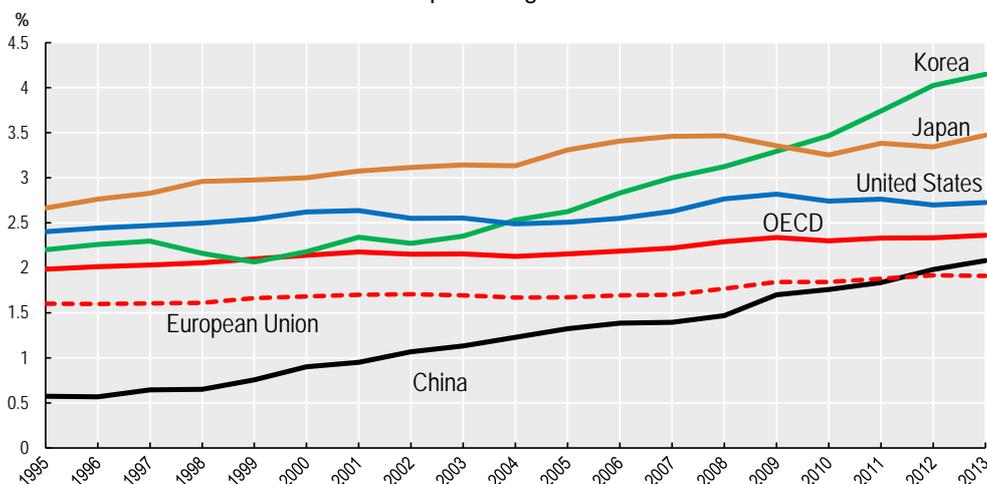


OECD Science, Technology and Industry Scoreboard 2015

KOREA HIGHLIGHTS

- Korea has one of the highest levels of R&D expenditure relative to GDP in the OECD area (4.1% in 2013). Korea leads in the development of frontier technologies and is a top player in 11 of today's 20 rapidly accelerating technologies. Equipped with an R&D-intensive manufacturing sector, a strong science and engineering base and firms operating at the global technology frontier, Korea is ready for the next production revolution.
- Korea also leads in creative activities, as measured by ICT and audio-visual-related designs. Beyond R&D, Korea is investing heavily in the future, by nurturing human capital, improving organisational capabilities and strengthening workers' skills.
- Korea has increased its integration in global value chains (GVCs) over time, mostly relying on Factory Asia and its close engagement with China. China's demand for Korean products accounts for almost 10% of jobs in the Korean business sector, the highest percentage in G20 economies. Yet, the service content of Korea's manufactured exports and the innovation rates in the service sector are fairly low, pointing to the need to improve innovation and competitiveness in services for firms to capture more value along GVCs.
- With Korean firms increasingly operating at the technological frontier, investment in fundamental research is a key challenge, as is better tapping into domestic and global science and innovation networks. Strengthening collaboration across firms and with the research sector, as well as connecting to knowledge abroad, including through greater international mobility of researchers, can provide an additional impetus for new sources of growth and creativity.
- Another challenge for Korea is to engage smaller companies more widely in the use of frontier technologies for new production and innovative processes. In empowering society through science and technology, it will be important to pay attention to the emergence of "divides".

Figure 1. Total expenditure on R&D, OECD and selected economies, 1995-2013
As a percentage of GDP



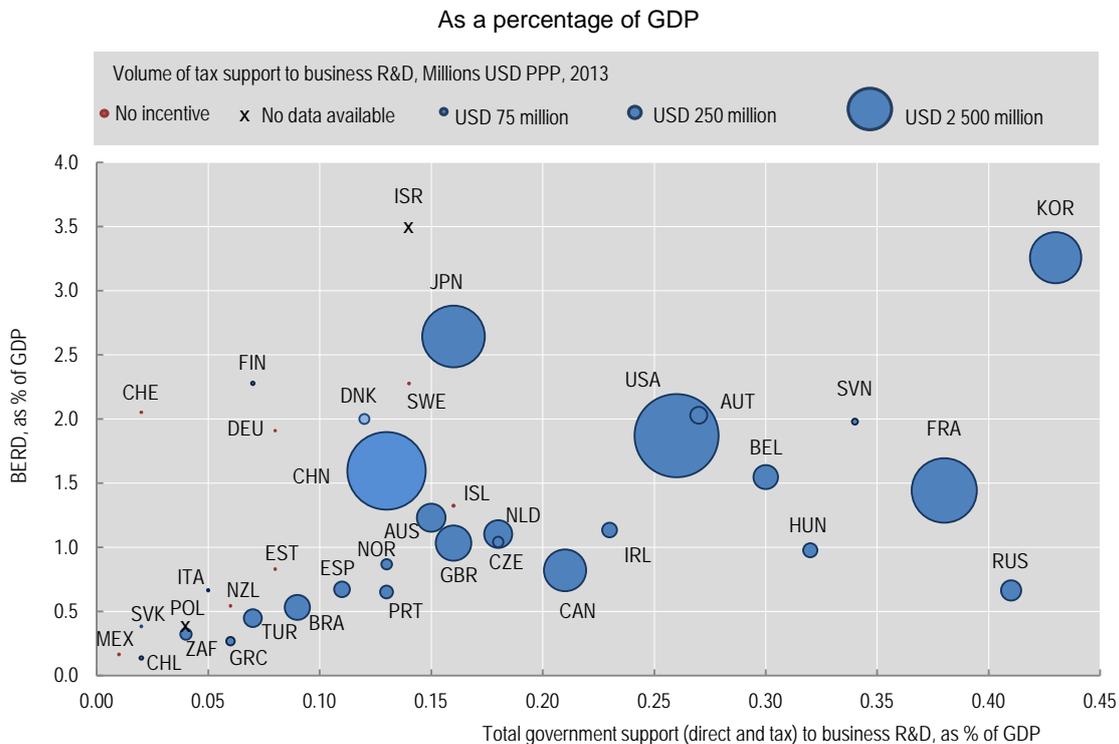
StatLink  : <http://dx.doi.org/10.1787/888933273253>

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see www.oecd.org/sti/msti.htm.

By 2013, total R&D spending in the OECD area grew by 2.7% in real terms to reach USD 1.1 trillion, while its share in GDP remained unchanged from 2012 at 2.4%. In Korea, R&D expenditure grew by 6% over 2012-13 and by 66% in real terms over 2007-13, primarily boosted by the business sector. Over the past 20 years, Korean R&D spending as a share of GDP has doubled to reach 4.1% in 2013, the second highest R&D intensity in the OECD, only slightly below Israel.

Business R&D dominates, including in basic research – R&D in Korea is almost entirely performed (78.5%) and funded (76%) by the business sector. 63% of all R&D is directly targeted at developing specific new or improved applications (i.e. experimental development). Spending on basic research represented about 20% of total R&D spending in 2013, a share similar to other countries such as the United States or the United Kingdom. However, while most basic research in other economies (between 50 % and 75%) is performed in the higher education sector, in Korea about 60% of all basic research is done in companies and only 20% in universities and higher education institutions. Korea has one of the lowest rates of **business R&D funded by firms or institutions from abroad**. Most business R&D is internally funded, with 6% of direct funding received from government. In addition, Korean firms receive the equivalent of 8% of total business R&D through tax incentives. As a percentage of GDP, total government support to business R&D is the highest of all OECD countries (Figure 2).

Figure 2. Business R&D intensity and government support to business R&D, 2013



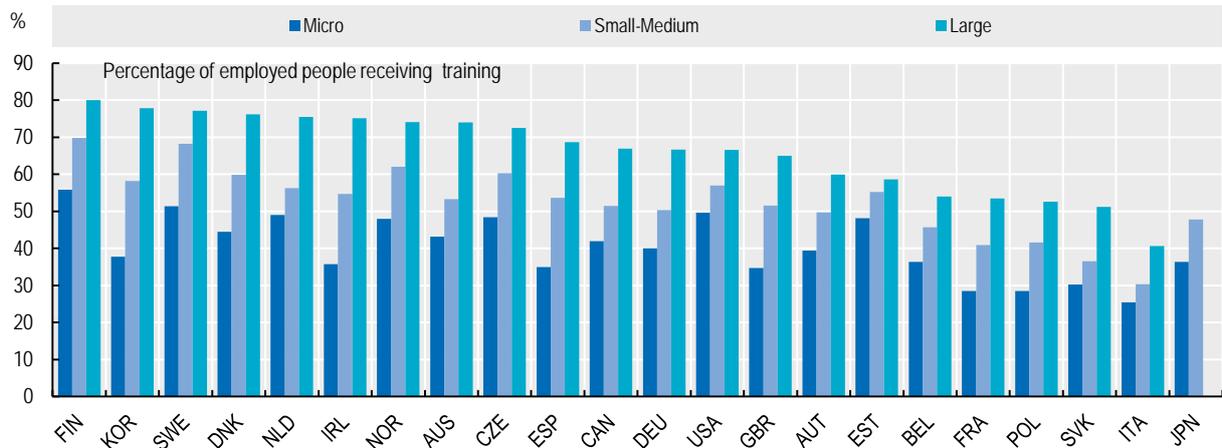
StatLink  : <http://dx.doi.org/10.1787/888933273275>

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see www.oecd.org/sti/rd-tax-stats.htm

Strong investment in broader knowledge – Innovation relies not only on investment in R&D, but also on knowledge-based capital (KBC) - complementary assets such as software, design and human capital. KBC investment globally has proven resilient to the crisis, and 2013 data show KBC investment intensifying in every sector of OECD economies. As for Korea, the country is investing beyond R&D in assets such as organisational capabilities and firm-specific skills. With Canada and the United States, Korea has among the highest levels of expenditure on higher education as a share of GDP, at 2.6% in 2011. New OECD indicators also show that workers in Korea benefit from on-the-job training to a similar extent as in Northern European countries (Figure 3). Korea also features the highest percentage of investment in on-the-job training (almost 3% of gross value added).

Figure 3. Investment in firm-specific on-the-job training, by firm size, 2011-12

Percentage of employees receiving training in the respective size category



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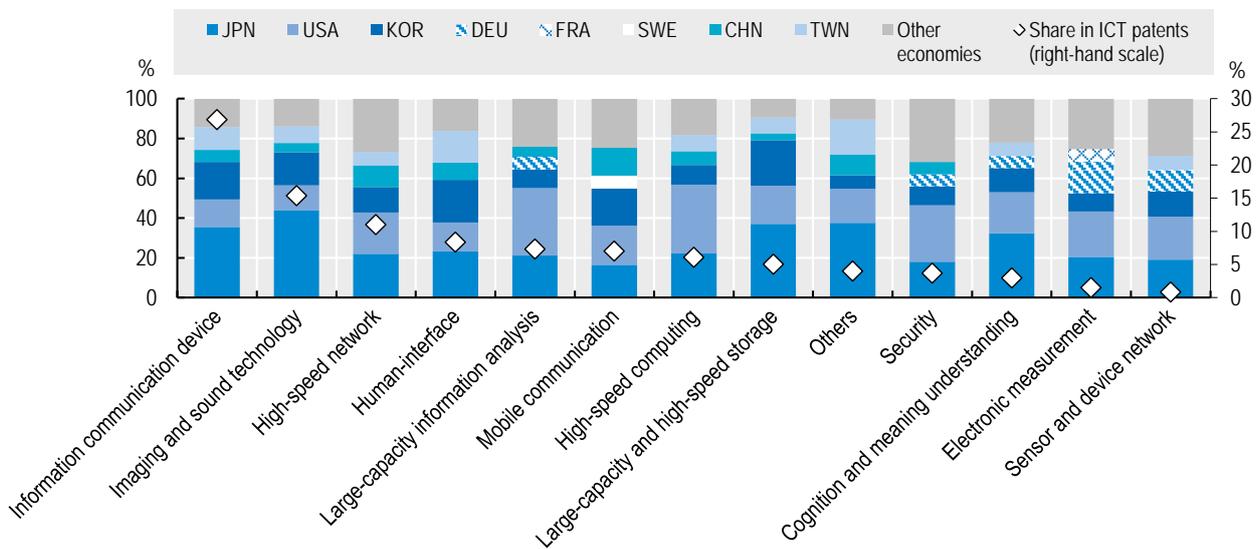
Note: Micro firms employ 1-10 workers, small and medium-sized firms employ 11-250 workers, and large firms employ more than 250 workers.

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

Leadership in ICT technologies – Buoyant R&D in Korea is built upon strong education in natural science and engineering. The country has the highest percentage of tertiary graduates in these disciplines in the OECD area (32% in 2012, although this is down from 39% in 2002). As a consequence, [the share of R&D personnel in total employment has doubled](#) over the past 10 years, with 80% of researchers employed in the business sector. R&D leadership has placed Korea at the frontier in the development of cutting edge technologies, in particular in ICT-related technologies (Figure 4). Information industries in Korea account for 56% of total business R&D, the highest share in OECD. The patent portfolio of leading R&D corporations located in Korea reveals a strong technology specialisation in all ICT-related technology areas, and in associated fields, such as [semiconductors and optics](#).

Figure 4. Patents in ICT-related technologies and major players, 2010-13

Share of the top five players in specific fields and share in all ICT patents



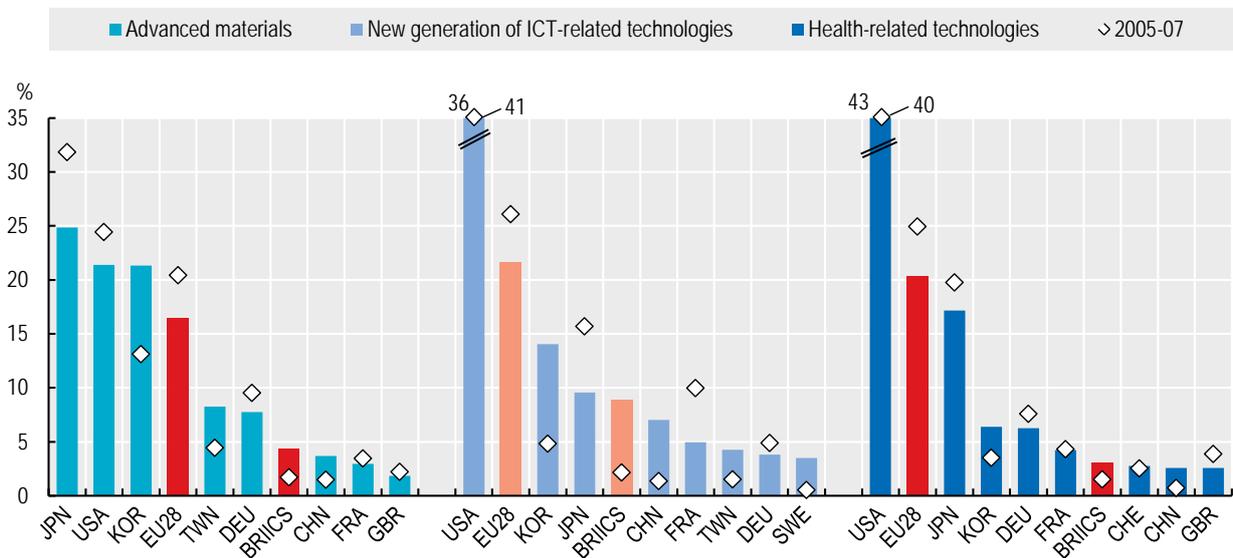
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Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/ipstats>.

Top player in frontier technologies – Disruptive technologies displace established ones and affect production processes, the entry of new firms, and the launch of groundbreaking products and applications. Examples of such technologies include sensors, computers and experimental gene therapies. Many of the most exciting or useful products available today owe their existence, performance, efficacy and accessibility to the recent development of disruptive technologies in fields such as advanced materials, information and communication technologies, and health-related technologies. In 2010-12, the United States, Japan and Korea led inventive activities in these domains, together accounting for more than 65% of patent families filed in Europe and the United States (Figure 5). Over time Korea has increased its leadership in these disruptive technologies. New OECD work points to the extent to which technologies emerge, develop, stabilise or abate. Korea is a top player in [11 of the 20](#) fastest accelerating technologies, notably in technologies relating to the “human interface for digital data transfer”, a set of technologies that underpin the Internet of Things.

Figure 5. Top players in selected disruptive technologies, 2005-07 and 2010-12

Economies' share of IP5 patent families filed at USPTO and EPO, selected technologies



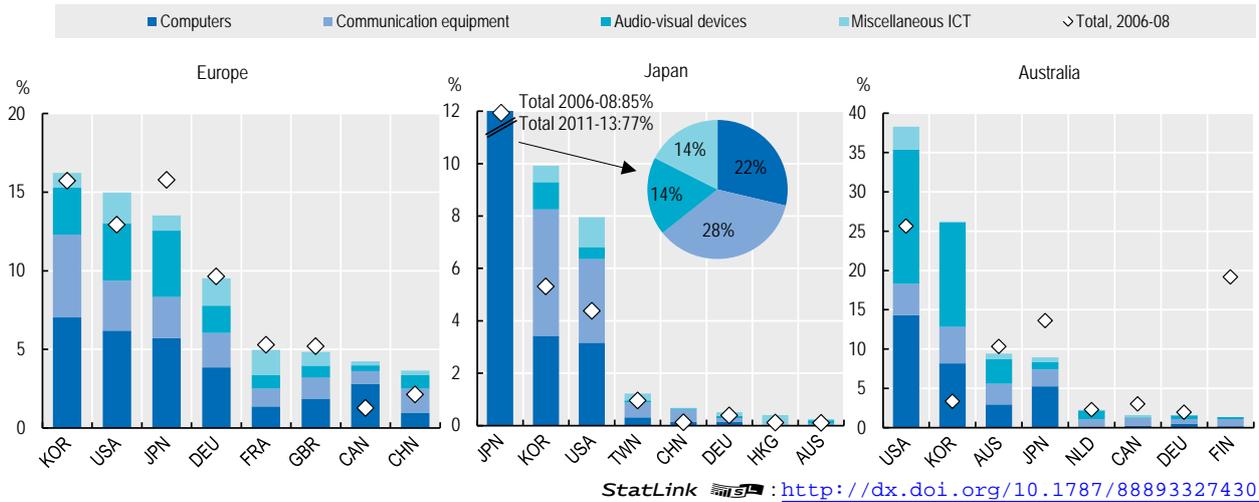
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Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/ipstats>.

Creativity in the digital economy – Products that embody the latest technologies and have an appealing design and brand are very likely to meet with success on the market. Besides patents that reflect the output of inventive activity, Korea is also leading in creative activities related to ICT and audio-visual, as measured by design applications. Design differentiates products in a unique manner that makes them visually appealing to consumers and is at the heart of creative industries. Industrial design protects the aesthetic aspects of products, not their functionalities, and is increasingly used in ICT to protect intellectual property related to the appearance of new smartphones and media players. Korea, the United States and Japan are top ICT design applicants in all the markets considered, with a particularly high penetration of Korea in the European market (Figure 6).

Figure 6. Top applicants' share in ICT and audio-visual-related design applications, 2006-08 and 2011-13

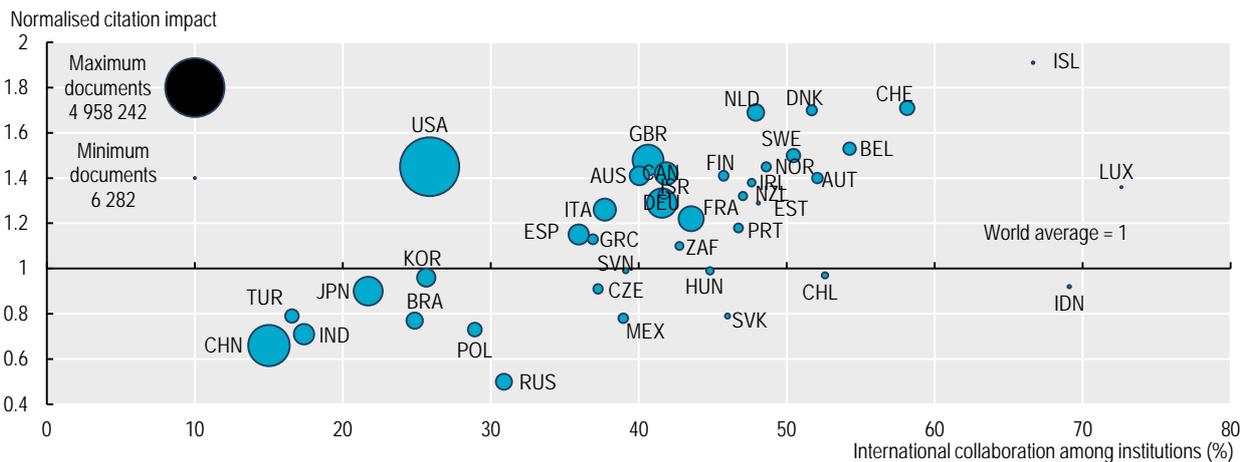
Percentage share of top 8 applicants at EU trademark office, Japan Patent Office and Australia IP office



Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/ipstats>.

Low domestic and global linkages – Korea’s output of scientific publications is similar to that of countries like Australia and Spain, reflecting a relatively modest public research effort within the broader innovation system. The “average” overall impact of these publications as measured by normalised citations is just below the global average. The average impact of scientific production and the extent of international scientific collaboration are highly correlated, with the exception of the United States (which has high impact but relatively low levels of collaboration) (Figure 7). A key weakness of Korea’s science and research system, reducing the impact of its scientific research, is its low level of international collaboration, as measured by co-authorships, co-inventions, and collaboration among innovative companies.

Figure 7. The citation impact of scientific production and the extent of international collaboration, 2003-12



Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/scientometrics>.

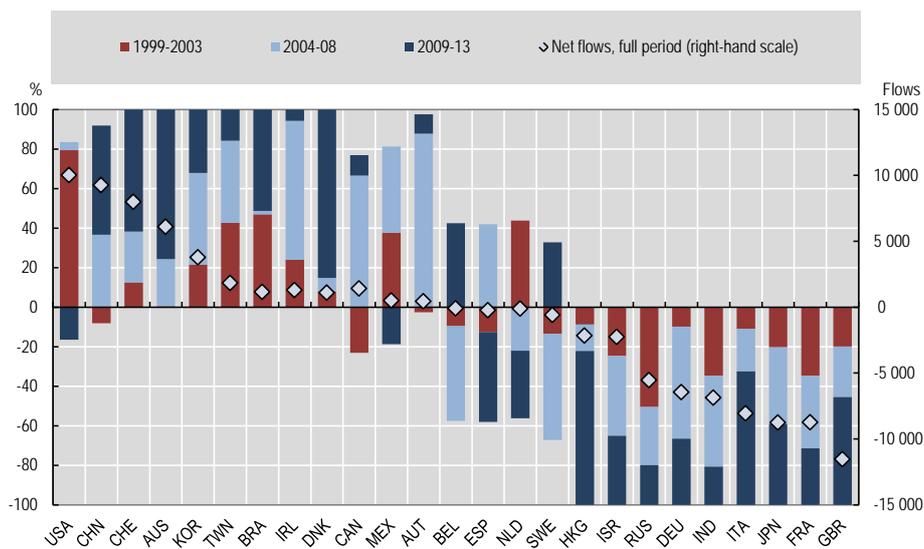
The need for more open and collaborative innovation – International collaboration can play an important role also in business innovation by allowing firms to gain access to a broader pool of resources and knowledge at lower cost and to share risks. While on average large firms have a higher propensity to collaborate abroad than SMEs, in Korea, less than 7% of large firms introducing new products and processes and less than 4% of innovative SMEs

collaborate internationally. Korean companies also appear to [engage less with customers and suppliers](#), partly due to Korea's conglomerate industrial structure, which tends to retain technology development within the group. Collaboration on innovation with higher education or public research institutions constitutes an important source of knowledge transfer, especially for large firms. Business engagement with the research sector is still limited, however. [About 26%](#) of large innovative companies were engaged in collaborative innovation activities with the research sector over 2011-13 as were about 15% of innovative SMEs.

Building research capacity – The diffusion and circulation of scientific knowledge is aided by the international mobility of students in higher education and of scientists. One means to track mobility of scientists who publish is to trace changes in institutional affiliation over their full list of publications in scholarly journals. This approach shows that the nine largest international bilateral flows of scientists over the period 1996-2013 involved exchanges with the United States. In the case of Korea, there has been [a net inflow from the United States to Korea](#), i.e. over the last twenty years. This implies more scientists who started by publishing in the United States that changed affiliation to institutions in Korea than vice versa, perhaps reflecting a return home of Korean nationals, after having studied and started their research career in the United States. Most of the positive net inflows of researchers in Korea occurred over the 2004-2008 period (Figure 8). Since 2010 these net flows have been declining, although they remain positive.

Figure 8. International net flows of scientific authors, selected economies, 1999-2013

Difference between annual inflows and outflows, as percentage of cumulative net flows



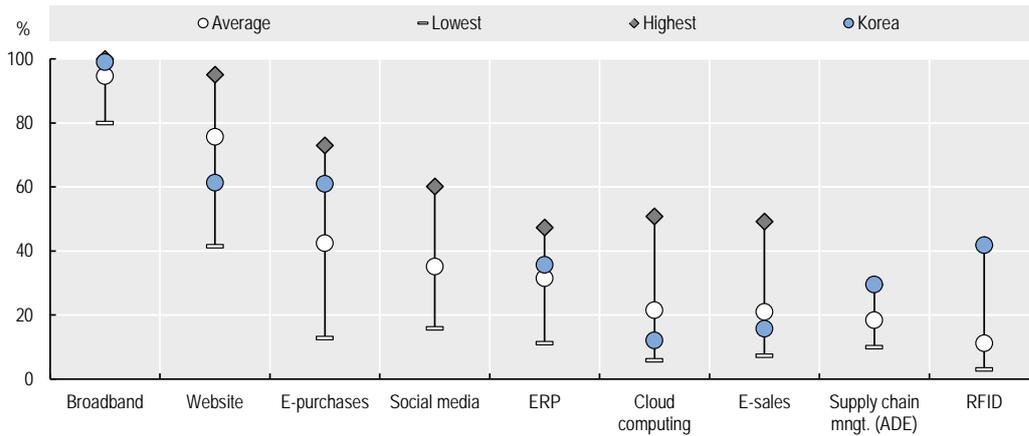
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Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

Engaging all businesses in digitisation – Electronic business (e-business) can help drive business growth by enlarging enterprises' market reach and saving on costs. In 2014, 95% of enterprises in the OECD area had a broadband connection and over 76% had a website, but only 42% purchased via e-commerce. The use of more sophisticated ICT applications e.g. those used to manage information flows (ERP) or Radio Frequency Identification (RFID), is usually less widespread or uptake is limited to certain type of businesses. Cloud computing merits special attention, as it allows firms to scale up, use and pay for on demand computing services. In Korea, the uptake of cloud computing and e-sales are below the OECD average, particularly due to smaller businesses. In Korea, 15.7% of enterprises were selling online, below the OECD average at 21%. Only 10% of Korea's small and 24% of its medium-sized enterprises were using cloud computing in 2013. Conversely, the use of some other sophisticated applications, such as those for managing supply chains or RFID technologies, was more common in Korea than in other OECD countries for which the data are available (Figure 9).

Figure 9. Diffusion of selected ICT tools and activities in enterprises, 2014

As a percentage of enterprises with ten or more persons employed



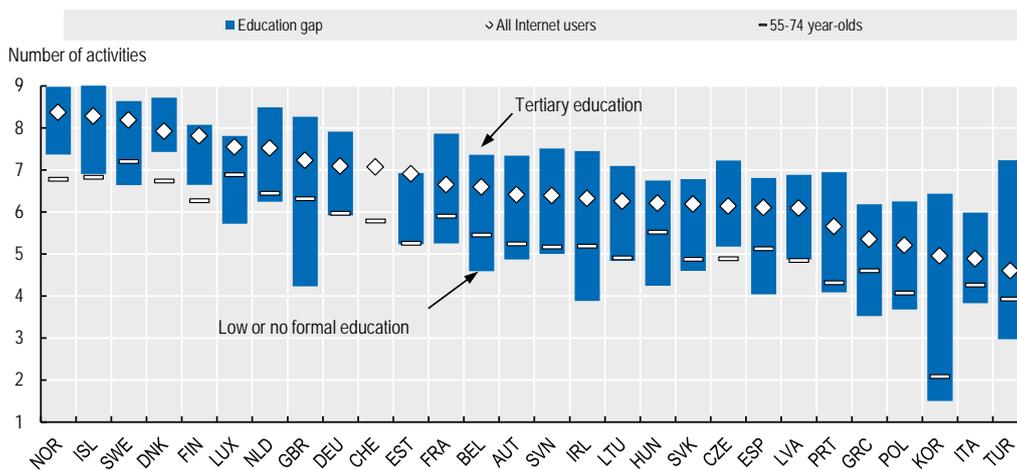
StatLink : <http://dx.doi.org/10.1787/888933274447>

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

Strong Internet uptake, but mind the digitalisation gap – Korea is among the most wired nations in the world. 80% of individuals used the Internet in 2014 and over 80% of them did that via a mobile phone, the highest rate in the OECD. However, the activities carried out over the Internet vary widely across countries, as a result of institutional, cultural or economic factors. When looking at indicators of user sophistication, Internet users in the Nordic countries performed on average eight activities per user, out of the 12 identified, while on average only five activities are performed in Korea. A digital divide, with large education and age gaps in the degree of user sophistication (Figure 10) was evident for Korea in 2014. Users over 55 years of age, especially in Korea, tend to perform fewer online activities than the OECD average. Elderly people, in particular those with a lower education, are therefore a potential focus of strategies to foster digital inclusion.

Figure 10. Number of activities performed online, 2014

Per Internet user by educational attainment and age



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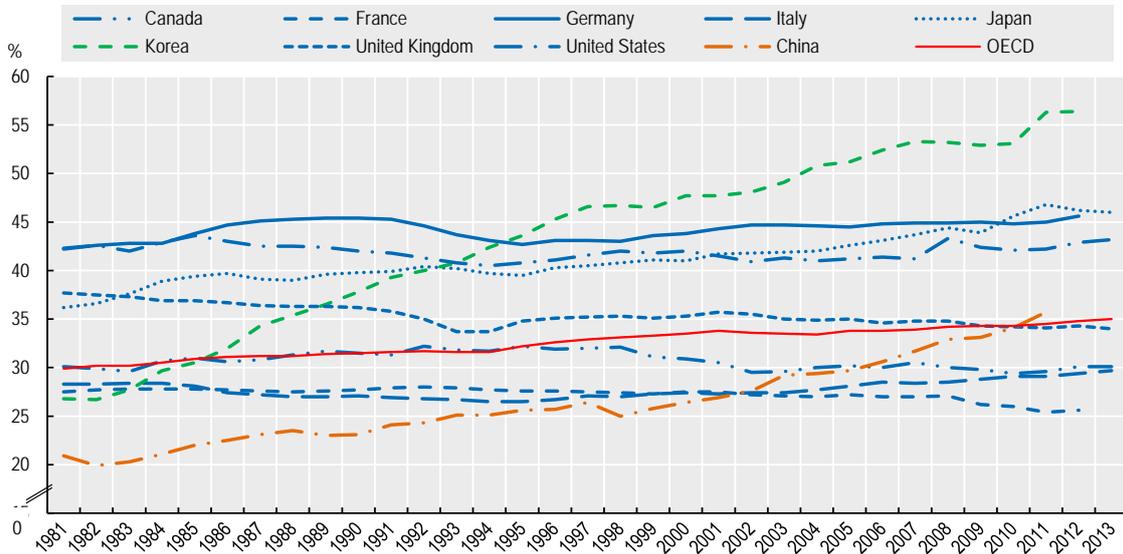
Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

A strong R&D-intensive manufacturing base – 35 years ago, manufacturing typically accounted for about a quarter to a third of employment, whereas today in some OECD countries the share has dwindled to 10% or lower. In Korea, the manufacturing base increased steadily, reaching a peak of 28% in employment in the early 1990s before starting a slow decline. With a 16.7% share, Korea still maintains the highest share of manufacturing jobs in the OECD after Germany. Over time Korean manufacturing has become increasingly focused

on R&D-intensive activities. R&D-intensive manufacturing employment in Korea has doubled over the past 20 years, reaching almost 60% of total manufacturing employment in 2013 (Figure 11). With an R&D-intensive manufacturing sector, a strong STEM base and firms operating at the global technology frontier, Korea is well placed to benefit from the next production revolution.

Figure 11. Long-term trends in R&D-intensive manufacturing employment, 1980-2013

As a percentage of total employment in manufacturing, selected economies

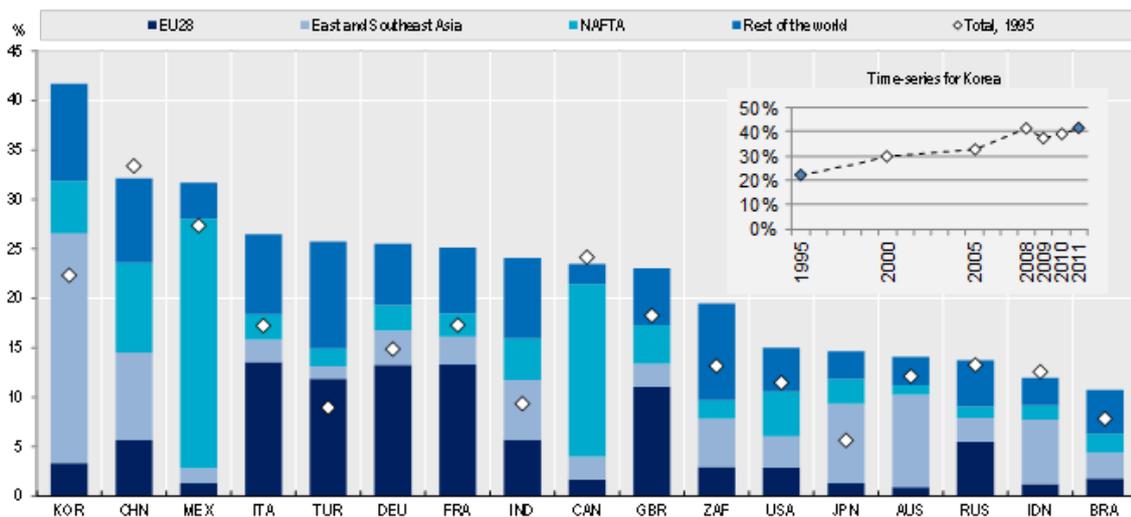


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Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

Figure 12. Foreign value added shares in exports by source region, 2011

As a percentage of total exports, selected economies



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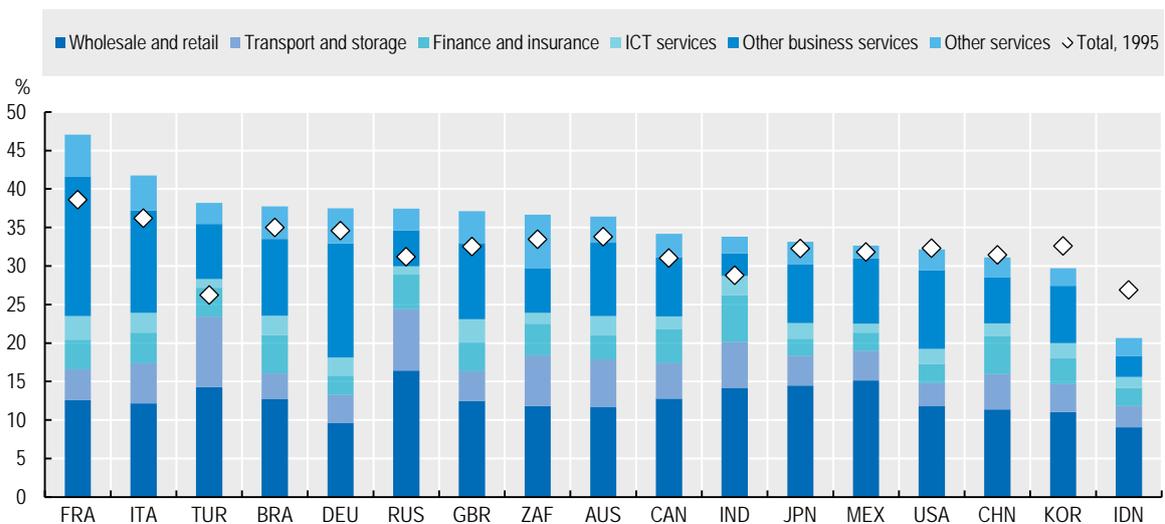
Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/tiva>.

Growing integration in global value chains – Korea is highly integrated within global value chains, with the highest share of foreign content (41.6%) of exports in 2011 in the G20, a near doubling since 1995 (Figure 12). Integration within Factory Asia drives Korea’s value chains, with China being by far the most significant importer of Korea’s exports of intermediates in value-added terms in 2011, accounting for 37.1% of the total. However, the United States still

imported over 10% of all Korea's intermediate exports in value-added terms in 2011. Over half of all of Korea's intermediate imports in 2011 were destined for use in producing exports, with shares of up to two-thirds in products used in key export industries such as ICT & electronics and Motor Vehicles (parts and components) (see <http://oe.cd/tiva>).

Innovation and competitiveness in services – Manufacturing today involves much more than the production of goods, it includes service-related activities both upstream and downstream in the value chain. Firms increasingly use logistics, communication services, business services to facilitate the efficient functioning of GVCs. In addition, services like design, marketing, after sale services help differentiate, customise and upgrade products, enabling firms to capture more value. The share of value added from service activities embodied in total gross exports varies generally between 40% and 70% across OECD countries, Korea being at the lower end with 40%. In 2011, the service content of manufactured exports in Korea was 29.7%, the second lowest in the OECD and down from 32.6% in 1995 (Figure 13). The share was significantly below the OECD average (36.9%) reflecting below average values in all sectors except for Mining and ICT and Electronics (see <http://oe.cd/tiva>). In 2013, Korea displayed one of the **lowest R&D intensity in services, 28.2%** of firms in the service sector introduced some type of innovation over 2011-13, the lowest rate in OECD, and only **1.5%** of service firms introduced new-to-market product innovations, a quality-adjusted measure of innovation. The relatively low service content of Korea's manufactured exports and innovation rates in the service sector point to the need to improve innovation and competitiveness in services for firms to capture more value along GVCs.

Figure 13. Services value added embodied in manufacturing exports, by type of service, 2011
As a percentage of total manufacturing exports, selected economies

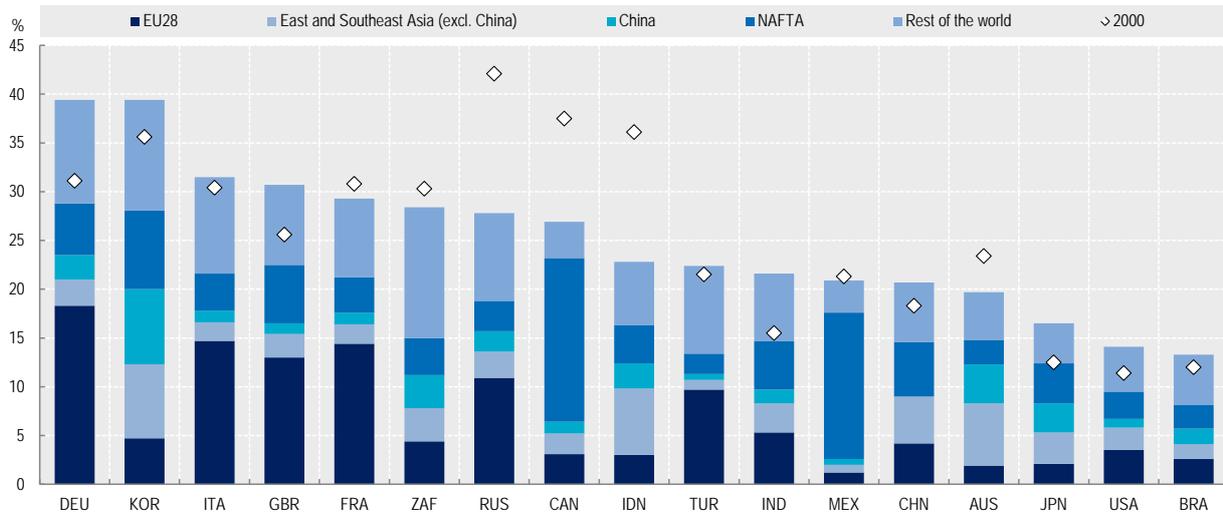


StatLink : <http://dx.doi.org/10.1787/888933274615>

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/tiva>.

Factory Asia sustains jobs – The ability of countries to meet foreign final demand increasingly determines the evolution of job markets. How can consumers in one country drive production and thus sustain jobs in economies further up the value chain? New OECD indicators tell us that about 40% of jobs in the business sector in Korea were sustained by consumers in foreign markets in 2011, up from 35% in 2000. These were mostly (43%) sustained by demand from East and South East Asia, i.e. 2.5 million jobs (Figure 14). The role of Factory Asia for the Korean job market is similar to that of European markets for Germany. In particular, China's demand for Korean products accounted for 8% of Korean jobs in the business sector in 2011.

Figure 14. Jobs in the business sector sustained by foreign final demand, by region of demand, 2011
As a percentage of total business sector employment, selected economies



StatLink : <http://dx.doi.org/10.1787/888933274578>

Source: OECD (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth*, OECD Publishing, http://dx.doi.org/10.1787/sti_scoreboard-2015-en. For more information see <http://oe.cd/tiva>.

The OECD Science, Technology and Industry Scoreboard 2015

Over 200 indicators show how OECD and major non-OECD economies are starting to move beyond the crisis, increasingly investing in the future.



The aim of the STI Scoreboard is not to “rank” countries or develop composite indicators. Instead, its objective is to provide policy makers and analysts with the means to compare economies with others of a similar size or with a similar structure and monitor progress towards desired national or supranational policy goals. It draws on OECD efforts to build data infrastructure to link actors, outcomes and impacts, and highlights the potential and limits of certain metrics, as well as indicating directions for further work.

Featuring in the 2015 edition: Knowledge economies: trends and features; Investing in knowledge, talent and skills; Connecting to knowledge; Unlocking innovation in firms; Competing in the global economy; Empowering society with science and technology.

The charts and underlying data in the STI Scoreboard 2015 are available for download and selected indicators contain additional data expanding the time and country coverage of the print edition. Thematic briefs and country notes, as well as online tools to visualise indicators are available at the OECD STI Scoreboard webpage (<http://www.oecd.org/sti/scoreboard.htm>).

Notes:

The information included in this note is based on the October 2015 release of the OECD Science, Technology and Industry Scoreboard. The data can be accessed from www.oecd.org/sti/scoreboard.htm.

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For more information