

### Financing constraints reduce innovation activities

The current financial crisis and the possible reluctance of banks to give loans for innovation projects will probably only have a limited impact on innovation financing, because the figures for the period 2004–2006 indicate that there were hardly any companies which obtained funds for innovations solely in this way. The economic downturn can be expected to have a greater effect due to reduction of revenues and profits, because this will reduce the scope for internal financing. It is to be feared that the restrictions on company funds will mean that companies have to significantly reduce their activities in research and innovation. Even at the start of 2007 – under favourable economic conditions – there were financing constraints on the innovation activities of the companies. If their profit situation had improved, 27 percent of the companies said they would have carried out more innovation activities. In particular, companies carrying out research and development could obviously not implement all their ideas because of the lack of sufficient internal financing. A greater potential to increase the R&D-expenditure of the German economy lies above all in those companies which have so far only carried out research and development occasionally. Of this group, more than 15 000 small and medium-sized enterprises were prepared to invest more in research and development if additional funds were available. Broad support measures, such as fiscal R&D-support, which are aimed at improving internal financing opportunities for research and development could therefore have a highly mobilising effect. Instruments which ease the access to (low-interest) credit facilities seem to be less effective ways to improve the internal financing possibilities. Not even half the companies which would have carried out additional innovation activities if the profit situation improved, would have been willing to do so if additional (low-interest) credit facilities were available.

## C4 SMALL TO MEDIUM-SIZED ENTERPRISES

The following section is based on an evaluation of various studies on aspects of research and innovation.<sup>108</sup> Small and medium-sized enterprises (SME) are defined by the European Union as companies with up to 249 employees. In Germany, the proportion of large companies is much higher than in other

European Union member states so that the proportion of SMEs in accordance with the EU definition is comparatively low. Therefore many German institutes still use the upper limit of 499 employees in their analyses, and their statistics are not available in accordance with the EU standard.

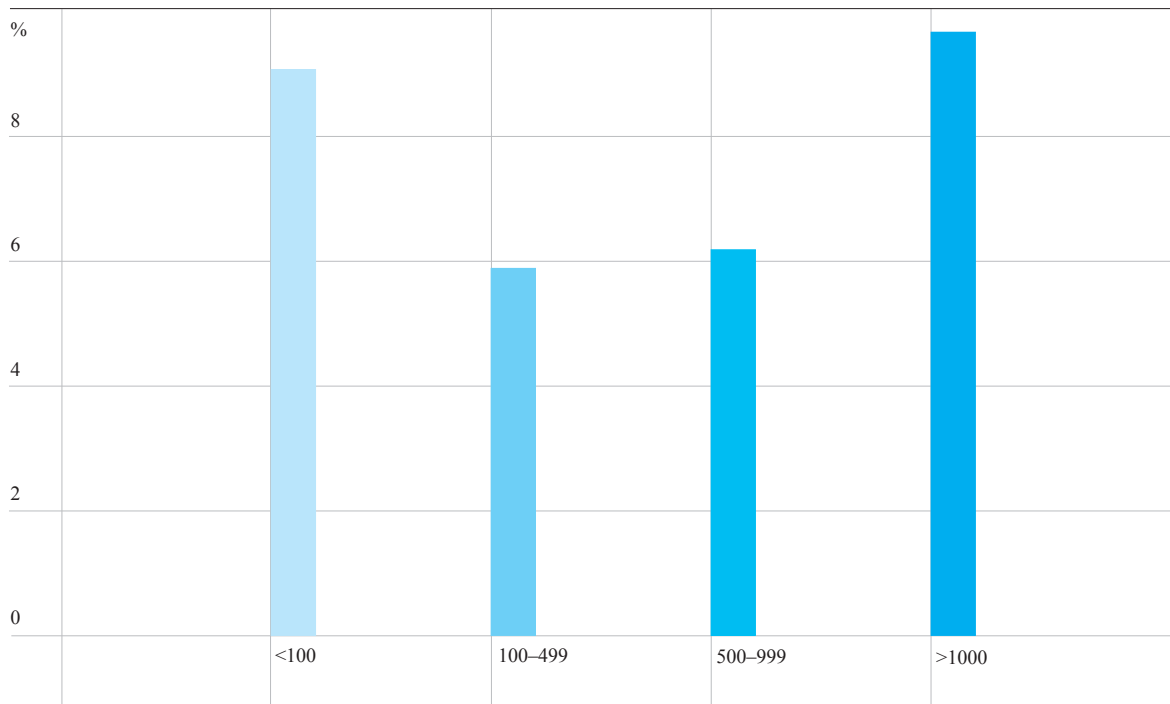
Using this higher level in the following, in 2007 some 70 percent of the workforce in the business economy were working in these small and medium businesses.<sup>109</sup> In the sector of commercial services, some 75 percent worked in small and medium companies, and in the manufacturing sector about 60 percent.<sup>110</sup> Small and medium enterprises can be found in particular in the services sector, and about half the personnel working in the commercial services are employed in small and very small businesses with no more than 49 employees. The proportion of all gainfully employed people who were working in the services sector in Germany rose between 1980 and 2007 from 54 percent to 72 percent.

There are very different types of small and medium-sized enterprises with specific functions for the economy. These are discussed in more detail in Chapter B 4. In the case of researching companies, the R&D intensity (the proportion of all personnel who are R&D personnel) is particularly high for small companies; it falls for companies with between 100 and 499 employees and then rises again for large companies, giving a U-shaped curve of R&D-intensity as a function of company size (Fig. 23).

Only 13 percent of all business R&D expenditure is attributable to small and medium companies, so that the R&D-share is much smaller than the 70 percent share of the workforce. The low proportion reflects a limited participation in research and development, and in contrast to many other countries it is not increasing markedly.<sup>111</sup> The R&D-involvement of small and medium-sized companies in the sectors of cutting-edge technology is clearly above the average of 12 percent, for example in pharmaceuticals at 59 percent, in telecommunications at 59 percent or in control technology at 79 percent.

For “transnational patents” the share of applications by small and medium companies is 20 percent; large companies account for 60 percent, and the remainder come mainly from science. In the case of patents from companies, the small and medium company share of

**FIG 23 R&D-intensity of researching companies in Germany 2005**



According to numbers of employees.  
 Source: SV-Wissenschaftsstatistik. Calculations by NIW.

25 percent is much higher than their share of R&D-expenditure (13 percent). Small and medium-sized companies use patents to secure their inventions particularly intensively. In an international comparison, they specialise in Germany on mechanical engineering, in particular machine tool construction.

Above-average numbers of patent applications are made in the fields of control and measurement engineering, and materials, but there is a weakness in information and communications technologies. German small and medium companies are broadly specialised in high-value technology – in contrast to the United States, where they concentrate on the fields of information and communications technology, control and measurement engineering, medical technology, and pharmaceuticals, or in other words in sectors of cutting-edge technology.

Scientific publications by companies are an indicator of the results of basic research with a high potential for radical innovations. Since the start of the 1990s there has been a steady rise in the publications by small and medium/large companies, and their absolute numbers are meanwhile higher than those from large companies. The actively publishing small and medium/large companies are mainly R&D-intensive

start-ups and R&D service providers, which despite their low absolute numbers make a considerable contribution to German innovation activities.

There are considerable differences concerning the employment of highly-qualified professionals depending on the size of the companies. In the manufacturing sector the proportion of natural scientists and engineers in the workforce of companies with up to 50 employees was 5 percent, compared with 12 percent in companies with more than 1 000 employees. Overall there is a clear positive relationship between the proportion of natural scientists and engineers employed and the size of the company. This can be found similarly for the group of other graduates in the commercial services. In companies with up to 50 employees the rate was about 9 percent, and in companies with more than 1 000 employees it was 19 percent. This situation did not change in the boom-years of 2005 to 2007, in which the annual growth in employment for graduates (1.8 percent), and in particular for natural scientists and engineers (1.5 percent), was much weaker than for employment overall (2.7 percent). This applies in particular for small and medium companies, for which in the knowledge-intensive sector the proportion of natural scientists and engineers is stagnating and in the non-knowledge-in-

tensive sector is even declining. This clearly reflects the shortage of qualified personnel.

A recent study on graduate careers<sup>112</sup> shows that highly-qualified professionals are increasingly deciding to work for large companies, and that particularly in recent years there has been a clear shift to the disadvantage of small and medium companies. One reason for this is that incomes at a small company can be 15 000 euros per annum less than at a large company. And the income disadvantages for women are even greater. A further important reason for preferring to work in a large company is the expectation of greater job security. The reasons given for working in a small or medium company are often defensive, such as the lack of an alternative, the threat of unemployment, and above all limited mobility. But the preference for large companies has little to do with the contents of the work: the work in SMEs and large companies is thought to be similarly interesting.

In summary, small and medium-sized enterprises are already at a disadvantage when it comes to recruiting academics, and in particular natural scientists and engineers in manufacturing. Given the clear preference of university graduates to join large companies this situation will in all probability grow worse.

Further details about the structures and development of small and medium companies are provided in the Studies on the German Innovation System.

## C5 NEW ENTERPRISES

New enterprises promote the technological structural change by using new business ideas to expand or modernise the existing products and services, challenging existing companies. New enterprises in the research- and knowledge-intensive sectors are particularly important in this respect. In new fields of technology, when new consumer trends emerge, and in the early phase of transfer of scientific knowledge through to the development of new products and processes, new enterprises open niche markets and help innovative ideas to achieve a breakthrough if they have not been picked up by large companies. The following results about company dynamics in research- and knowledge-intensive sectors of the economy are

based on an evaluation of the ZEW-Start-up Panel and the Mannheim Company Panel (MUP).<sup>113</sup>

### **Every seventh start-up is in research- and knowledge-intensive sectors**

Start-up activity in Germany bottomed out after the collapse of the New Markets in 2002, but in the following two years there was a marked rise in the numbers of new companies being started up. The development was boosted in part by the labour market reforms in 2003/2004. Since 2005, the numbers of start-ups have begun to decline again. In 2007 there were 226 000 start-ups, which is 16 percent below the level of 2004.

In the research- and knowledge-intensive sectors, start-up activities in 2003 and 2004 were less dynamic than for the economy as a whole. But in turn, the decline in start-up numbers from 2004 to 2007 was 11 percent compared with 16 percent overall.

In 2007, there were 31 400 start-ups in the knowledge-intensive services and the R&D-intensive manufacturing sector. Every seventh newly started company is in research- and knowledge-intensive sectors:

- In 2007 nearly 13 percent of all start-ups were in the knowledge-intensive services. 14 000 companies were started in knowledge-intensive consultancy and 15 000 companies in technology-oriented services.
- More than 1 percent of all start-ups in 2007 were in the R&D-intensive manufacturing sector: 1 700 start-ups in high-value technology and 700 in cutting-edge technology.

### **Low start-up rates in the R&D-intensive manufacturing sector ...**

The number of start-ups related to the overall number of companies gives the start-up rate. It is a measure of the renewal of the stock of companies. The average start-up rate in the research- and knowledge-intensive sectors in 2007 was 6 percent, which is close to the average for all start-ups, which is 6.5 percent. For the knowledge-intensive services the start-up rates were 6.5 percent (technology-oriented services) and