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OECD Science, Technology and Industry Scoreboard 2005

Executive Summary

The long-term trend towards a knowledge-based economy continues. Science, technology and innovation have become key factors contributing to economic growth in both advanced and developing economies. This seventh edition of the OECD *Science, Technology and Industry Scoreboard* focuses on the growing globalisation of knowledge. This is not a new phenomenon *per se*, but it has become more pervasive, mainly driven by the use of information and communication technology (ICT). In the knowledge economy, information circulates at the international level through trade in goods and services, direct investment and technology flows, and the movement of people. Firms use ICTs to organise transnational networks in response to international competition and the increasing need for strategic interaction. As a result, multinational firms are a primary vehicle of the ever-spreading process of globalisation.

New technologies and their implementation in productive activities are changing the economic structure and contributing to productivity increases in OECD economies. Some examples of recent trends include:

- New channels for knowledge generation, diffusion, protection and application.
- New interactions owing to the increasing importance of networks, linkages, partnerships and mobility.
- New global actors from non-OECD countries.

This publication brings together a wide range of charts and analyses relative to emerging policy issues including the changing nature of research activities, the international mobility of researchers and scientists, the increasing pace of innovation as measured by patenting, the growth of the information economy, the important role of multinational enterprises, and new patterns in trade competitiveness. It also focuses on the emergence of key international players outside the OECD area, notably China. A selection of the most notable facts and figures in each of these areas is presented below:

R&D and innovation: creating and diffusing knowledge

- Investment in knowledge (comprising expenditure on R&D, software and higher education) in the OECD area reached around 5.2% of GDP in 2001, compared to around 6.9% for investment in machinery and equipment.
- In 2003, Sweden had the highest R&D intensity (4% of GDP), followed by Finland, Japan and Iceland (all over 3%).
- China has become the third largest R&D performer behind the United States and Japan (mainly owing to rapid growth in researchers' salaries).
- Small and medium-sized enterprises (fewer than 250 employees) play an important role in innovation but only account for around 30% of total R&D expenditure.

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- R&D activities are increasingly internationalised, but the share of foreign affiliates in industrial R&D varies widely, from less than 5% in Japan to over 70% in Hungary and Ireland.
- Government R&D budgets in OECD countries have increased annually by an average of 3.5% (in real terms) since 2000. Three-quarters of the growth in the government R&D budget in the United States between 2001 and 2005 is attributable to defence R&D.
- An increasing number of countries use R&D tax concessions to encourage business R&D expenditure. Today, 18 OECD countries have R&D tax credits in place, 50% more than in 1996. Canada, the Netherlands and Italy focus on small firms, while others do not distinguish by size.
- In 2001, 82% of the world's scientific articles were from the OECD area, two-thirds of which from G7 countries. In terms of relative intensity (articles per population), Sweden, Switzerland and Finland have the highest figures within the OECD.

Human resources in science and technology: knowledge and skills

- Science and engineering (S&E) degrees represent 23% of new degrees awarded in OECD countries, 27% in the EU and 16% in the United States. However, since 1998, these shares have declined in many countries.
- Professional and technical workers represent between 25% and 35% of total employment in most OECD countries, and over 35% in Sweden, Luxembourg, Switzerland and Australia.
- In 2003, China had the world's second largest number of researchers (862 000), behind the United States (1.3 million in 1999), but ahead of Japan (675 000) and the Russian Federation (487 000).
- More women than men have found employment in the rapidly rising professional and technical occupations, but women represent only 25% to 35% of total researchers, mainly in the higher education sector. Their participation is particularly low in industry.
- Migration streams converge towards four main destinations: the United States with over 7.8 million highly skilled expatriates, the European Union (4.7 million), Canada (2 million) and Australia (1.4 million). Over half come from outside the OECD area.
- Foreign students represent more than a third of doctoral enrolments in Switzerland and Belgium and more than a quarter in the United Kingdom and the United States.

Patents: protecting and commercialising knowledge

- More than 442 000 patent applications were filed in Europe and the United States in 2002, compared to around 224 000 a decade earlier.
- Patenting activity is heavily concentrated. In 2001, France, Germany, Japan, the United Kingdom and the United States accounted for 83.6% of all triadic patent families.
- Two technology fields contributed more than the average to the overall surge in patenting: biotechnology and ICT. Between 1991 and 2001, biotechnology and ICT patent applications to the European Patent Office (EPO) increased by 9.1% and 8.3% respectively, compared to 6.0% for all EPO patent applications.

- Non-member countries such as Brazil, China, India and the Russian Federation have a high level of internationalisation compared to large OECD countries. For example, two-thirds of the Russian Federation's EPO patents are owned or co-owned by foreign residents.
- Of the G7 countries, the United Kingdom is the most internationalised according to three measures: foreign ownership of domestic inventions, domestic ownership of inventions made abroad and patents with foreign co-inventors.
- The breakdown of internationalisation indicators by partner country shows that common language, historical links and geographical proximity play an important role in determining partner countries.

ICT: an enabler for the knowledge society

- In 2001, the ICT sector represented 10% of business value added in the OECD area. Its share was highest in Finland (16%), followed by Ireland (13%).
- The ICT sector invests heavily in R&D. In 2002, ICT manufacturing industries accounted for more than a quarter of total business R&D expenditure in most OECD countries.
- In the OECD area on average, a quarter of all businesses use the Internet for purchasing and about one-eighth for selling.
- The share of Internet sales in total sales is increasing across the OECD area, but the level is still quite low. The most commonly reported barrier is that the products are not suitable for Internet sale. Other significant barriers are security and legal concerns.
- By the end of 2004 there were 118 million broadband subscribers in the OECD area, an increase of 34 million from 2003.
- For the first time, the number of fixed telephone lines is falling, with the increasing prevalence of mobile phones and broadband. With the latter, many users are giving up fixed lines previously used for dial-up Internet access.
- Demand for the Internet has largely driven the growth in home computer access. In Iceland in 2004, 86% of households had access to a computer.
- In almost all OECD countries, households with children are more likely to have Internet access at home and men are more likely than women to use the Internet. However, significantly more women than men use the Internet in the United States.

Knowledge flows and the global enterprise

- Over 1999-2003, trade in both goods and services increased but the share of trade in goods was four times that of trade in services. High-technology goods (mainly computers and aircraft industry products) were the most exposed to international trade competition as they had the highest export (exports/production) rates and import penetration rates (imports/domestic demand).
- Over the period 2000-03, direct investment flows showed a marked decline. Among the G7 countries, the decline was largest in the United Kingdom and France for outward investment and in Germany, France and the United Kingdom for inward investment.
- In 2001, the share of the turnover of foreign-controlled affiliates in total manufacturing turnover ranged from 75% in Ireland to less than 3% in Japan.

- In 2002, the share of the turnover of foreign affiliates was lower in services than in manufacturing industry, except in Norway, Finland and Germany.
- Between 1995 and 2001, the share of foreign affiliates in manufacturing value added increased, particularly in Ireland, Sweden and Norway.
- The contribution of foreign affiliates to labour productivity growth in host countries was largest in the Czech Republic and Sweden.
- As regards trade in technology, between 1993 and 2003, the United States and Japan were largely in surplus while the European Union showed a deficit, mainly due to Germany, Italy, Spain and Ireland.

The impact of knowledge on productive activities

- Investment in ICT accounted for between 0.35 and 0.9 percentage point of growth in GDP over the period 1995-2003. Australia, Sweden, and the United States received the largest boost from ICT capital. In Ireland, Finland and Greece, growth in multi-factor productivity was also an important source of GDP growth.
- In many OECD countries, notably Australia, Greece and the United States, business sector services accounted for the bulk of labour productivity growth in recent years. ICT manufacturing and services were particularly important in Finland and Sweden, whereas other high- and medium-high-technology industries were particularly important in Japan, Sweden and the United States.
- The share of knowledge-based "market" services continues to rise and now accounts for over 20% of OECD value added. The share of high- and medium-high-technology manufacturing fell to about 7.5% of total OECD value added in 2002, compared to about 8.5% in 2000.
- Trade in high technology industries has recovered from a strong downturn in 2000-01. From 1994 to 2003, pharmaceuticals had the highest growth rate in manufacturing trade in the OECD area.
- High-technology industries accounted for over 50% of all manufacturing exports in Ireland, and for over 30% of exports in Switzerland, Korea, the United States, the United Kingdom, Hungary and the Netherlands.
- In 2002, about 40% of all persons employed in the manufacturing sector were employed in occupations that can be considered services-related, *e.g.* management, business, finance and legal professionals.
- OECD countries accounted for just under 80% of worldwide value added in manufacturing in 2002. China accounted for about 8%, slightly above Germany's share. Out of the ten top global manufacturing countries in 2002, nine were OECD members.