sities which have introduced these have already been able to achieve initial success with reducing drop-out rates in languages, and cultural and social sciences.[94] However, these mechanisms must be coordinated with other measures and as well as making demands of students, they must also be supported. In particular, faculties with high drop-out rates should make greater efforts to develop selection and admission procedures, with tests to establish the suitability of applicants.Developing systems of funding.

– Student fees are an important component of university finances in some Laender and they make sense when the receipts are invested in the teaching. But they must not act as a disincentive to young people who want to study.[95] The Expert Commission believes that in particular students from low-income households must be offered the best possible financial conditions. This includes expanding and increasing the student grant system (BAföG), without age restrictions.[96] The current regulations are too restrictive. Student grants are generally only available for those under thirty years of age. Special conditions apply for those who have qualified for tertiary education through adult education schemes, or who have children. However, the students must begin studying immediately after obtaining the qualifications or when the impediment no longer exists. The Expert Commission welcomes the announcement by the Federal Government that they intend to raise grant levels and parental allowances, and to increase the age limit for master's degree students in 2010 to 35 years. But further changes are needed. In addition to government support, the mobilisation of private sources of funding for university education can also be improved, analogous to the strategy of the Federal Government for expanding the grant system, or along the lines of the grant system in North Rhine-Westphalia.[97]

– Including the supervision of doctoral students as part of the teaching duties of professors. The supervision of doctoral students in structured programmes such as the DFG postgraduate colleges should be included as part of the teaching duties. The Expert Commission points out that the time spent in this way by professors is to the detriment of research, active institutional involvement, individual career counselling, and the supervision of student organisations.

RESEARCH AND INNOVATION IN EASTERN GERMANY B 3

The 20th anniversary of the fall of the Berlin Wall last year and of German unification this year have once against raised the question about the state of development in the new federal states and appropriate support strategies. The Commission of Experts for Research and Innovation wishes to contribute to answering this question. It seems appropriate to start with a short review of the historical roots of the current situation in the new federal states and in Berlin. What happened in the course of the transformation process and which innovation policies were implemented?

Transformation process and the collapse of industrial R&D in eastern Germany

At the time of the fall of the Berlin Wall, the GDR had a well-developed research and university landscape and a high proportion of highly-qualified personnel in the workforce.[98] However, in the socialist planned economy, research and innovation could not power economic development.
The innovation process organised by the planning authorities was linear. New technologies were generated by scientific research and passed on for implementation to the 'state holding companies' (kombinat) or specific companies. There was thus controlled transfer of knowledge and technology, with hardly any direct feedback from the users of the products. The contents and goals of scientific research were largely derived from plan targets for production. The research and innovation system was not organised to develop new potential for value creation and in this way to continuously renew the structure of the economy. There was no innovation competition, and measures to maintain existing structures were dominant. In addition, the work of scientists was considerably impeded by supply shortages and the lack of opportunities to develop new ideas.

Industrial research and development in the GDR was carried out in special company departments and in legally independent industrial research institutions. The R&D departments were responsible for supervising production processes and for introducing new products and processes, through to series production. The relatively large industrial research

institutions were assigned to the state holding companies and in some cases they worked for an entire manufacturing sector. Their remit was to pursue product and process innovations with targeted applied research.

In the course of the transformation of the economic structures of the former GDR, the individual enterprises of the state holding companies were sold off, re-privatised or liquidated. West German and foreign investors were mainly interested in factories and market access, and much less in developing independent R&D capacity in the companies they took over. And where there were management buy-outs, funds were not usually readily available for in-house research and development. The result was that the new Laender experienced a massive decline in company research and development.

The former industrial research institutions run by the state holding companies were evaluated in 1991 for the Treuhand holding agency. Many of them were retained as highly subsidised external industrial research institutions – the aim being to maintain research capacities. Other external industrial research institutions were created from the R&D departments of companies, for which no investor could be found. The collapse of production in the new federal states in the early 1990s meant that privatised companies had much less demand for R&D services. This resulted in massive lay offs in the external industrial research institutions. Some of the research companies were wound up. The remaining external industrial research institutions now operate as commercial enterprises or as non-profit organisations without institutional support. The number of R&D employees in the private sector (full-time equivalents) sank from 86 000 in 1989 to 32 000 in 1993.[99]

Basic research in the GDR was carried out by the non-university institutes, which were organised in the Academy of Sciences (AdW). The academic research showed greater variety than industrial research, but was also subject to the decisions of state bodies and the requirements of the plans. The Unification Treaty envisaged winding up the AdW by the end of 1991. With dismissals, departures, the formation of spin-off companies and (early) retirements the personnel numbers of AdW fell from 24 000 in June 1990 to nearly 16 000 in November 1991.[100]

The German Council of Science and Humanities evaluated the institutes and made recommendations about which should be retained. Positively assessed institutes were "re-established" and integrated in west German research institutions; the others were closed. By January 1992 this led to 32 institutes in the so-called "Blue List" (now the Leibniz Association); in addition, eight institutes were integrated in the Fraunhofer Society and two institutes in the Max Planck Society.[101] In some cases, research groups or parts of institutes transferred to existing non-university research institutes or universities in west Germany. The former employees of the "re-established" institutes were not automatically re-employed, but had to submit a new job application. Some research groups therefore preferred to create spin-off companies in private initiatives.
The universities in the GDR carried out some research, but their main remit was to teach. When East Germany joined the Federal Republic of Germany, the new Laender assumed responsibilities for the universities, whose structures were adapted to those of the west German universities. This involved a revision of contents and changes in personnel. Specialist facilities were in part integrated in other universities, and some universities received a new profile as universities of applied sciences. These measures meant that most universities in the new federal states could be retained. Some scientists from individual universities got together and established external industrial research institutions.

The overall result has been that the transformation of the university and research landscape in the new Laender led to a massive decline in industrial research and development. Links which had existed between the manufacturing sector and science in the GDR were for the most part broken. New networks had to be built up from scratch. The external industrial research institutions remain a special feature of the German R&I system, and a reminder of the transformation process. They now have an important service function, in particular for SMEs in the new federal states, which do not have the resources to carry out their own research and development. The public sector in the new federal states and Berlin currently includes 57 universities, 42 institutions of the Leibniz Association, 31 institutes or centres of the Fraunhofer Society, 23 locations of the Max Planck Society, and four research centres of the Helmholtz Association, as well as a se-

ries of Federal and Laender institutions with R&D remits.[102] In east Germany (including Berlin), there are nearly 79 000 R&D personnel (full-time equivalents), of which 40 percent are in the private sector and 60 percent in universities und scientific institutions.[103]

Promoting innovation: From stop-gap measures to all-German programmes

Following unification, the key political goal in the new Laender was to establish a viable economic structure, which would be able to survive market exposure and offer sufficient employment and earnings potential.[104] It was recognised at an early stage that research, innovation and technology policies were crucial for reaching this goal. However, in the course of two decades there has been a marked shift in the measures adopted and the philosophy behind these.

Following German unification, the Federal Government adopted innovation policies intended to stabilise R&D in the new federal states and prevent a mass migration of R&D personnel. This involved special programmes for eastern Germany ("Personnel Promotion East" –PFO, and "Economic Stimulation East" - ZFO). And in order to give companies financial scope to place orders for R&D, "Research Commissioning East" was introduced in 1990. Instruments for project-based support were also adopted, in particular for SMEs, and measures were adopted to make it easier to set up new companies. The system of joint industrial research in West Germany, which provides support for research work for SMEs by university and non-university research institutions, was extended to cover the new federal states.[105] Finally, massive investments were made in innovation-relevant infrastructure, both by the Federal Government and the Laender, for example in technology and start-up centres.[106]

This policy of providing broad support was appropriate directly after unification. However, it soon became clear that more focused support instruments were needed, which would operate more efficiently. Until the mid-1990s, the innovation activities of companies in the new Laender were mostly restricted to the imitation of existing products. However, the innovation policies in western and eastern Germany at this time were already having to face new challenges, as described in Section B 1.[107] This made it necessary to develop further the instruments of research and innovation policies in both national and regional contexts. The priorities were the optimisation of the framework conditions and the support for R&I cooperation projects.[108] This reflects the fact that innovations are usually the product of complex systems involving many actors, which do not progress along a one-dimensional, technology-driven line of development, or solely within one organisation.[109]

In order to use R&D support funds more efficiently, they should be concentrated on growth drivers. The Federal Government now increasingly adopts a region-oriented innovation strategy, which requires actors to be more independent and responsible for their own actions.[110] The "Enterprise Region" programme has the goal of strengthening the innovative potential of individual regions in east Germany, which have been selected in a competition. The Expert Commission welcomes the inclusion of competitive elements in the support measures of the Federal Government.

In the recent past, more importance has been attached to the market implementation of research and development results. It is also noticeable that many programmes aimed at supporting east Germany have been merged in national programmes. A good example is the Central Innovation Programme for Small- and Medium-sized Enterprises (ZIM), which has absorbed various east German programmes.

Since the mid-1990s, the proportion of the Federal Government's R&D expenditure going to east Germany has remained stable at about a quarter. The largest sums in east Germany go to the Laender Berlin und Saxony (with Bavaria und Baden-Württemberg receiving most in the old Laender). However, at least twice as many R&D companies in the east receive public support as in the west. And support intensity, (i.e. the proportion of the R&D expenditure of companies carrying out research, which derives from government support) is appreciably higher in east Germany than in west Germany.[111] This shows that the existing support instruments are reaching many companies in the new federal states.

Economic performance in the east still lower than in western Germany

Given the considerable political efforts to create viable, self-supporting structures in the new federal states and Berlin, how successful have these measures been? What is the current economic potential and innovation performance in the new federal states?
In 1991, the real gross domestic product (GDP) in the new federal states bottomed out and then began to rise sharply. Since the mid-1990s the growth rates of GDP in east and west moved closer, with the new federal states mostly growing slightly more than the old Laender. However, the difference in growth rates is so slight that it is not possible to speak of catching up.[112] GDP per resident in the new federal states (without Berlin) is some EUR 22 000; this is 73 percent of the national average. The regions and cities with the lowest GDP per capita are still almost all in the new federal states (Figure 7).

High R&D expenditure in the science sector in the new federal states

High value creation is frequently associated with knowledge- and technology-intensive production and corresponding investments in research and development. Taking overall expenditure on R&D as a proportion of gross domestic product, the west German Laender, at 2.6 percent, are above the OECD average (2.3 percent). However, this is still some way behind leading countries Sweden, Korea, Finland und Japan, who spend about 3.5 percent of GDP on R&D. Eastern Germany, with 2.2 percent, has nearly reached the OECD average. This puts the region ahead of Great Britain (1.8 percent) or the Netherlands (1.7 percent). Of the German Laender, Saxony is well placed (Figure 11) and Berlin is one of the front-runners, with an R&D intensity of almost 3.4 percent. However, in view of its function as the capital city and its status as a Federal State, and given the economic history of the region, Berlin can only be compared with the other Laender to a limited extent.

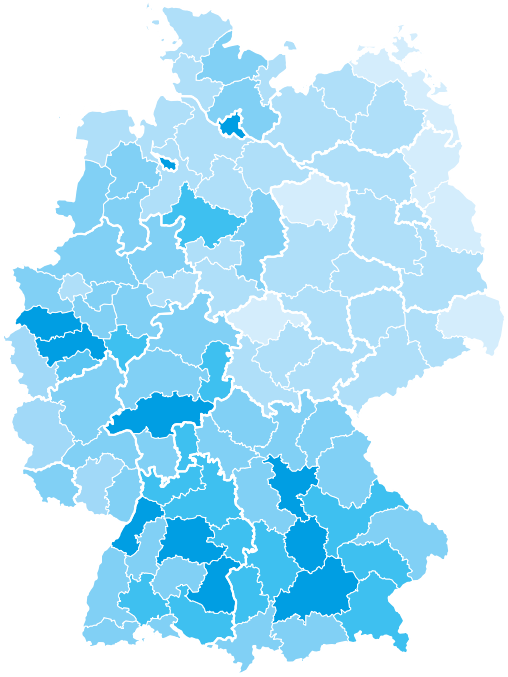
Whereas the large part of R&D expenditure in the old Laender is provided by the private sector, R&D in the new federal states is mostly government funded. This remains the Achilles heel of the innovation system in east Germany. There is a shortage of innovative companies, which generate growth. Nevertheless, the R&D expenditure has risen continuously since unification. In 2006, it was at least 40 percent higher than in 1995 in east Germany and increased in particular in the private sector.[113] In contrast, the number of R&D employees began to decline slightly after the stabilising in the second half of the 1990s.
Despite the increase in R&D, the new Laender have not been able to reach the level of the old Laender. In west Germany, R&D employment and R&D expenditure have increased more since 1995 than in east Germany. This is above all due to the development of the private sector, because R&D expenditure and employment in universities and scientific institutions have developed more or less in parallel in east and west.[114] As well as east-west differences in R&D intensity in Germany, there are also differences between north and south. The group of northern Laender are some way behind the southern Laender. There is a considerable deficit in developments in some regions. In general, more R&D work is carried out in urban agglomerations than in rural areas. None of the regions in eastern Germany reaches an R&D intensity above the national average (Figure 9), but individual cities with technology-intensive manufacturing companies do, such as Dresden, Leipzig, and Jena.

In 2007, 84 percent of all R&D personnel in Germany were working in west German Laender, with a slightly upward trend. This is more than would be expected from the distribution of the national population (Table 5). The new Laender account for more than 10 percent of R&D personnel, and Berlin for 5.5 percent. The new Laender are able to maintain their share over time. R&D employment in the private sector is lower than in western Germany, but this is balanced by an increase in the public sector. Berlin has experienced a considerable reduction in R&D personnel, so that its proportion of the national R&D employment has fallen over time.

The gains in the old Laender are mostly due to increased R&D efforts in Bavaria, Baden-Württemberg, and Hesse, which together employ 55 percent of all R&D workers. Correspondingly, an above-average proportion of private sectors employees in these Laender are R&D personnel, whereas the figures in all other Laender are below average. Corresponding trends for R&D expenditure are observed

FIG 07 **Per capita gross domestic product in 2007 (k€)**

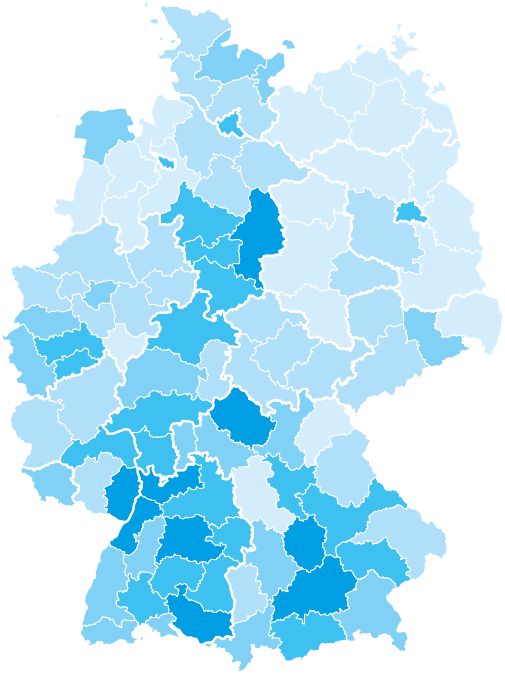
< 20 | 20 to 25 | 25 to 30 | 30 to 35 | > 35



Shown for the 2008 boundaries. Data using older boundaries has been converted where appropriate..
Source: Federal and Laender Statistics Offices. Bundesinstitut für Bau-, Stadt- und Raumforschung.
Calculations by EFI.

FIG 08 **Employees in knowledge- and technology-intensive sectors as a proportion of all employees in the commercial sector (31 December 2008) in percent**

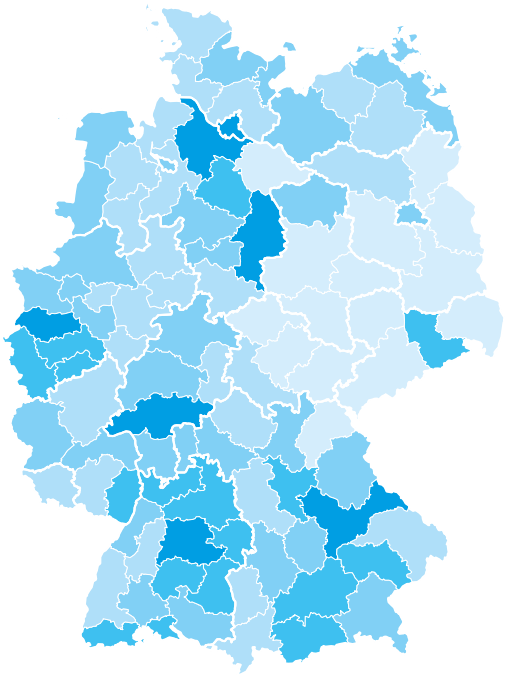
< 30 | 30 to 35 | 35 to 40 | 40 to 45 | > 45



Shown for the 2008 boundaries. Data using older boundaries has been converted where appropriate. Source:
Statistics of Federal Employment Agency. Calculations by EFI.

R&D intensity of the commercial sector in 2007 (x EUR 1 000 per full-time employee) FIG 09

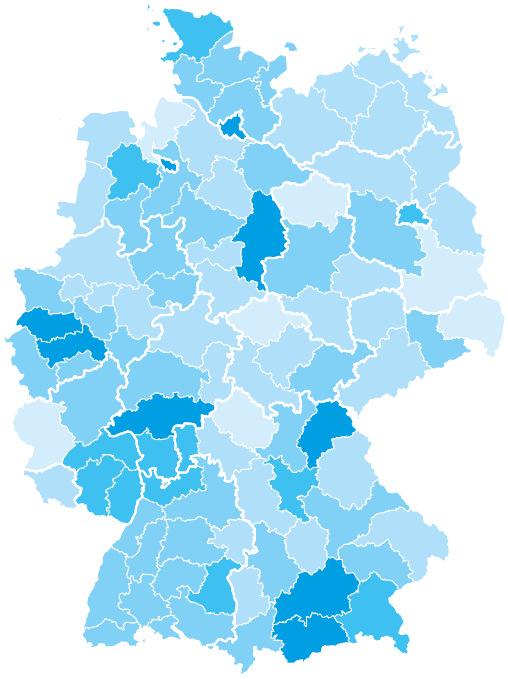
< 90 | 90 to 110 | 110 to 130 | 130 to 150 | > 150



Shown for the 2008 boundaries. Data using older boundaries has been converted where appropriate.
Source: Mannheim Company Panel (ZEW). Calculations by EFI.

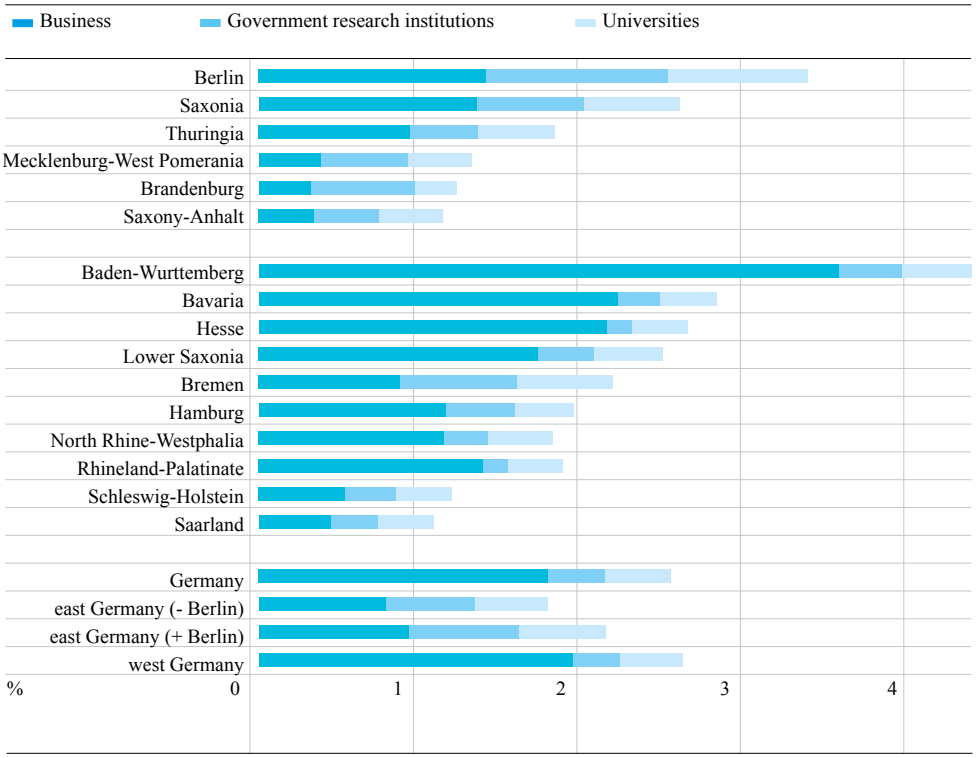
Start-up intensity (start-ups per 10 000 employees) in technology- and knowledge- intensive sectors (annual mean 2005 to 2008 FIG 10

< 4 | 4 to 6 | 6 to 8 | 8 to 10 | > 10



Shown for the 2008 boundaries. Data using older boundaries has been converted where appropriate.
Source: Stifterverband. Calculations by EFI.

FIG 11 **Federal state expenditures on R&D as a proportion of GDP (2007)**



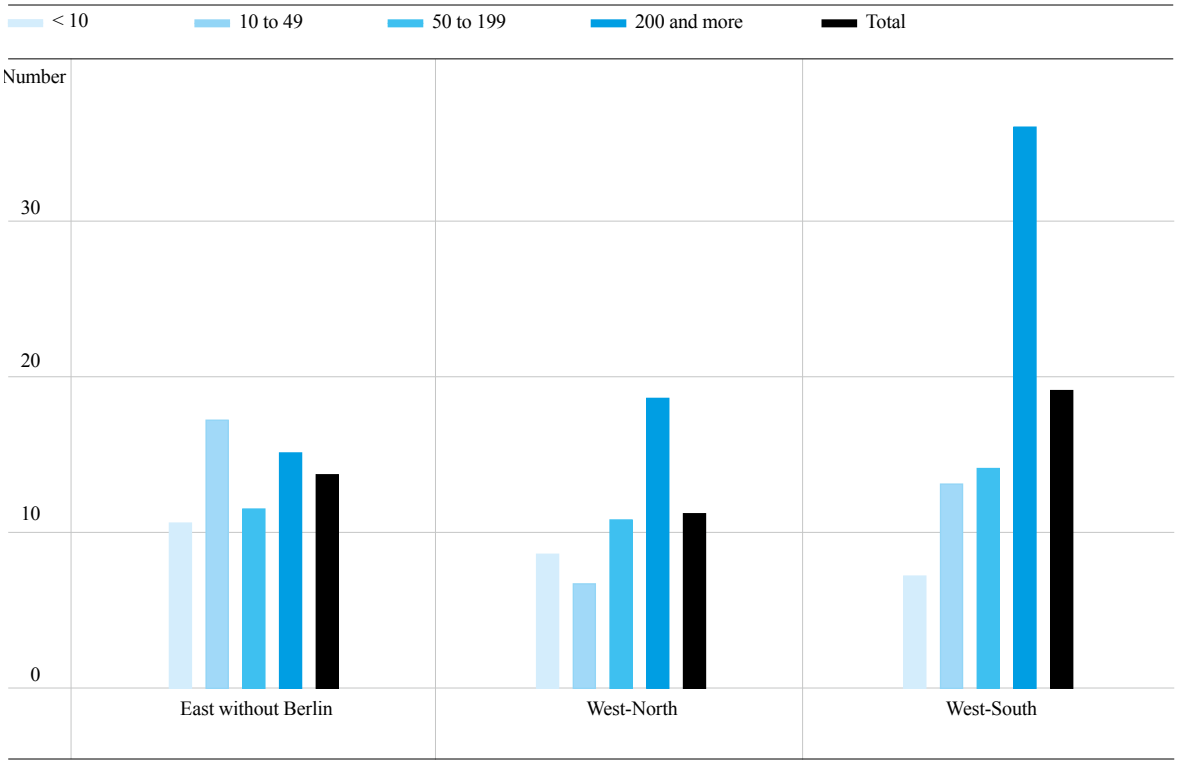
Source: Statistical Federal Agency. Stifterverband, Günther et al. (2010b).

TAB 05 **Structural indicators in comparison**

	east Germany (+ Berlin)	west Germany
No. of residents on 31 December 2008	16.5 million	65.5 million
R&D expenditure as % of GDP 2007	2.2	2.6
R&D expenditure by business as % of GDP 2007	0.9	1.9
Employees in the knowledge economy as % of all business employees. 31 December 2008	32.4	39.9
New enterprises per 10 000 employable persons (start-up intensity) in technology- and knowledge-intensive sectors*	6.1	8.3

*Annual average 2005 to 2008. Sources: Federal and Laender statistical offices. Stifterverband. Federal Employment Agency. Mannheim Company Panel (ZEW). Gehrke et al. (2010). Own calculations.

R&D personnel intensity of companies in 2007 classed according to size[120] FIG 12



Sources: IAB panel 2007. Calculations by IWH. Günther et al. (2010b).

above all from 2002, since when the three Laender have further established their dominant position. In 2007, 58 percent of internal R&D expenditure was concentrated in these Laender.[115]

Different economic structures in east and west Germany

Differences in the R&D intensity between the new and old Laender are attributable mainly to the weak R&D involvement in east Germany. On closer inspection, it is noticeable that there are considerable differences between the economic structures in east and west Germany.

R&D in Germany is mainly carried out by companies in the manufacturing sector. In the old Laender, 89 percent of all private sector R&D personnel work in this sector, although it only accounts for nearly 20 percent of the west German workforce overall. In east Germany only 71 percent of R&D employees work in the manufacturing sector.[116] More important in east Germany is the R&D capacity in the services sector. A quarter of R&D personnel in the east German private sector work in services companies, compared with only eleven percent in western Germany. Correspondingly, the innovation intensity in the knowledge-intensive services sector in east Germany is also much higher than in west Germany. Currently in east Germany, 48 percent of the companies in the knowledge-intensive services sector pursue innovation processes or introduce new services product, which is still lower than the proportion for west Germany (52 percent).[117] But it seems that an innovative core of knowledge-intensive services companies has developed. This is due among other things to the fact that small and medium-sized enterprises in particular outsource research and development assignments to external service providers, e.g. external industrial research institutions.

If individual companies are considered, rather than economic sectors, then there are clear signs that east Germany is beginning to catch up. This approach is possible using the IAB Panel [118]. The proportion of all personnel in east German small enterprises working in R&D is markedly higher than the corresponding value in Bavaria, Baden-Wurttemberg, and Hesse (Fig. 12). In the services sector, the average independent of company size is as high as in the corresponding companies of the leading west German Laender.[119]

More cutting-edge technology in the new federal states

In the new federal states and in Berlin, sectors of cutting-edge technology are better represented than in west Germany, and in addition they show more growth, e.g. in the period 2000 to 2007 employment in these sectors in east Germany increased by 20 percent, whereas in the west it virtually stagnated. Correspondingly, the proportion of employees in manufacturing companies in east Germany working in research-intensive industries increased from 30 percent (2000) to 35.5 percent (2007). The figure in western Germany (45 percent) is still considerably higher, but east Germany has clearly caught up. This also applies for R&D employment. Whereas in east Germany in 2007 some 40 percent of private sector R&D personnel were working in a cutting-edge technology company, only 26 percent in the west were. Information and communications technology, and control and measurement technology are particularly well represented in the east, and are clustered in accordance with the economic history of the various regions. Economic incentives, e.g. in the form of investment subsidies, have had an additional positive influence on the development. The photovoltaics industry is also clustered in east Germany (Box 10), providing a good basis for the future. However, the research-intensive industries in east Germany spend less on R&D than the same sectors in western Germany. This indicates that R&D projects are on average less demanding. However, it also shows that east German structures are not simply copies of those in west Germany, but that new paths are being pursued, though at present there is

BOX 10

The photovoltaic industry

The photovoltaic industry (PV) is a good example of the development of new networks of technological expertise in the new Laender. Meanwhile a number of these industrial centres have established themselves in eastern Germany, with a total of some 10 000 employees (Bitterfeld-Wolfen / Thalheim, Freiberg, Dresden, and Erfurt / Arnstadt).

Photovoltaic cells were already being used in the late 1950s in astronautics. However, broad terrestrial use for power generation seems uneconomic and unnecessary until the early 1990s. Things changed with the emergence of the debate on climate change and sustainable energy supplies. Previous German governments introduced incentive measures such as the "1 000 Roofs Programme", the "100 000 Roofs Programme" and also legislation on energy from renewable sources (EEG). These steps led to the development of a lead market in photovoltaics and a strong photovoltaics industry in Germany.

Along with Japan, Germany became worldwide technology-leader. Offered further financial support, a number of investors chose to locate in former GDR-operations with relevant product spectra, e.g. Freiberg for metallurgy, Dresden and Erfurt for microelectronics. The subsequent clustering phase saw specialised suppliers also locating in the region and the networking of the PV industry with the regional public sector research landscape. Special university chairs and degree courses were set up to meet the demand for skilled personnel in the PV industry.[121] At present, some 60 percent of all jobs in the German PV industry are in eastern Germany and subsidiaries and branches of foreign companies are also locating there.

The PV development shows that eastern Germany can offer a very attractive location for innovative, research-intensive technologies, which are at first less dependent on existing networks that on suitable regional location factors. These companies bring more research activity into the region than conventional manufacturing companies. Establishing PV in the new Laender not only led to reactions in the universities, which offered appropriate new courses, but also stimulated the further development of the non-university research landscape.

In Halle, for example, the Fraunhofer Centre for Silicon Photovoltaics (CSP) was established as a joint initiative of the Fraunhofer Institutes for Material Mechanics (IWM) and for Solar Energy Systems (ISE). The CSP has good links with the private sector. In 2008 the "Solar Valley in Central Germany" was chosen as one of five clusters in the first round of the Federal Ministry of Education's best cluster competition. Over five years it will receive some EUR 40 million funding. Saxony, Saxony-Anhalt and Thuringia and the private sector each also invested comparable sums. A partnership has been formed by 35 companies, science and education institutions in order to rapidly reduce the costs of photovoltaic power. Intensive R&D work is being conducted in the field of crystalline silicon technology.

often not the critical mass needed to develop an independent dynamic.

SMEs in the new federal states play a much more important role in conducting research and development than they do in the old Laender. 39 percent of R&D personnel in the new federal states work in companies with fewer than 100 employees, compared with only 5.6 percent in the old Laender. Large-scale companies carrying out R&D are correspondingly under-represented. Over time, the importance of SMEs for R&D in east Germany has increased. Whereas in the west large scale high-value technology companies (motor industry, chemistry, etc.) represent crystallisation points for the development of R&D clusters, this was hardly possible in the east.
After German unification, foreign and west German companies invested considerable sums directly in east Germany. It is sometimes still claimed that much of this involved the introduction of basic, standardised production methods for low-technology products. In fact, though, the R&D intensity of these companies is now above average, and they have a more modern range of products than the original east German companies.[122] In the past, direct investments were important in order to spread new technologies and expertise in the new federal states. But while they were highly relevant when the east German innovation system was establishing itself, they are mostly inadequately positioned to stimulate its further development. The modern range of products is in part explained by the transfer of company R&D results to their branches in eastern Germany. The local research and development of these technology recipients is often of a lower quality than that of companies in the old Laender.

Fewer private sector, but more academic patent applications in east Germany

Whether investments in R&D subsequently "pay off" is of great importance for the success of the east German economy. There are indications of both a successful process of catching up and also of potential for further improvements. Patent applications per 100 000 inhabitants in west Germany (62 applications in 2008) are 1.6-times higher than in the new federal states. This difference is due to the patent weakness of the east German private sector, although the gap to west Germany is slowly closing. In contrast, the numbers of scientific application in the new Laender relative to the number of scientists is higher than in the old Laender, and the publication activity is also above average. In 2008, there were about 1 200 publications per million inhabitants in the new federal states (not including Berlin), compared with about 1 000 in west Germany.[123] The Berlin science system registered 2 800 publications per million inhabitants. These results are evidence of a viable, application-oriented science system.

According to the Mannheim Innovation Panel[124], the innovator rate, that is the proportion of manufacturing companies who have introduced new products in the past three years, was lower in east Germany in 2008 than in west Germany (44 percent vs. 48 percent), but for companies in the services sector it was considerably higher. There are no signs that the gap here is being closed, although the productivity of innovative manufacturing companies in east Germany is now much the same as that in comparable west German companies.[125]

Companies in east Germany invest a greater proportion of their revenues in innovation processes than companies in west Germany. This is the case in particular for services companies and less so for manufacturing companies. Whether innovations are economically successful is shown by the share of revenues achieved with new products. In 2008, the figure for the east German research-intensive industry was 35 percent compared with a west German value of 39 percent. The proportion of revenue generated with new products in east German services companies is also lower in comparison with the west German Laender. The proportion of revenue generated with market innovations in the knowledge-intensive services sectors in east Germany in 2007 was still higher than in west Germany, but it has now fallen to well below the west German level.[126]

In east Germany, about 44 000 companies were started up annually in the period 2005 to 2008. Of these, some 10 000 were in the technology- and knowledge-intensive sectors, giving an average annual start-up intensity of 6.1 start-ups per 10 000 employable persons (Table 5). In west Germany over the same period a start-up intensity of 8.3 was registered. The start-up intensity in east Germany is only above average in Berlin (9.6). More than a quarter of all new enterprises in east Germany start up there. All

other regions of eastern Germany have below-average start-up activity. However, some urban centres in the new federal states have a start-up intensity, which can stand comparison with west German levels, e.g. Jena, Dresden and Leipzig, and also Potsdam and Magdeburg.

Challenges to innovation policies

The main challenges faced by policy-makers concerning innovation in eastern Germany are the persistent weakness of R&D in the manufacturing sector and the underdeveloped knowledge-intensive services.

In contrast, special strengths include:

- The well-developed public sector research infrastructure and higher education landscape
- The performance of public sector research, as expressed by above-average numbers of patent applications and publications[127]
- The R&D activities in subsidiaries of foreign companies and in the few large-scale companies (which are frequently higher than those of original east German companies)
- The increasing presence of cutting-edge technology companies, which are contributing to the process of catching up with technology in the old Laender.

In view of the fact that development of viable new, innovative structures in the new federal states began almost from scratch 20 years ago, the achievements are impressive.

Favourable conditions for innovation rather than special innovation programmes for eastern Germany

Twenty years after unification, Germany now has a largely uniform R&I system. Certainly, the innovation potential and innovation performance in the new Laender has not yet reached the level of the old Laender, but the evident weaknesses of the eastern German university and research landscape are not fundamentally different from those of the structurally weak regions of western Germany.

- The objective of making the German research and innovation system more competitive internationally and the goal of establishing comparable living conditions in all regions can be seen to be competing, in the short-term, for limited resources. Strengthening the innovation location involves providing support for agglomerations where innovation is already well-developed. Convergence processes, in contrast, require compensation measures between strongly-growing conurbations and structurally weak regions.

- The primary task of the R&I policies of the Federal Government is to strengthen the overall position of Germany in the competition for innovations. In the medium- and long-term this is also in the interests of structurally weak regions. The Expert Commission no longer sees any need

BOX 11

The threat of shortages of skilled personnel – also in the east

The further economic development of the new Laender is threatened in particular by the considerable decline in population being observed in all regions except the area around the capital Berlin. From 1989 to mid-2008 a total of 1.1 million mainly young people left the region. They continue to do so – between 30 000 and 60 000 annually. The new federal states have experienced a considerable reduction in the proportion and absolute numbers of females aged between 15 and 49 years old since the fall of the Berlin Wall, so that there has also been a drop in birth rates.[128] Many of these women were well educated. Migration and low birth rates not only lead to a significant reduction in population, but have also increased the average age from 37.5 years in 1989 to 45 years at the end of 2007.[129] The demographic projections of the Federal Statistical Office show that a further decline in population levels must be expected in the new Laender.[130]

This development can have serious consequences for the innovation system in east Germany. Despite high unemployment, some sectors and regions also face shortages of skilled labour, and this can hinder innovation and make it more difficult to catch up.[131] The demographic problems thus represent a key constraint on the innovative potential of the new federal states.

to develop new programmes specifically for R&I policies in eastern Germany. Neither is there any need to plan new investment programmes, which would only benefit the old Laender. Accelerating or maintaining the convergence process is a concern for structural policy-makers rather than innovation policies. A powerful structural policy instrument are the investment subsidies under the Joint Project "Improving the Regional Economic Structure" (GRW).[132] The Laender should make more use of the scope available to them in order to focus subsidies more on promising sectors of the economy in regions with high development potential.[133] The Expert Commission feels that the instrument of investment subsidies shows deficits both in terms of its efficiency and its effectiveness. Entitlement to investment subsidies only require general conditions to have been met (such as an initial investment by manufacturing companies, production-related services, or the hotel industry). In view of budgetary constraints, it would make more sense to concentrate the support funds.

– The coalition agreement between the parties CDU, CSU, and FDP proposes to evaluate the external industrial research institutions in the new federal states. In consultation with the Laender, the Federal Government will then decide which institutes will be integrated in the research organisations supported by the Federal Government and Laender.[134] The Expert Commission approves of offering institutional support to institutions carrying out important tasks in knowledge- and technology transfer, which can demonstrate adequate quality of research. However, the Commission does not believe that enforced integration in the Fraunhofer Society, the Helmholtz Association, the Max Planck Society or the Leibniz Association would have the desired effects. The Federal Government and Laender could encourage such integration processes where appropriate, but should otherwise leave this up to the institutions concerned.

– The Expert Commission has repeatedly called for the introduction of tax incentives for R&D, improved conditions for the provision of company with equity, and improved framework conditions for business angels and providers of venture capital. This would also have positive effects in structurally weak regions, (e.g. in eastern Germany), where the equity base for companies is particularly weak, little venture capital is available, and large companies are lacking. Innovative new enterprises and financing innovative projects in SMEs would be eased considerably by such measures.

ELECTROMOBILITY B 4

A revolution in the mobility sector

The transformation of the energy systems towards more sustainability is gaining speed. Today, Germany generates 16 percent of its electricity from renewable sources, largely free of CO2 emissions.[135] By 2020 it is planned to at least double this proportion.[136] As a consequence, a largely CO2-free transport system will emerge in the medium- to long-term. This development will be accelerated by the insecurity of supplies of fossil fuels, rising fuel prices, and state regulations driven by climate goals.

Electromobility (Box 12) offers the opportunity to contribute effectively to this transformation process. In addition, it will be possible to achieve a new quality of living in towns and cities. Electric vehicles have the advantage that they release no harmful local emissions[137] and can be designed to

Electromobility BOX 12

Electromobility refers to the use of electrically-powered vehicles, in particular cars and light goods vehicles, but also electric scooters and bicycles and light-weight vehicles, together with the associated technological and economic infrastructure. The various vehicle types under discussion are listed in Table 6.
Both electric power and hydrogen fuel require the construction of appropriate infrastructure. Setting up the hydrogen infrastructure is much more complicated than providing power supplies. Hybrid vehicles are already commercially available, and Asian companies were pioneers in their introduction. Battery electric vehicles currently only find niche applications, e.g. as light-weight vehicles produced in small series. Many car makers have announced that models will go into series production in the coming years.