

OECD SCIENCE, TECHNOLOGY AND INDUSTRY SCOREBOARD 2007

BRIEFING NOTE ON GERMANY

Innovation and performance in the global economy

Throughout the world, innovation and globalisation are the two major sources of countries' economic performance. They directly affect productivity, job creation and citizens' well-being, and they help make it possible to address global challenges such as health and the environment. As their role has taken on greater prominence, their characteristics have evolved and policies have had to adapt.

The eighth edition of the *OECD Science, Technology and Industry Scoreboard* explores recent developments in matters relating to science, technology, globalisation and industrial performance. It points to an increasing globalisation of science and technology activities encompassed by more stable trends in investment in knowledge. The pace of diffusion of information and communication technologies has become steadier than in the heady days of the late 1990s, notably in terms of broadband Internet access among households and adoption by businesses for e-commerce. Public policies that seek to foster innovation are being progressively reoriented, from subsidies and procurement to alternative instruments such as R&D tax relief and reinforcement of industry-science linkages.

Investment in knowledge mainly driven by R&D

Like Denmark, Finland, Canada, Spain, Portugal, Greece, Australia and Austria, **Germany** is one of the countries where investment in knowledge has been driven mainly by the investment in R&D over the period 1997-2004. The gross domestic expenditure on R&D (GERD) reached 2.5 % of GDP in 2005, placing Germany among the top ten OECD countries for this indicator. The R&D activities are mainly financed and performed by business enterprises (over 60%).

Contrary to France, business R&D intensity in Germany was above the OECD average in 2005 (2.4%). The change in this share over the 1995-2005 period in Germany is comparable to the EU27 average (3.0%). The share of R&D performed by small and medium-sized enterprises (SMEs) was less than 20% as in most of the large OECD economies.

One important particularity observed in Germany is the low share of R&D carried out in service sectors (8.3%). In this respect, this country is comparable to France (9.8%), Japan (9.3%) and Korea (7.2%). As regards manufacturing R&D expenditure, it is skewed towards medium-high-technology industries, which accounted for 60% in 2004.

In Germany, the level of venture capital as a percentage of GDP (0.05%) was under the EU and the OECD average (0.1%). As in Sweden and Japan, in Germany the share of high-technology sectors in total venture capital was around 35%, slightly under the OECD average (40%) in 2005.

Significant human resources in S&T...

After China, Korea and Sweden, Germany, with 2.1 doctorates granted per 100 inhabitants, is among the OECD countries where highest rates at doctoral level are observed. The doctorate holders are equally distributed in science and engineering fields (approximately 30% each), even though their overall share showed a decrease in 2004 compared to the 1998 figures.

...but modest employment of tertiary level graduates

On the other hand, Germany's average annual growth rate of tertiary-level graduates was the weakest (1.0%) compared to other OECD countries (3.6% on average) over the 1998-2004 period. Tertiary-level graduates represent around 25% of the total employment in Germany (similar to the EU19 average), with Canada (43.8%), Japan (41.7%) and the United States (38.9%) being the leading countries in this field.

In 2004, HRST workers represented over 35% of total employees in Germany as is also the case in Sweden, Luxembourg, Switzerland, Australia, Denmark and the Netherlands. 43.9% of the HRST workers are concentrated in services and 24.2% in manufacturing. R&D personnel represented 12.2% of the total employees in Germany (compared to the highest: 24% in Finland) and this share remained quite stable over the 1995-2005 period. Researchers represented less than 10% of total employment (against 16.5% in Finland) in 2005.

Innovation policy: a focus on industry science linkages

The share of R&D financed by the government reached 5.9% in Germany (this figure was 9.3% in France and the United States, 8.6% in the United Kingdom and 2.4% in Denmark). Between 1995 and 2005, business funding of public R&D (higher education and government sectors) increased slightly in the European Union (from 6% to 6.5%) and more in Germany (from 6% to 8%). It remained stable in France at 6%.

In Germany R&D expenditures do not benefit from special tax relief whereas they do in most of the OECD countries, notably Spain, Portugal, Norway and France.

In Germany, Sweden and Japan, university professors are entitled to own patents resulting from their research. The patents are thus registered as belonging to individuals or businesses rather than to public institutions. This is why the share of patents filed under PCT owned by universities is low in these countries.

In Germany firms collaborate on innovation with higher education institutions to a quite important extent (4.4% of SMEs and 22.4% of large firms). These shares are, respectively, 2.6% and 18.7% in France, and 3.9% and 12.7% in the United Kingdom. In most of the Northern European countries, firms cooperate more with government institutions than in Germany (2.0% of SMEs and 13.2% of large firms).

A leading place in biotechnology R&D

Business sector expenditures on biotechnology R&D are the highest in Germany (USD PPP 1347 million) among the EU countries for which data are available. This corresponds to 3.3% of total R&D expenditures (5.7% in France, 7% in the United States).

The majority of biotechnology firms are active in health (65% in Germany and the United States, 41% in France), followed by agro-food (21% in Germany and 17% in France) and industry-environmental applications (14% in Germany).

Outstanding performance in S&T and innovation...

The number of triadic patent families remained stable in Australia, Germany, France, Sweden and Switzerland, while those originating from Denmark, Finland and the United Kingdom decreased on average by 2%, 6% and 1%, respectively, between 2000 and 2005. The United States, Japan and Germany accounted, respectively, for 31%, 28.8% and 11.9% of patent families in 2005. When triadic patent families are normalised using total population, Japan, Switzerland, Germany, the Netherlands and Sweden appear as the five most innovative countries in 2005.

Germany, together with Japan, Korea, the Netherlands and Switzerland, has had the highest level of patent intensity (patents by R&D) in the OECD area in recent years. In Germany, as in most of the European countries, technologies for medium-high R&D-intensive industries are the most important in total patenting.

Germany issued 6.3% of world-wide scientific publications in 2003, against 4.6% for France and 6.9% for the United Kingdom. In terms of the “prominence” of scientific publications (citation rates), Germany ranks behind the United Kingdom and the European Union average, and far below Switzerland and the United States.

The shares of product innovators among large firms and SMEs are very high in Germany (53.7% and 27.3% respectively) and rank among the leading countries of the EU. However, German SMEs fare worse as process innovators, with a lower rate than French SMEs (15.4% against 17.8%). The leading performance of German SMEs (second after Japan) as compared with large firms applies to non-technological innovation as well (78.5%).

...but modest internationalisation of S&T sectors

The extent of internationalisation as reflected in foreign ownership of domestic inventions varies substantially across countries. For the 2001-2003 period, it represented over 50% in Luxembourg, 25.4% in France, 15.1% in Germany and 13.6% in the United States.

In the 2000s, like most OECD countries, Germany has become more strongly involved in cross-border innovative activity, but domestic ownership abroad represents 12.9%, which is quite low compared to France (20.7%), Belgium (34.1%) or the Netherlands (38.3%).

In both these respects, and as with most European countries, Germany’s main partners are the EU countries, followed by the United States.

For the 2001-2003 period, Germany reported that 12.3% of patents had foreign co-inventors, which is another indicator of S&T internationalisation. In France, Sweden and the Netherlands, this share was around 16%.

Investments in ICT continue to grow

In 2003, the share of ICT investment in GDP was under 2% in Germany, Ireland, Greece, Italy and Portugal, whereas it was at least 3.5% in Australia, the United States, Sweden and Finland. In Germany, as in most of OECD countries, the share of ICT in total investment declined from 2000 to 2005 following the burst of the dotcom bubble.

Software remains the fastest-growing component of ICT investment. Its share in non-residential investment was multiplied by 2 in Germany, 3 in Sweden and 5.5 in France between 1990 and 2005. Software's share in total investment was 7% in Germany, 10.7% in the United Kingdom, 11% in France and 14.5% in the United States.

Germany is among the leading EU countries with respect to the number of Internet subscribers per 100 inhabitants (33), after Sweden (35.4), the Netherlands (33.7) and Denmark (33.6) in 2005. In the United Kingdom and France, these figures were 26.7 and 21.2.

In Germany, as in most OECD countries, the volume of Internet and other e-commerce sales transactions is increasing as a percentage of total turnover.

Labor productivity slowing down

A country's labour productivity level is typically the most significant factor in determining differences in income. Labour productivity, measured as GDP per hour worked, was 6 percentage points lower in Germany in 2005 compared to the United States (-15 in the United Kingdom, +1 in France, +11 in Belgium and +38 in Norway). Since 2000, like most OECD countries, Germany experienced a marked slowdown in labour productivity growth. In the first half of the 2000s, this figure was around 1.3% in Germany, 1.5% in France and 2% in the United Kingdom.

Technological effort is a critical determinant of productivity growth and international competitiveness. Of the larger OECD economies, only Germany, Japan and Korea have maintained a strong and persistent presence in high and medium-high-technology manufacturing over the last decade. The share of gross value added in the high and medium-high-technology manufactures was 15.1% in Korea, 12.7% in Germany, 9.7% in Japan and 5.6% in France. As in most of the European countries, the share of medium-high and high technology manufactures in total exports is quite high in Germany (20.2% and 50.8% respectively).