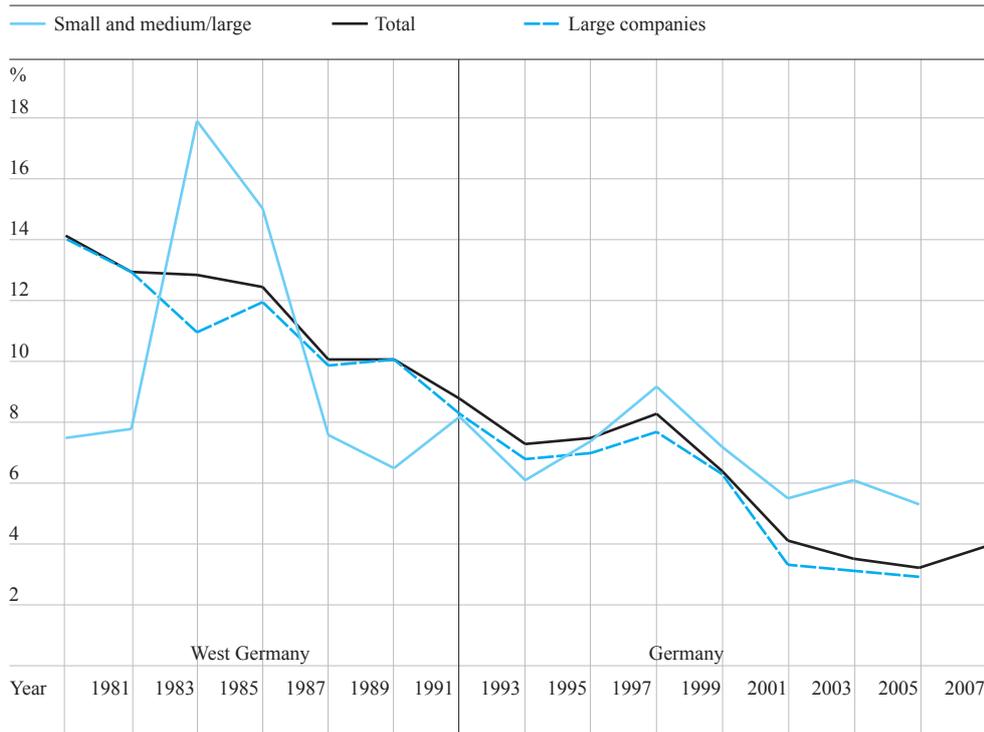
This distribution of smaller businesses between these various types differs between the manufacturing sector and services (Fig. 04). At nearly 25 percent, the proportion of small and medium-sized manufacturing

**ABB 04 Sectoral distribution of small- and medium-sized businesses**



Data 2007. Companies with between 5 and 499 employees.<sup>62</sup>  
 Source: Mannheimer Innovationspanel 2008. Calculations by ZEW and Fraunhofer ISI.

**ABB 05 State R&D-financing as proportion of total R&D-expenditure for small and medium-sized enterprises and large companies**



Source: SV Wissenschaftsstatistik, BMBF (2008). Calculations and estimates by NIW. Calculations by Fraunhofer ISI.

businesses carrying out research is much higher than the proportion of small and medium-sized services businesses (less than 10 percent). The proportions of innovators without R&D is similar in both sectors. The proportion of non-innovators among manufacturing SMEs is just under 40 percent which is considerably lower than the corresponding percentage in the services (58 percent).

### **Research and development in small and medium-sized businesses**

The proportion of small and medium-sized businesses regularly carrying out research had been declining for some time and has recovered slightly since 2003.<sup>62</sup> Even though Germany still has a leading position in a European comparison of the percentages of researching and innovating SMEs,<sup>63</sup> this lead has clearly shrunk and is at risk in the medium term.

Since the 1980s, the state financing<sup>64</sup> of R&D in companies has declined in absolute terms from 6.0 billion euros in 1985 to 1.5 billion euros in 2005. But the sum of 6.0 billion euros in 1985 would have corresponded to 8.5 billion euros at 2005 prices.<sup>65</sup> The proportion of state R&D financing for SMEs has dropped – as with large businesses (Fig. 04).<sup>66</sup> In recent years there has been an increase in public R&D support for companies. In 2007, the corresponding expenditure of the Federal Government is 22.4 percent above that of 2005.<sup>67</sup> This is an important step in the right direction, but in view of the decline in the previous years it is not yet adequate. Therefore the Expert Commission urgently recommends introducing the fiscal R&D support described below.

### **Supporting research and innovation in small businesses**

The Expert Commission welcomes the long-term initiatives of the Federal Government for the improved support for research and innovation of small and medium-sized enterprises. However, in view of the high relevance of SMEs, the Expert Commission sees a need for reflecting on new forms of support for this target group. It has to be taken into consideration that research and innovation are usually financed by equity and the equity ratio of Ger-

### **Example of an R&D service provider**

EMC Microcollections was founded in 1996 as a private company and established as a limited company in 2000. It currently has 30 employees, of which 15 have a Ph.D. The company based in Tübingen develops new products and instruments for the systematic discovery of active pharmaceutical substances. Specialities of EMC Microcollections are combinatorial chemistry, the scaling of synthesis processes, peptide and protein chemistry, synthetic vaccines, and siderophores.

EMC Microcollections works mainly on behalf of large pharmaceutical companies.

BOX 16

man small and medium/large businesses is low by international standards (Chapter B 1). The technological and economic uncertainties of R&D projects are hard to assess, so that it is often not possible to find investors. Research and development also bind a minimum volume of funds and demand a certain continuity in conducting R&D projects.

It is therefore not surprising that financing problems prove to be a major impediment for research and innovation for small and medium-sized businesses.<sup>68</sup> This applies in particular in times of economic stagnation or decline. When business is booming, on the other hand, the shortage of skilled and qualified personnel is perceived as the greatest constraint.

### **Support instruments**

R&D support for SMEs in Germany is usually organised as project funding. This form of support is selective and aimed at supporting particularly capable companies. The effectiveness and efficiency of these programmes is almost always judged as being very positive.<sup>69</sup> The selection process involves screening applications, and the procedure often appears to be very bureaucratic to the companies. In addition, the variety of programmes generates friction between the various supporting agencies and causes costs for the applicants.<sup>70</sup> The heterogeneous funding possibilities at the levels of the Federal Government, the federal states and the European Union have resulted in a confusing array of options.

Important measures to introduce simplification and increase transparency have been taken in hand.<sup>71</sup> The High-Tech Strategy of the Federal Government aims to establish a centre for inter-departmental information and advice on state aid and support for research and innovation. This is intended in particular to assist small and medium-sized enterprises and offer guidance on the relevant aid and support programmes. Despite these steps, the aspect of transparency continues to warrant attention.

### Further development of project support

In recent years, the project support instruments for the target group of SMEs have been developed further. In the BMBF programme “SME-innovative” which forms part of the High-Tech Strategy the application procedure has been made much simpler (Box 17). The support is concentrated in particular fields of technology and advanced research. This focussing may well represent a limitation for some SMEs. They may find the SME support offered by the BMWi through its Central Innovation Programme *Mittelstand* (ZIM) is particularly appropriate, because this is open to all technologies. And recently a long-standing restriction has been lifted under which the research projects had to be carried out in cooperation groups or

BOX 17

#### BMBF Programme: SME Innovation

With SME Innovation, the Federal Ministry for Education and Research aims to promote cutting-edge research in important advanced sectors, in particular in biotechnology, information and communications technology, production technology, resource and energy efficiency, optical technologies, and in nanotechnology.

This programme is intended to offer uncomplicated access to funding support. For example, it is possible to submit a project sketch before completing the actual funding application. The sketch will then be assessed within two months. The full application will also be evaluated within two months. Since the start of the programme in 2007, sketches have been recommended in the previous selection rounds to receive a combined funding of nearly 200 million euros, with a corresponding project volume of more than 320 million euros. More information is available at [www.kmu-innovativ.de](http://www.kmu-innovativ.de).

BOX 18

#### BMBF Programme: Innovations with services

The research programme “Innovations with services” promotes research and development projects in the services sector and focuses on innovation management, innovations in fast-growing fields and people in services companies. The programme is intended for companies, universities and independent research institutions as well as associations. Companies of all sizes are entitled to apply, but mainly smaller and medium/large companies will be supported. Among other things, the programme is intended to broaden the knowledge-base for innovation processes in the services sector. Over the next five years some 70 million euros will be available for this purpose. For more information visit [www.hightech-strategie.de/en/250.php](http://www.hightech-strategie.de/en/250.php)

networks (Box 19). The Expert Commission welcomes this relaxation. The programme “Innovations with services” which is part of the High-Tech Strategy also addresses an important SME sector (Box 18). In the view of the Expert Commission, these activities of the Federal Government contain a series of highly promising approaches. The applications are simplified, restrictive requirements about cooperation agreements and networks are dropped, and increasing attention is paid to innovations in services. This positive assessment does not alter the recommendation of the Expert Commission that fiscal R&D support should be introduced rapidly.

The involvement of two Federal Ministries – BMWi and BMBF – can be explained by the research-related BMBF-programmes and the applied technology orientation of the BMWi programmes. In the opinion of the Expert Commission these arguments are not convincing. Innovation processes do not follow a linear logic according to which research can be carried out far removed from the market, and only then do thoughts need to turn to an application. It therefore seems appropriate to bring together “SME innovative”, “ZIM” and “Innovations with services” in one programme. Whether this is possible in view of the rivalry between departments is a political consideration, but the separation does not seem sensible. Particularly regarding support for SMEs, more efforts must be made to follow the goal of the High-Tech Strategy – the improved harmonisation and cooperation between government departments.

In addition to further development and standardisation of the existing instruments, German R&I policy should also endeavour to extend the range of support instruments for specific contexts. Other countries have interesting approaches to providing support for research and innovation in SMEs, which could give important ideas for innovation policies in Germany. The Expert Commission presents two such strategies. As in the case of fiscal R&D-support, the details of a German strategy could be decided on by working groups of the Research Union Business - Science, in order to integrate the expertise of representatives from politics, business and public administration in the planning.

## BOX 19

### Programme of BMWi for SMEs

#### Central Innovation Programme *Mittelstand* (ZIM)

The ZIM programme is aimed at medium-sized companies and combines the previous BMWi programmes for supporting cooperation and network building between SMEs. It is intended to provide a more transparent programme offering support under standard conditions. ZIM supports both manufacturing projects and projects relating to technological services. Since January 2009, individual projects from east German SMEs can be supported independently from nationwide cooperation projects and networks. (For more information visit [www.zim-bmwi.de](http://www.zim-bmwi.de)). In 2009, 323 million euros has been made available for this.

In addition, the Federal Government has made an additional 900 million euros available through the Second Recovery Package in 2009 and 2010 for the ZIM Programme. At the same time, the programme has been extended to include the provision of support for individual projects of west German SMEs and projects for companies with up to 1 000 employees.

#### „*Jeune Entreprise Innovante*“ in France

An interesting measure is the introduction of the status of *Jeune Entreprise Innovante* (JEI)<sup>72</sup> in France. New SMEs qualify for this status for the first eight years of their existence. They correspond to Type 4 in the classification outlines above, or early-phase R&D and knowledge-intensive enterprises. The JEI-status confers on the companies considerable reduc-

tions in taxes and social payments (Box 20). The effect is therefore an improvement in the financial situation of young, research-active companies, irrespective of their involvement in any specific projects. Given the limited target group, the total of 1 789 French JEI-enterprises in the first year of the scheme is a good start.

Other countries such as Belgium, the Netherlands or Spain have introduced similar regulations. Norway, Sweden, Estonia, and Finland plan to use comparable models in particular to support new biotechnology enterprises. The European Commission officially recognised the status of Young Innovative Company (YIC) in 2007 so that such support for young companies does not contravene EU Law. The Expert Commission recommends the examination of the advantages and disadvantages of introducing the YIC status in Germany, taking the experience in other countries into account.

### *Jeune Entreprise Innovante* (JEI) in France

## BOX 20

The status of JEI was introduced in France in 2004. In order to be granted this status, a company must meet five criteria:

1. It must be an SME in accordance with the EU definition, e.g. it must have less than 250 employees.
2. The company must not be more than eighty years old.
3. Research costs must account for at least 15 percent of the total costs.
4. The company must be independent, i.e. no other company may have a majority holding in it.
5. The company must be a genuine new enterprise.

The JEI-status confers the following advantages in France:

1. JEI are freed from social security payments for research personnel
2. JEI are completely freed from taxes on profits for three years, and then have 50 percent tax relief for a further two years.
3. JEI is completely freed from the annual IFA turnover tax.
4. JEI can be freed by the district authorities from paying French company tax and other company contributions for seven years.

## Small Business Innovation Research (SBIR) in the USA

In the United States, the SBIR Program is the central instrument for the public support of research and innovation in small businesses (Box 21). All ministries awarding R&D contracts are required to reserve at least 2.5 percent of their R&D funds for small businesses. The Expert Commission views the special consideration of small businesses when awarding public contracts as a central advantage in this case. This prevents large companies from enjoying the exclusive benefit of research support from a specific department.

SBIR Projects have three phases: a feasibility study, the research project, and the market launch. For the first two phases, the companies receive financial assistance. The financing of the feasibility analysis is particularly helpful in the opinion of the Expert Commission, in order to increase the probability of technological and commercial success of the project. In the evaluation of applications, the marketing potential plays a role from the start, and the process involves not only technology experts, but also economists.<sup>73</sup> Project evaluation in accordance with the SBIR model also has the advantage that international venture capital investors are familiar with it. Young entrepreneurs therefore have a better chance of acquiring venture capital after receiving a positive evaluation of their application. The Expert Commission recommends examining whether key elements of the SBIR system would be suitable for use in German R&I programmes.

### High time to introduce fiscal support for research and development

Many countries – e.g. Austria, the Netherlands, France, Canada, or USA – have introduced fiscal R&D support. This is an indirect instrument which only relates to research activity as such, but not to the specific contents. The provision of a legal entitlement removes the need for complex application procedures, and claims are registered through the annual tax return. This fiscal support is a considerable incentive, which has been proved in other countries to lead to an appreciable increase in R&D-activities by SMEs.<sup>74</sup> Because it is open in nature, it also reaches SMEs in sectors with less research-intensive technologies

BOX 21

## Small Business Innovation Research (SBIR) in the United States

The SBIR Programme was introduced in 1982 and last extended in 2000. It obliges specialist ministries which finance research to any appreciable extent to reserve 2.5 percent of their R&D funds for companies with fewer than 500 personnel. The SBIR support is divided into three phases:

1. Feasibility studies for a research project; project duration of about 6 months, maximum budget of 100 000 dollars.
2. Carrying out the actual research project; project duration of about 2 years, maximum budget of 750 000 dollars.
3. The marketing of the research results, for which there is no explicit SBIR support. Financing by other private or public investors.

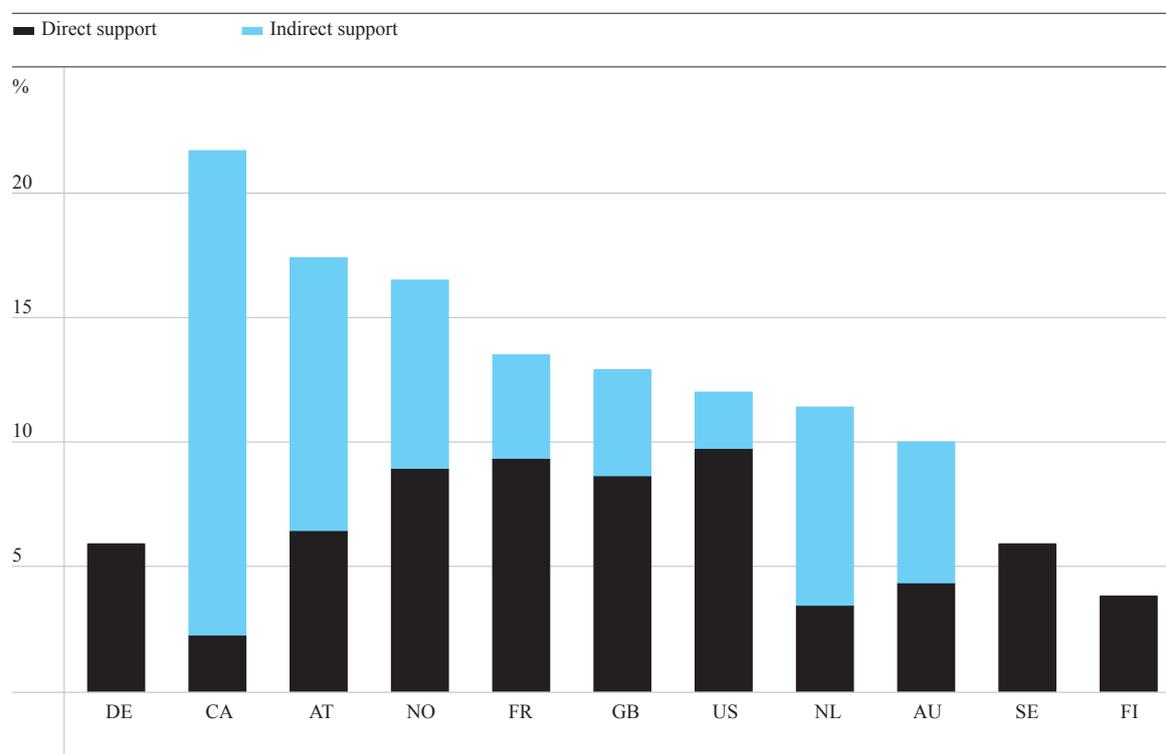
Closely linked to the SBIR programme is the Small Business Technology Transfer Program (STTR), which covers the support of research cooperation between small and medium-sized companies and public scientific institutions and which uses similar support mechanisms.<sup>75</sup>

which rarely benefit from the other programmes. This is focal point for the activities of many Type 3 SMEs (innovating companies). Without research, they can become uncompetitive in the medium-term.

In many OECD-countries, indirect fiscal support for R&D is meanwhile more important than direct support – for example in Canada, the Netherlands or Austria (Fig. 06). Germany has a middle position in an international comparison regarding the provision of direct support. But when the overall state financing is considered it only has a bottom ranking. The Expert Commission therefore pleads for the rapid introduction of fiscal R&D support. This will mean that a much broader range of SMEs will be reached. The EFI Report 2008 already proposed this, and meanwhile a general consensus has formed on the suitability of this measure for Germany. The German Council of Economic Experts,<sup>76</sup> as well as a working group of the Research Union<sup>77</sup> and numerous associations have all recommended the introduction of fiscal R&D-support. A study commissioned by the BMWi<sup>78</sup> also approved of this measure. A Federal Government working group confirms that fiscal R&D support is feasible and will have a positive effect on R&D activities. It is time to

## State financial contributions to business R&D for selected OECD-countries

ABB 06



Data: 2005. Support as a percentage of internal R&D-expenditures.  
Sources: OECD, MSTI 2007/I. OECD, S&T Scoreboard 2007. OECD, S&T Outlook.

introduce fiscal R&D support in Germany. This would have already been appropriate as part of the Second Recovery Package. The Expert Commission sees an important task here for the Federal Government.

There are many possible options for fiscal support. Either it can be tightly restricted to the target group of SMEs, or linked inversely to the size of the company, or it could be completely open, allowing large companies to benefit in the same way as SMEs. One argument in favour of involving large companies is that the provision of fiscal R&D support can be an important factor for multi-national companies when they are choosing their research locations. This is why the working group of the Research Union Business-Science favours this option.<sup>79</sup> The Expert Commission regards an initial focus on SMEs or setting a limit as sensible, because in this way the instrument can develop a particularly broad macroeconomic effect.<sup>80</sup>

### Cooperation partners for SMEs

For small and medium-sized enterprises it is particularly important to be able to draw on external

expertise with respect to innovations. The costs involved in cooperation between a small or medium-sized enterprise and a scientific institution are met in full through the “SME Innovative” by the Federal Government. But the question is which institutions are the best partners for the SMEs. If these are Type 4 technology and knowledge-oriented new enterprises then universities and research institutions are certainly appropriate, especially since many new enterprises are direct research spin-offs. But for the large group of Type 3 companies which do little or no research involving less advanced technology, the cooperation with universities can be problematic, because their “cultures” are very different and communications can be difficult. An alternative can be Fraunhofer Institutes, which are better prepared for the cooperation with business companies and which carry out many research projects for SMEs. Much the same applies for the “associated” institutes at universities, which have relaxed their ties to the university in order to be in a better position to deal with businesses.

The *Fachhochschulen* or universities of applied sciences are often overlooked, although they can provide valuable support for many SMEs. Universities

of applied sciences are oriented towards practical problems and applied research. It is therefore perhaps not so surprising that in the competition “Exchange processes of universities, research institutions and companies” organised by the *Stifterverband* innovation agency and BMBF in 2007, three of the five prizes went to universities of applied sciences. But these institutions only have very limited research capacities, and their professors do not usually have any assistants to support them in their research.

Some federal states have launched initiatives to improve the cooperation between universities of applied sciences and companies.<sup>81</sup> The BMBF is also active here with its “FHprofUnd” programme (previously “FH3”). This involves providing support for cooperation projects, and thus indirectly increasing third-party funding for the universities of applied sciences. But these initiatives cannot change much regarding the poor infrastructure. There is an interesting model in Switzerland, where the *Fachhochschulen* are provided with adequate resources for applied research and can play an important role in supporting the research of SMEs.<sup>82</sup>

In the opinion of the Expert Commission, the R&I policies of the Federal Government and the *laender* should aim to improve the research conditions at the universities of applied science and to provide incentives for their cooperation with SMEs.

### **Smaller businesses in the market for highly-qualified professionals**

The shortage of highly-qualified professionals affects in particular the small and medium-sized enterprises particularly hard. In the medium-term, demographic developments and knowledge intensification of the economy will only make this problem more acute.<sup>83</sup> Graduates prefer to work for large employers because they can earn significantly more there and feel they have a more secure job. This preference is one reason why the proportion of graduates in smaller businesses is only half that of the large companies. There is a significant shortfall in graduates in mathematics, natural sciences, computer sciences, and engineering. In the current financial crisis, the shortage of qualified specialists will be less significant for the smaller businesses than the financing problems. Indeed, smaller businesses have an opportunity at present to

attract highly-qualified professionals with interesting innovations projects. There is no need here for government intervention. The small and medium-sized enterprises and their associations should take the initiative and do more to approach graduates, e.g. by taking part in careers events, job-experience offers, and closer contacts to universities and research institutions.

In order to increase the innovation potential of small and medium-sized enterprises, the Expert Commission sees in summary a need for the following steps:

- The responsible government departments should continue to work to increase the transparency of the support programmes and coordinate these better.
- The financial burden of small and medium-sized enterprises carrying out research and development should be reduced, e.g. by a smaller tax bill and lower social security payments, as with the status of Jeune Entreprise Innovante in France or the EU Young Innovative Companies.
- More public R&D orders should be placed with innovative small and medium-sized enterprises, following the US Small Business Innovation Research Program.
- In order to provide broad support for independent R&D in small and medium-sized enterprises, non-specific fiscal support is needed for R&D.
- Small and medium-sized companies should be integrated more effectively in knowledge and technology transfer processes. This requires strategies and measures to identify suitable science partners. In particular, the universities of applied sciences should be better equipped, so that they can play a more active role as transfer partners of small and medium-sized enterprises.