G20 ARGENTINA 2018

TOOLKIT FOR MEASURING THE DIGITAL ECONOMY

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1. Introduction

Sound measurement is crucial for informing and guiding policymaking, as it helps policymakers produce precise diagnostics, assess the potential impact of alternative policy options, monitor progress, and evaluate the efficiency and efficacy of implemented policy actions.

The demand for new data, indicators and measurement tools is particularly acute in the case of the digital economy due to the growing role it plays in G20 economies and everyday life, its potential to transform jobs and production, and the fast pace of change that characterises it.

The G20 has taken note of this need in its 2017 Ministerial Declaration, encouraging members to reflect the measurement of the digital economy in their national statistics in a comprehensive way and to review existing statistical frameworks. Following that mandate, and in particular that included in point 10 of the G20 Roadmap for Digitalisation, this G20 Toolkit for Measuring the Digital Economy brings together different methodological approaches and indicators that may be used to monitor the digital transformation, and highlights critical gaps and challenges that G20 countries and IOs involved in digitalization measurement could consider for further work.

The Toolkit aims to provide a first assessment that could serve to propose possible measurement approaches that support evidence-based policymaking, diagnoses the challenges and opportunities of the digital economy, identifies the issues that could be addressed by public policies, and serves as a potential guide for countries to implement standardized measurement activities.

Rather than producing new content, the document focuses on existing indicators and methodologies, in an effort to compile core, standardized and comparable indicators about the digital economy in G20 countries, make them easily accessible, and allow them to serve as a guide for countries to implement measurement activities. Indicators were selected based on previously published statistics on the digital economy and ongoing efforts to develop comparable metrics by major international organizations active in this area. Sources include the Organisation for Economic Co-operation and Development (OECD), the International Telecommunication Union (ITU), the United Nations Conference on Trade and Development (UNCTAD), the European Union, The World Bank Group (WBG), the International Monetary Fund (IMF), and the International Labour Organization (ILO).

More than 30 key existing indicators and methodologies to monitor and assess the size and penetration of the digital economy are organized in four themes according to their main purpose of measurement:

1. **Infrastructure.** This section covers indicators of the development of physical, service and security infrastructures underlying the digital economy. It includes access to mobile and fixed networks, the development of next generation access (NGA) networks, the dynamics of household and business uptake, secure servers infrastructure, and infrastructure for the internet of things.

2. **Empowering society.** This section considers indicators that portray the evolving role of the digital economy in people's life, how they access and use digital technologies, and their abilities to fully exploit their potential. It includes indicators on people's use of the internet, education, financial inclusion and interaction with government, among others.

3. **Innovation and technology adoption.** This theme contains indicators that address innovation in digital technologies, new digitally-enabled business models, the role of ICTs as an engine for innovation, and adoption of ICTs and other emerging technologies by businesses.

4. **Jobs and Growth.** The metrics collected within this section explore the different ways in which digital technologies contribute to economic growth and employment creation. It includes indicators related to the labour market, employment creation, investment in ICTs, value added, international trade, e-commerce, and productivity growth.

To complement these standard measures, the toolkit also includes other studies, surveys, pilot initiatives, and various measurement efforts in G20 countries and international and regional organizations. These cases are intended to serve as examples of initiatives that could improve existing methodologies, deepen our knowledge on specific aspects of the digital economy, and potentially expand coverage to more countries or to new areas within a country.

The rest of the document is organized as follows. Section 2 elaborates on the main gaps and challenges that derive from the analysis of the indicators compiled by the toolkit. It also includes crucial actions that could inform the digital economy measurement agenda of G20 members in the next years. Section 3 presents selected indicators used to measure the digital economy. Finally, section 4 includes initiatives and experiences from G20 countries and organizations.

2 Towards a measurement agenda

The main conclusion of the toolkit is that, even if we only consider existing measurement efforts, there is ample room for improvement, as data are far from being comprehensive, country coverage is limited, timeliness is often an issue, and differences in data collection methodologies and approaches across countries persist.

2.1 Gaps and challenges

We identify two types of gaps: methodological and availability. Methodological gaps relate to what existing indicators measure and how they capture the digital economy, or to what extent they do it. They address issues such as the need to improve existing indicators, identification of new measures to be developed, or the review of data sources and collection methods. Availability gaps are closely linked to effective implementation. Even in areas where international standards to guide statistical collection exist, countries may lack the capacities and resources to implement them systematically, disseminate the resulting information openly, or make efforts to ensure that data are comparable. In what follows we organize the presentation of the main gaps and challenges in the same themes used to classify the indicators in the next section of the toolkit, according to their main purpose of measurement.

Infrastructure

Connectivity is well covered by standard indicators, but digital platforms, an important dimension within the infrastructure topic, is not treated and deserves an assessment. The digital economy would be incompletely measured without taking into consideration the size and impact of platforms.

The toolkit includes and indicator to measure machine-to-machine (M2M) communication, one of the main underlying infrastructure technologies of the Internet of Things (IoT), a key emerging technology that drives digitization economy-wide. Although tracking M2M subscriptions is a reasonable proxy, there are other transmission technologies the application of which could be covered by standard indicators.

More generally, there are important difficulties in measuring data flows. G20 members may wish to explore ways to better utilize existing usable data sets.

Empowering society

Indicators about educational attainment and occupations are available and there are independent efforts to produce standards and definitions. We encourage G20 members to continue to participate or start participating in those measurement activities. However, we identify a lack of widespread measurement of skills, abilities and competencies that would allow for cross-country comparison. These are very relevant to reflect the ability of economies to adapt to the digital economy. One example is the absence of systematic data collection on the perception of firms about the abilities and skills that will be demanded in the near future. This is especially the case for developing economies. Moreover, digital access, which can be measured and can be used as an indicator of how the digital economy affects education, does not directly translate into educational attainment or academic outcomes.

Innovation and technology adoption

Measures about the use and quality of emerging technologies, such as artificial intelligence, internet of things, 3D printing, robotics, distributed ledgers or data science-based processes, should be improved to capture their use in different industries and their impact on the change in aggregate and business-level value added. For instance, with a few exceptions, metrics of robotization do not capture increases in the value of robots or their ability to perform tasks, nor they capture the use of robots in services industries, e.g. computer algorithms. We celebrate initiatives to include information on robot use in business ICT use surveys, which some G20 countries have already started to implement.

Jobs and growth

More emphasis should be placed on the development of methodologies to measure digitally-enabled trade and produce related indicators. Related to this, we identify methodological challenges in the collection of e-commerce statistics, such as differences in industry coverage, actors involved, and type of survey used to gather data across countries (e.g. some countries obtain them from household surveys and others from business surveys). Consistent and comparable data on the growth and adoption of e-commerce by both individuals and businesses in all industries should be helpful in identifying barriers to trade.

There is a clear gap in our ability to measure job creation associated to the digital economy, for example the nature and evolution of independent or freelance work. Current definitions and indicators are sometimes problematic, e.g. jobs covered under “alternate work arrangements”, and it would be important to discuss how best to define and measure these indicators across countries.

General challenges

Existing top down indicators are limited in their ability to capture the complexities of the digital economy. G20 members may wish to explore ways to better utilize existing usable data sets and use complementary bottom up measurement methodologies whenever possible. Moreover, current indicators do not always allow for gender and age breakdowns to examine use of new technologies, jobs, or potential biases in how society is affected by digitization.

Current measurement efforts do not always reflect the socio-economic impact of the digital transformation or the upstream and downstream consequences on the economy as a whole as opposed to just the digital share. For example, digital platforms pose upstream and downstream methodology issues. Upstream issues arise when the dynamics of the digital economy impacts the internet market, for example when a data driven business model affects the boundary of commercial feasibility of internet access in a developing country. Downstream issues arise when digital disruption impacts the product/service market: the emergence of digital platforms affects hospitality, local transport, real estate business, and other activities. Having this type of indicators being developed could help to create targeted approaches to develop and implement digital technologies.

The use of more diverse sources of data is another area where we see important challenges. The number of indicators produced jointly with the private sector and other actors of civil society is limited, and almost exclusively related to infrastructure. While statistical offices need independence to ensure quality and objective statistics, interaction between businesses, government and actors from civil society to explore new sources of data, tools, and alternatives to exploit available data could have a positive impact on countries' measurement capacities.

On a related point, household and business surveys are used in several G20 countries to measure the digital economy, but the use of administrative records, which could reduce the cost of performing some statistical activities to measure the digital economy, remains very limited.

Information on the extent of regional disparities or dispersion within countries is often absent from key standardized measures of household or business uptake of digital technologies. Although surveys generally collect regional codes, indicators are usually not tabulated by that dimension in international comparisons. Collaboration between international organizations and G20 countries to make regional data available, for example by advancing on methods to make microdata more accessible, should help to make progress on this front.

Current indicators may not adequately reflect the transformation unleashed by digitalization and the value added to national economies, particularly in developing countries. We see a challenge to report on the rate of growth of digitalization across various indicators to highlight the impact of digitalization along its various dimensions.

Regarding availability, there is a clear lack of coverage in developing countries compared to developed countries due to differences in statistical capacity in countries, or user needs and priorities for statistical collection. Moreover, the timeliness of available data varies widely across countries for critical indicators.

For example, the most recent data for "Enterprises engaged in sales via e-commerce" compiled by international organizations ranges from 2006 to 2015.

2.2 Actions for improvement

One of the challenges associated to measuring the digital economy is to develop new and more flexible approaches to meet the specific priorities and resources of G20 countries. To make statistical systems more flexible and responsive to the new and rapidly evolving digital era, G20 members could: **i)** experiment with concepts and data gathering within existing measurement frameworks, ii) exploit the potential of existing survey and administrative data, **iii)** add questions to existing surveys, **iv)** periodically augment existing surveys with topic-specific modules, **v)** develop short turnaround surveys to meet specific needs, **vi)** define policy needs and, in cooperation with other stakeholders, set priorities for internationally comparable measurement; and **vii)** work with stakeholders, including international organizations, to harness the potential of big data for developing indicators to measure the digital economy.

G20 policy makers, in co-operation with other stakeholders, may also wish to define policy needs and set priorities for internationally comparable measurement. Greater co-ordination can help avoid the fragmentation of statistical efforts and ensure that international organisations take up the results of successful experimentation by countries.

The toolkit identifies crucial actions that could inform the measurement agenda of G20 members in the next few years, considering the rapid pace of change in the digital economy:

1. Promote a comprehensive, high-quality data infrastructure and collection tools for measuring the use and impacts of digital technologies at the individual and business level, including collecting data on key characteristics such as sex, age, skills and education, region, as well as business size, sector and location.

2. Work towards improving the measurement of the digital economy in existing macroeconomic frameworks, e.g. by developing satellite national accounts.

3. Foster more fluid communication and cooperation between international organizations and G20 countries to share national initiatives, adhere and disseminate international standards and best practices, improve comparability of indicators and reduce differences in coverage and timeliness of the data, with greater emphasis on capacity building in developing countries where resources, both monetary and human, are scarce.

4. Encourage interactions among government, business and other actors of civil society to strengthen the evidence base and complement official statistics, improving the design of frameworks that facilitate and allow a better use of data in in business-to-business (B2B), business-to-government (B2G) contexts, and government-to-businesses (G2B) contexts.

5. Enable the collaboration between the public and private sector to plan and implement business surveys about innovation and the uptake of new digital technologies, including joint efforts to identify and anticipate the demand for skills and competencies.

6. Encourage development partners, in collaboration with international organizations, to assist less developed countries in the collection of relevant statistics needed to enable evidence-based policy making in this area.

7. Promote the use of interoperable tools and data formats that facilitate access to and sharing of public and private sector data in an effort to drive innovation, and make government activities more open and transparent.

3 Selected Indicators to Measure the Digital Economy

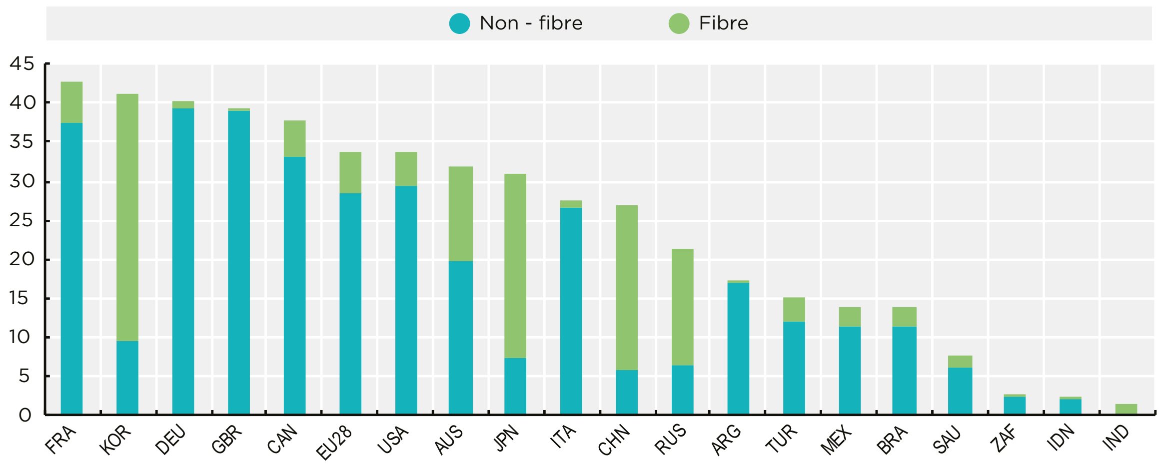
INFRAESTRUCTURE

3.1 Investing in Broadband

Broadband communication networks and the services provided over them support economic and social development goals, such as health, financial inclusion and education. The number of worldwide fixed broadband subscriptions has increased by 86% within just seven years - from 526.3 million in 2010 to 979.3 million in 2017. Within the G20, France had the highest fixed broadband penetration in 2017, at 42.4%, followed by Korea (41.6%) and Germany (40.5%). Fixed broadband penetration was below 3% in South Africa, India, and Indonesia. Because of the high cost of investment in infrastructure, there is a strong correlation between fixed broadband penetration and GDP per capita. Connectivity is above 20 fixed broadband subscriptions per 100 inhabitants on average in high and upper-middle income countries but is around 10 times less than that in lower middle income countries (1.8) and 0.2 in low income countries.

Communication operators have deployed fibre optics further into their networks to support "last mile" technologies designed to make the copper, wireless, and coaxial cable used where fibre is not taken all the way to customers' premises and deliver higher speeds. This explains why in some high-income countries, the share of fibre (to the home/premises) can be low. Although last mile technologies can provide relatively high connection speeds, fibre has the highest theoretical and demonstrated maximum speeds. Countries without legacy (copper-based) telecommunications networks can be able to leapfrog directly to fibre, though these countries tend to have lower broadband penetration overall. Additionally, conditions in such countries may favour take-up of wireless connections. Across the board, the devices people use in their daily lives are increasingly wireless; whether connecting over cellular mobile services or Wi-Fi. Nevertheless, fast connections are only possible if the fixed networks these wireless connections feed into have sufficient capacity to meet the growing demand for backhaul capacity connecting wireless towers or end users directly; here fibre is also a key enabling technology.

Fixed broadband subscriptions per 100 inhabitants, by technology, 2017



Notes: includes fibre-to-the-home and fibre-to-the-building but excludes fibre-to-the-cabinet/node. United States data are estimates. Data for Germany include fibre lines provided by cable operators. Country groups are unweighted averages.

Sources: ITU World Telecommunication/ICT Indicators database; OECD, "Broadband database", OECD Telecommunications and Internet Statistics (database), http://www.oecd.org/sti/broadband/broadband-statistics (June 2018).

Measuring fixed broadband penetration

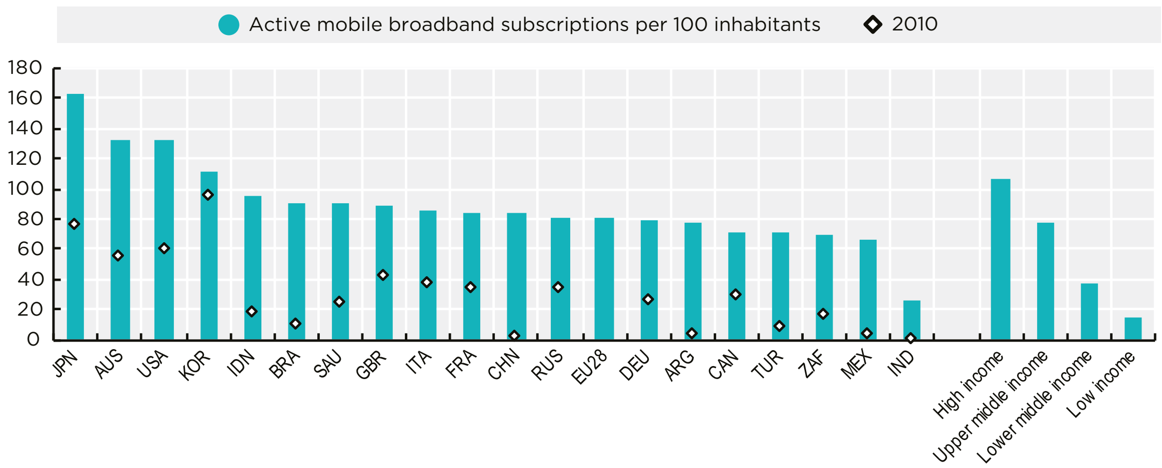
These data are typically supplied by communications regulators that collect them directly from network operators according to common definitions and leading to a high degree of comparability.

Broadband penetration refers to the number of subscriptions to fixed broadband services (i.e. with 256 kbps advertised speed or more), divided by the number of residents in each country. Fixed broadband comprises DSL, cable, fibre-to-the-home (FTTH), and fibre-to-the-building (FTTB), satellite, terrestrial fixed wireless and other fixed-wired technologies. Fibre penetration refers to subscriptions using fibre-to-the-home or fibre-to-the-building (e.g. apartment block LAN). This includes subscriptions where fibre goes directly to the subscriber's premises and fibre-to-the-building subscriptions that terminate no more than 2 metres from an external wall. The actual number of subscriptions to the fibre provider is counted and may differ from the number of end users. Fibre-to-the-node/cabinet is excluded.

3.2 The rise of mobile broadband

Growth in mobile broadband subscriptions has far outstripped fixed broadband growth since 2010, with worldwide subscriptions increasing from 806.9 million in 2010 to 4 220 million in 2017. At the end of 2017, 56.4% of the world's population had a mobile broadband subscription. In high income countries there is more than one mobile connection per inhabitant on average (107%). At 77%, upper middle income countries have adoption rates twice that of lower middle income countries (38%), while low income countries record 15%. The pace of change can be rapid. Since 2010 India and China have experienced over 20-fold increases in mobile broadband subscriptions (27-fold and 24-fold respectively), Argentina and Mexico both experienced 16-fold increases. The relatively limited availability and affordability of fixed broadband can be an important contributing factor to such strong growth. India alone added more than 127 million mobile broadband subscriptions in 2017.

Active mobile broadband subscriptions per 100 inhabitants, 2010 and 2017



Notes: Argentina data are for 2010 and 2016, India for 2011 and 2017.

Source: OECD, Broadband Portal, http://oe.cd/broadband and ITU, World Telecommunication/ICT Indicators Database (June 2018).

Measuring mobile broadband penetration

These data are typically supplied by communications regulators that collect them directly from network operators according to common definitions and leading to a high degree of comparability.

Mobile broadband penetration is defined as the number of active mobile broadband services subscriptions, divided by the number of residents in each country. Active mobile-broadband subscriptions refers to the sum of active handset-based and computer-based (USB/dongles) mobile-broadband subscriptions to the public Internet. It covers actual subscribers, not potential subscribers, even though the latter may have broadband-enabled handsets. Subscriptions must include a recurring subscription fee or pass a usage requirement – users must have accessed the Internet in the last three months. It includes subscriptions to mobile-broadband networks that provide download speeds of at least 256 kbit/s (e.g. WCDMA, HSPA, CDMA2000 1x EV-DO, WiMAX IEEE 802.16e and LTE), and excludes subscriptions that only have access to data transport technologies such as GPRS, EDGE and CDMA 1xRTT.

Broadband subscription penetration rates tell nothing of the prices that users pay, the realised speeds of connections, or whether there are restrictive data caps on those lines; countries performing well in one measure may be weaker in another. Active mobile wireless broadband subscriptions are collected according to common definitions and are highly comparable. Data for wireless broadband subscriptions have improved greatly in recent years, especially with regard to measurement of data only and data and voice mobile data subscriptions.

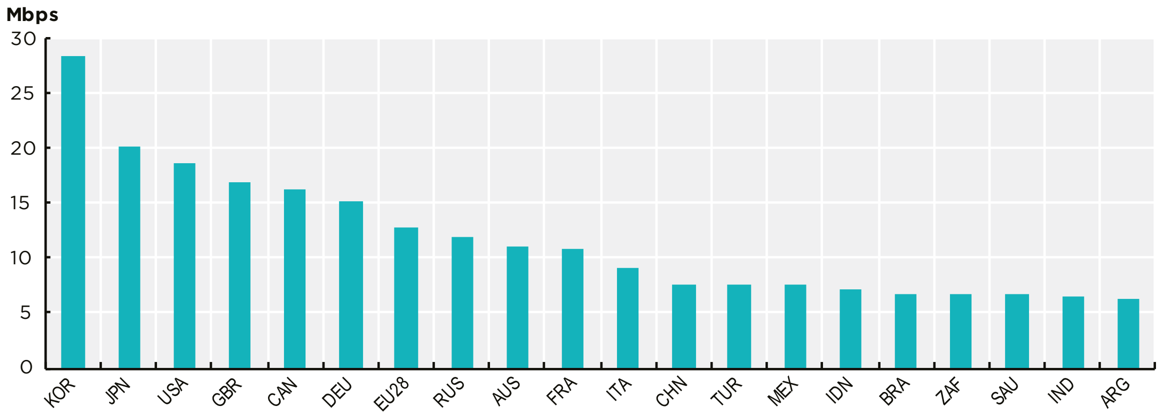
3.3 Toward higher Internet speed

Adequate network access speed is essential to fully exploit existing services over the Internet and to foster the diffusion of new ones. Differences in speed levels offers across customers have existed since the first commercial fixed network broadband services were introduced in the second half of the 1990s. This is particularly the case for business users, educational institutions and the public sector which can often secure offers tailored to their requirements through products such as leased lines between specific locations.

In terms of retail (consumer) service offers, although the official threshold for broadband is 256 kbps (Kilobit per second), globally most consumer fixed broadband subscriptions are already marketed at over 10 Mbps (1 Megabit corresponds to 1024 kbps). Nevertheless a significant proportion of subscriptions are still between 2 and 10 Mbps. As of 2017, the leading advertised download speed in G20 countries was 10 Gbps (10 000 Megabits per second), though only a relatively small number of consumer offers were available at that level. Nevertheless, consumer offers marketed at 1 Gbps are increasingly common in some countries, particularly where fibre to the premises or upgraded cable broadband networks are in place. This is the case in countries with high population densities, such as Japan and Korea, as well as in an increasing number of cities in the United States. Residential offers at 1 Gbps are most common where there is either strong infrastructure competition between operators or competition between retail providers using wholesale networks.

Even in countries where connections advertised at 1Gbps or greater speeds are available, delivering these speeds to all geographical locations remains a challenge. It is also common for actual speed in use to be below (sometimes significantly below) the advertised speed. Akamai measurements of the speed of content being downloaded through its global give one indication of average real-world internet speeds in different countries.

Akamai's average speed, G20, Q1 2017



Note: Mbps = megabits per second.

Source: Q1 2017 State of the Internet / Connectivity Report, Akamai Technologies

Using speed tests

Measurement of broadband performance is affected by the potential gap between advertised and "actual" speeds delivered to customers. Several tools are available to measure actual download or upload speeds, together with other quality-of-services parameters. Akamai is a content delivery network (CDN) and cloud services provider headquartered in the United States, responsible for serving between 15% and 30% of all web traffic making it one of the largest CDNs by volume. These data present the average download speed of content transiting the Akamai network to clients in different countries. Equivalent data from other CDNs might give a different picture.

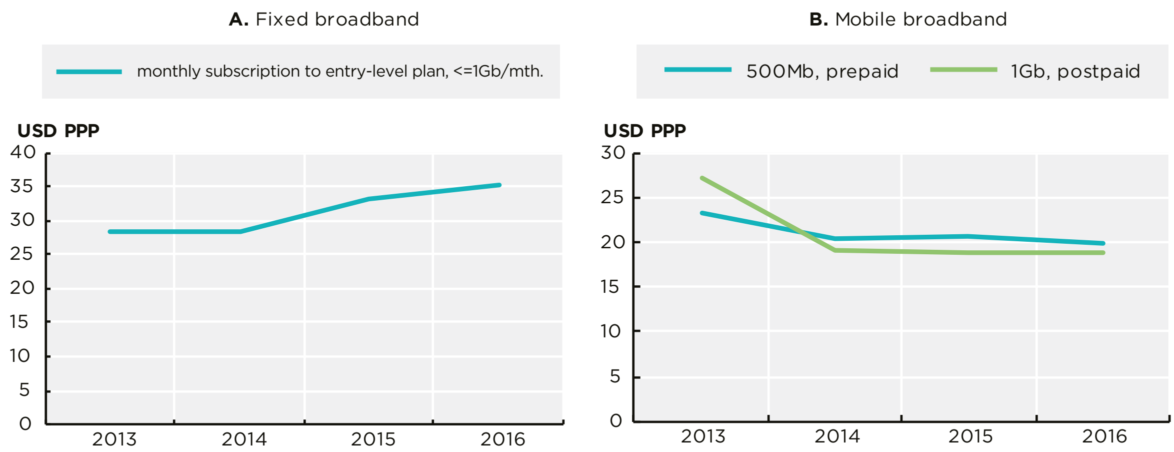
Statistics on the speed of data transiting CDNs give only one view on Internet speed. Regulators collect information on the advertised download speed of subscriptions which can be compiled into indicators of subscriptions broken down by speed tiers to give a view of the "theoretical" speed of subscriptions. It is necessary to select speed tiers that provide a meaningful breakdown of total subscriptions and to update these for the general increases in advertised speeds over time. Such indicators are available on the OECD broadband portal: http://oe.cd/broadband.

3.4 Prices for connectivity

Prices for connectivity provide insights into competition and efficiency levels in communication markets. Between 2013 and 2016, average prices across the G20 decreased for mobile broadband access but increased for fixed broadband connections. This is drawn from a comparison over time of the averages for specific ITU price comparison baskets for telecommunication services. The baskets are designed to provide a snapshot of prices at any given time rather than as a series. Accordingly, the lowest cost plan is selected at any point in time and may have different characteristics from earlier plans (e.g. higher speed or increased amount of data). That caveat aside, it is nonetheless worth considering an average for all G20 countries as an indicator of likely trends in the segment of the market shown (e.g. entry-level for fixed broadband). It should be noted, though, that the OECD also compiles broadband price indicators which cover different usage patterns – 20Gb and 200Gb for fixed broadband and up to 2Gb for mobile broadband; for more information see the OECD Broadband Price Baskets Methodology: https://oe.cd/2id.

Declining unit prices does not mean that all users will be paying less, as consumers can choose to pay the same amount as before for plans with higher included amounts of data, higher speeds, etc. or incur costs to switch plan. In mobile markets, increased competition has both lowered prices and increased the quality of the offers.

G20 trends in fixed and mobile broadband prices, 2013-16



Note: PPP = purchasing power parity; Gb = Gigabyte; Mb= Megabyte. Unweighted averages. The fixed-broadband sub-basket refers to the price of a monthly subscription to an entry-level plan. For comparability reasons, the fixed-broadband sub-basket is based on a monthly data usage of (a minimum of) 1 GB. For plans that limit the monthly amount of data transferred by including data volume caps below 1 GB, the cost for the additional bytes is added to the sub-basket. Broadband minimum speed is 256 kbit/s.

Source: ITU World Telecommunication/ICT Indicators database (accessed June 2018).

Different methods to measure broadband affordability

ITU price data are collected in the fourth quarter of each year. Data on mobile-broadband prices are collected by ITU directly from operators' websites, while fixed-broadband price data are collected through the ITU ICT Price Basket questionnaire sent to the administrations and statistical contacts of all 193 ITU Member States. For mobile broadband the basket is based on prepaid prices except where prepaid subscriptions make up less than 2% of the total, in which case post-paid subscriptions are used. The fixed-broadband sub-basket refers to the price of a monthly subscription to an entry-level fixed-broadband plan with a monthly data usage of 1 GB or more. Where data volume caps below 1 Gb exist, additional data cost is added. For more information see https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/pricemethodology.aspx

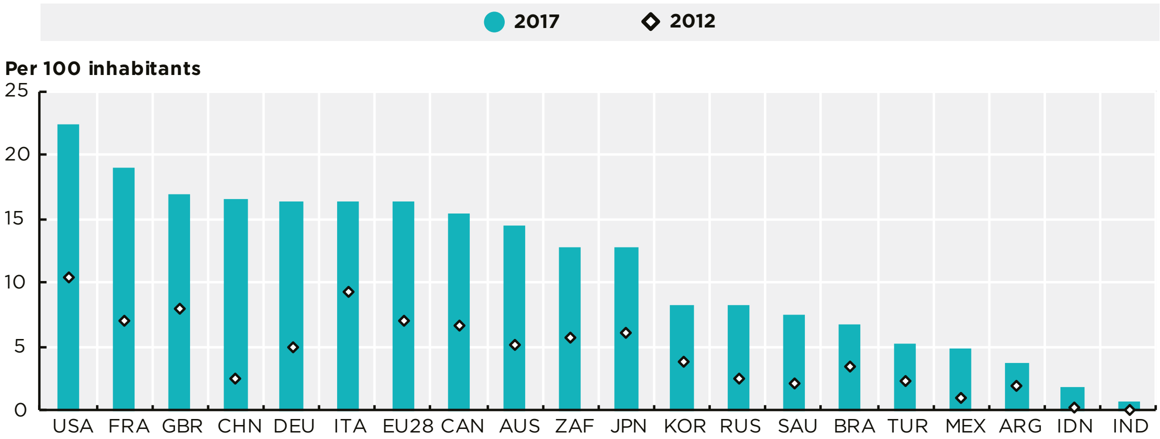
OECD broadband price data are gathered directly from network operator websites. For fixed-line broadband a set of three operators with a combined market share of at least 70% is compared. All DSL, cable, and fibre offers with advertised speeds over 256kbps are included. For mobile broadband, at least the two largest network operators, with 50% or more combined market share based on subscriber numbers, are covered. Offers include 3G and 4G mobile phone services, including post-paid, prepaid, and SIM only tariffs. Data and voice offers are treated separately from data only. Handsets are not included. Offers are for month-to-month service advertised clearly on the operator's website and should be available in the country's largest city. For more information see the OECD Broadband Price Baskets Methodology: https://oe.cd/2id.

3.5 Infrastructure for the Internet of Things

The Internet of Things (IoT) refers to an ecosystem in which applications and services are driven by data collected from devices that act as sensors and interface with the physical world. This ecosystem could soon constitute a common part of the everyday lives of people in G20 countries and beyond. Important IoT application domains span almost all major economic sectors including: health, education, agriculture, transportation, manufacturing, electric grids and many more.

Part of the underlying infrastructure of the IoT is machine-to-machine (M2M) communication. The Groupe Spéciale Mobile Association (GSMA) tracks the number of M2M subscriptions around the world. These data show the number of SIM cards embedded in machines, such as automobiles or sensors, which allow communication between such devices. Among G20 economies, the United States had the highest penetration (number of M2M SIM cards per inhabitant) in June 2017, followed by France and the United Kingdom. Between 2012 and Q2 2017, the number of subscriptions increased by 272% in the G20. The People's Republic of China had the largest share of worldwide M2M subscriptions (44%) at 228 million subscriptions in June 2017, representing three times the share of the United States.

M2M SIM card penetration per 100 inhabitants, G20, 2012 and 2017



Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://www.oecd.org/sti/scoreboard.htm OECD calculations based on GSMA Intelligence, September 2017.

Measuring the infrastructure for IoT using GSMA data

The GSMA's definition of M2M is: "A unique SIM card registered on the mobile network at the end of the period, enabling mobile data transmission between two or more machines. It excludes computing devices in consumer electronics such as e-readers, smartphones, dongles and tablets". The GSMA collects publicly available information about mobile operators that have commercially deployed M2M services. It then uses a data model based on a set of historic M2M connections reported at any point in time by mobile operators and regulators, along with market assumptions based on their large-scale survey of M2M operators and vendors. This pool of data is then reconciled by GSMA with their definition, normalised and analysed to identify specific M2M adoption profiles. These adoption profiles are then applied by the GSMA to all operators that have commercially launched M2M services, but do not publicly report M2M connections to produce national figures. For more information, see www.gsmaintelligence.com. While the OECD and ITU collect data on M2M SIM cards directly from countries, the GSMA Intelligence estimates have been used here to ensure a global coverage from the same source and applied methodology. It should also be noted that mobile technologies are just a few of the more than 15 transmission technologies of IoT[1].

[1] For related measurement issues regarding other transmission technologies see Biggs et al. (2016), Harnessing the Internet of Things for Global Development. Geneva: ITU.

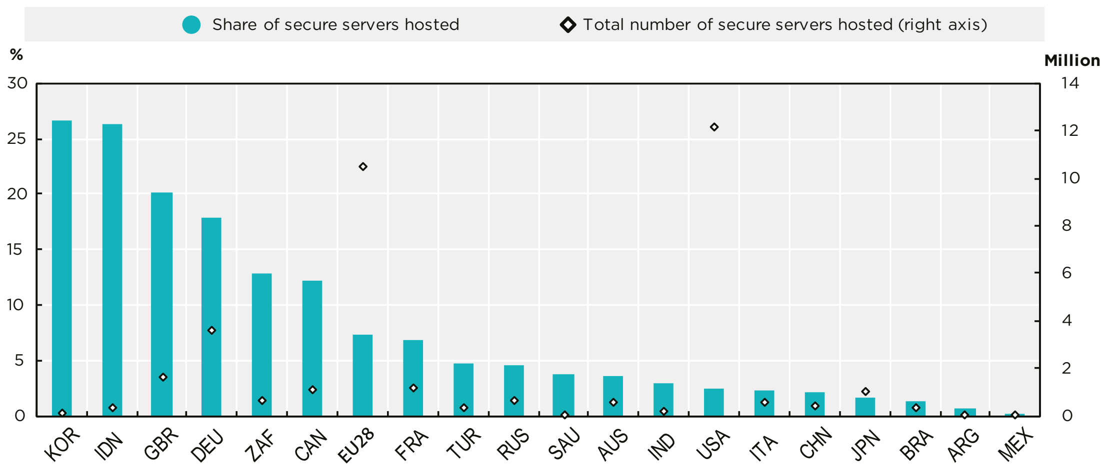
3.6 Secure servers' infrastructure

The rapid spread of digital technologies and reliance on digitised information creates new challenges for the protection of sensitive data and network communications. Data on secure servers provide information on the number of web servers that can be used for the exchange of sensitive information, such as passwords and credit card numbers. SSL is a security protocol used by Internet browsers and web servers to exchange sensitive information. It relies on a certificate authority, provided by companies such as Symantec and GoDaddy, which issue a digital certificate containing a public key and information about its owner, and confirm that a given public key belongs to a specific website. In doing so, certificate authorities act as trusted third parties.

According to data from the June 2018 Netcraft survey, 32.6 million secure servers were deployed worldwide. This corresponds to a compound average growth rate of 68% annually (from 19 million such servers June 2017). Growth rates accelerated markedly in 2014; having grown by around 20% year-on-year previously. The United States accounted for the largest number of secure servers (12 million) - 37% of the world total. It was followed by Germany (3.5 million, 11%) and the United Kingdom (1.6 million, 5%). However, most countries still have a low share of secure servers relative to the total number of servers; for example, in the United States less than 3% of all servers hosted use SSL/TLS.

Secured servers by hosting country, G20, June 2018

As a percentage of Internet hosts in each country and in millions



Source: Netcraft, www.netcraft.com, (accessed July 2018).

Measuring digital risk

Secure servers are servers implementing TLS or SSL security protocols. Netcraft carries out monthly secure server surveys covering public secure websites (excluding secure mail servers, intranet and non-public extranet sites) using electronic tools to ascertain whether public servers have TLS or SSL implemented.

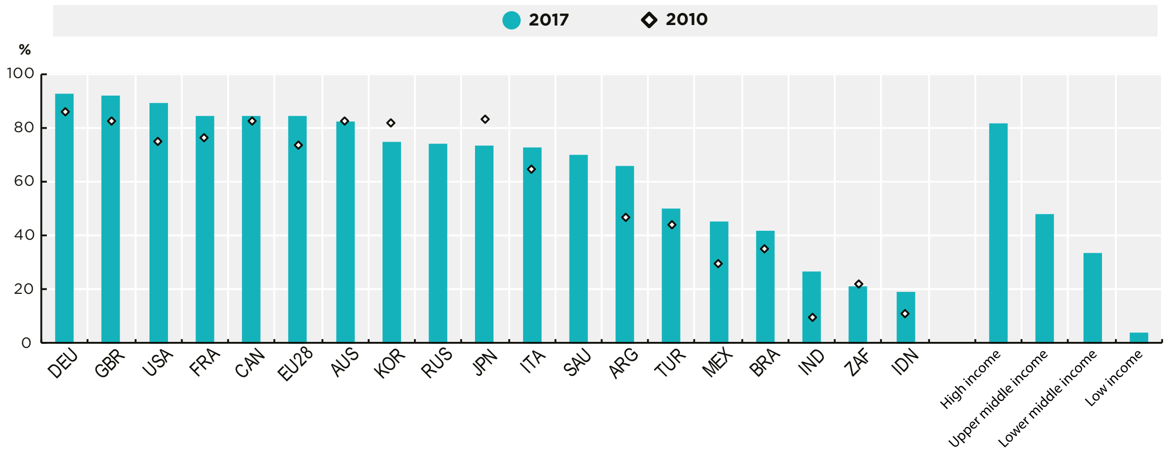
The protection of security and privacy online has become a key policy issue as individuals, businesses, and governments conduct considerable daily activities on the Internet. Statistical information on online security are typically drawn from three major sources: i) user surveys that are usually conducted by national statistical offices, ii) activity reports and iii) the Internet. Each data source has advantages and drawbacks. Besides the issues specific to each data source, there is a more fundamental challenge to the measurement of security and privacy, whether online or offline. To fill the measurement gap in this respect, the OECD has two major ongoing undertakings on the collection of information on digital security risk management practices in businesses and the reporting of personal data breach notifications by the Privacy Enforcement Authorities.

3.7 Household access to computers

In many countries, the number of households with computer access at home has continued to edge upward since 2010. Meanwhile, Korea, Japan, and South Africa have seen a declining share of households with computers. This is likely to be driven by substitution towards smartphones and tablet computers as alternative means for accessing the internet and running software. Nevertheless, there is considerable disparity in the share of households with computer access between G20 countries: over 90% in Germany and the United Kingdom compared to less than 30% in India, South Africa, and Indonesia – mobile devices are also widespread access means in these countries.

As computer hardware can be a significant outlay for any household, computer access at home is highly correlated with income level. Over 80% of households in high income countries have computer access while less than half that (34%) have access in lower middle income countries and 20 times fewer have access in low income countries (4.2%).

Proportion of households with a computer, G20, 2010 and 2017



Notes: Canada, Australia, Japan, United States, Brazil, Argentina, South Africa, Russian Federation, Saudi Arabia: 2016 instead of 2017. South Africa and India: 2011 instead of 2010. In Australia, Japan, and Brazil the methodology changed between the first and second observations leading to a break in series.

Source: OECD, ICT Access and usage by Households and Individuals Database, http://oe.cd/hhind; European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), "Households - Availability of Computers"; ITU World Telecommunication/ICT Indicators database (accessed June 2018).

Challenges for international comparability

Computers are defined to include desktop, portable or handheld computers (e.g. a personal digital assistant). A computer does not include other equipment with some embedded computing functions, such as cell phones, VCRs or TV sets.

These data are generally gathered through direct surveys of ICT access in households and by individuals or using questions on broader household surveys. The survey approach can differ considerably; for example, Argentina, Brazil, and Saudi Arabia, as well as European Union countries, conduct stand-alone surveys of ICT use by households and individuals, while other countries include ICT questions on broader household surveys. Related to this, and also to population size, sample sizes vary widely from three to four thousand households in Argentina and Saudi Arabia, to over 50 000 households in the United States' "Current Population Survey Computer and Internet Use Supplement" and 300 000 households covered by the "National Socio-Economic Survey" in Indonesia. In general, while they often have relatively smaller sample-sizes, adopting a specific survey vehicle can allow for more detailed questions to be asked.

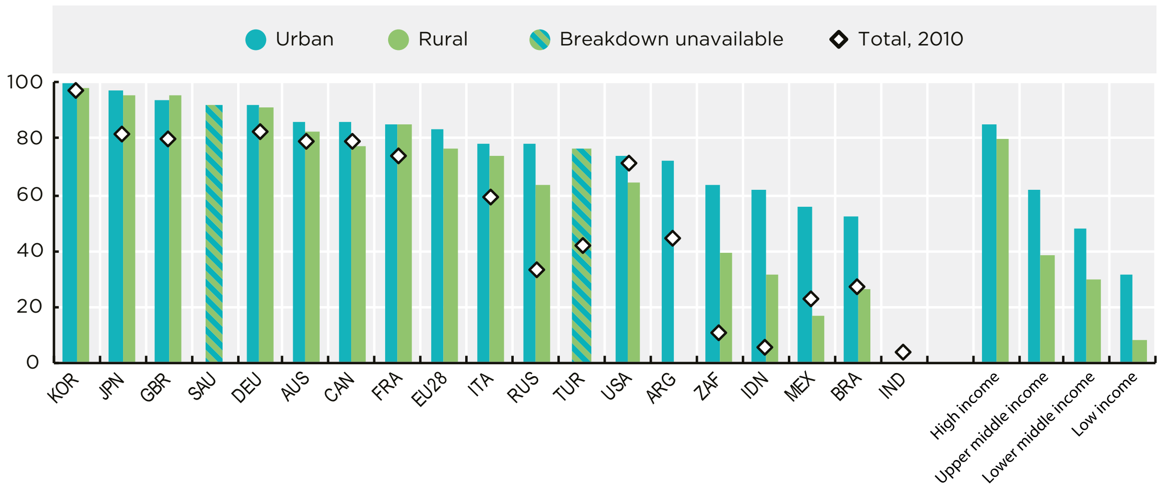
Other potential sources of differences include the compulsory or voluntary nature of responses and recall periods. Breakdown of indicators by age or educational attainment groups may also raise issues concerning the robustness of information, especially for smaller countries, owing to sample size and survey design.

3.8 Household access to the Internet

Internet penetration rates in households are an indicator of people's access to information and services. Disparities in Internet access are partly explained by urban-rural divides within countries, particularly in countries with lower per capita incomes. In G20 countries such as Korea, Japan, Germany, and France, urban-rural divides are negligible - and in the United Kingdom more rural households have internet connections than urban households. The disparity remains wide in some other G20 countries though; three times more urban households are connected than rural in Mexico, for example. It is of note that almost all Internet connections are now broadband connections; even in developing countries, most households with connections now connect to broadband.

Households with Internet connections, urban and rural, 2010 and 2016

As a percentage of households in each category



Notes: Australia and United States: 2015 instead of 2016. Argentina, Korea, India, Indonesia: 2011 instead of 2010. Breakdown not available for Saudi Arabia or Turkey - figure reflects overall total. For Brazil, areas are defined as urban or rural according to local legislation, as compiled by the NSO. Reported data refer to urban (densely populated) and rural (thinly populated). For the United States, population density categories are approximated based on a household's location in a principal city, the balance of a metropolitan statistical area (MSA), or neither, to protect respondent confidentiality.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, ICT Access and usage by Households and Individuals Database, http://oe.cd/hhind; ITU World Telecommunication/ICT Indicators database (accessed June 2018).

Measuring Internet access in households

These data are gathered through direct surveys of ICT access in households and by individuals or using questions on broader household surveys. Surveys are generally annual but are less frequent in Australia and Canada. In the European Union, surveys are compulsory in eight countries. The OECD actively encourages the collection of comparable information in this field through its guidelines on the "Model Survey on ICT Access and usage by Households and Individuals" (OECD, 2015b). ITU works actively with its Member Countries on the methodology and collection of data on the access and use of ICT by households and individuals through the Expert Group on Households, which meets annually and also through an online forum.

According to the OECD Regional Typology, a region is classified as rural (urban) if more than half (less than 15%) of the population lives in local units with a population density below 150 inhabitants per square kilometre. In Japan and Korea, the threshold is 500 inhabitants, as national population density exceeds 300 inhabitants per square kilometre. The OECD Regional Typology has been extended to include an additional criterion based on the driving time needed for 50% of the population of a region to reach a populated centre (Brezzi et al., 2011) to better discriminate between regions close to a large populated centre and remote regions. For the time being, the extended typology has only been computed for regions in North America (Canada, Mexico, and the United States) and Europe. The ITU does not recommend a particular definition of urban/rural, leaving it instead to the country to make its own classification.

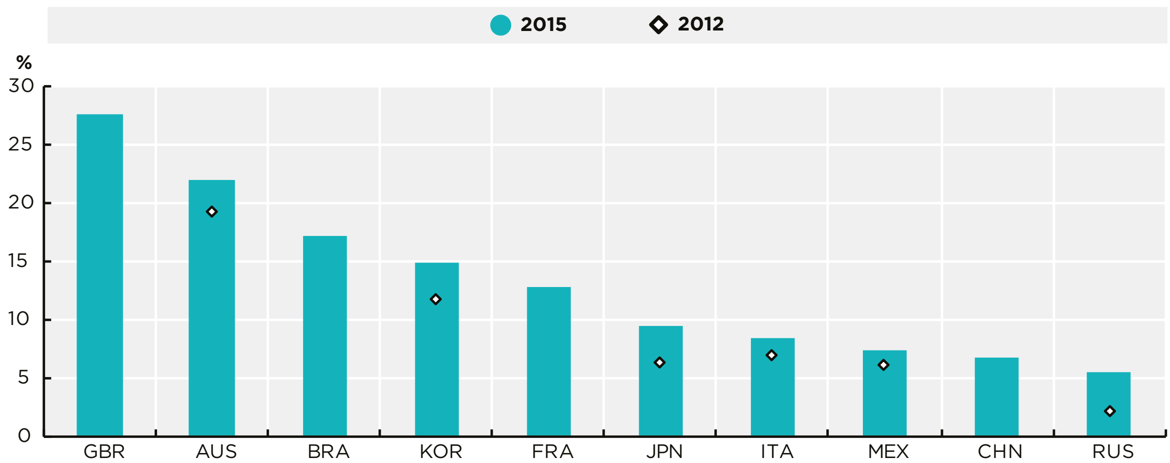
3.9 Digital natives

The Internet permeates every aspect of the economy and society, and is also becoming an essential element of young peoples' lives. Increasingly, policymakers require evidence of the impact of ICTs on students' school performance. However, current research presents a rather mixed picture and underlines the need for additional metrics. According to the results of the 2015 OECD Programme for International Student Assessment (PISA), 17% of students in the OECD area first accessed the Internet at the age of 6 or before. For countries where data are available, less than 0.3% of 15-year-olds reported never having accessed the Internet.

The age of first access to the Internet varies across countries. Over 25% of students started using the Internet at the age of 6 or before in the United Kingdom, and over 20% in Australia. The most common age of first access to the Internet is between 7 and 9 years in about two-thirds of the countries surveyed by PISA, and 10 years and over in the remaining third. Brazil was among countries with the greatest proportion of students (over 30%) spending more than 6 hours a day on the Internet outside school.

Students who first accessed the Internet at the age of 6 or before, G20, 2012 and 2015

As a percentage of 15 year-old students



Notes: Data for China relate to the four PISA participating provinces: Beijing, Shanghai, Jiangsu, Guangdong.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; OECD calculations based on OECD PISA 2015 Database, July 2017.

What is the OECD PISA survey?

The OECD PISA assesses the skills of 15-year-olds in 72 economies. Over half a million students between the ages of 15 years, 3 months and 16 years, 2 months, representing 28 million 15-year-olds globally, took the internationally agreed 2-hour test for the 2015 PISA. All students must be enrolled in school and have completed at least six years of formal schooling, regardless of the type of institution, programme followed, or whether the education is full-time or part-time. All G20 countries except India, Saudi Arabia and South Africa participated in PISA 2015 (see http://www.oecd.org/pisa/sitedocument/PISA-2015-technical-report-final.pdf). Four provinces of China participate: Beijing, Shanghai, Jiangsu, and Guangdong. The optional ICT familiarity module inquires on the availability of ICTs at home and school, the frequency of use of different devices and technologies, students' ability to carry out computer tasks and their attitudes towards computer use. In 2015, 47 out of 72 economies participating in PISA ran this specific module. Despite the valuable information that can be gained, the ICT optional module was not administered in several participating G20 countries (Argentina, Canada, Germany, Indonesia, Turkey, and the United States), often due to the costs of including additional questions in the survey. Data from multiple PISA waves allow student use of ICTs both at school and outside school to be explored over time, as well as investigation of the impact on school performance - a key policy concern.

3.10 Narrowing the digital divide

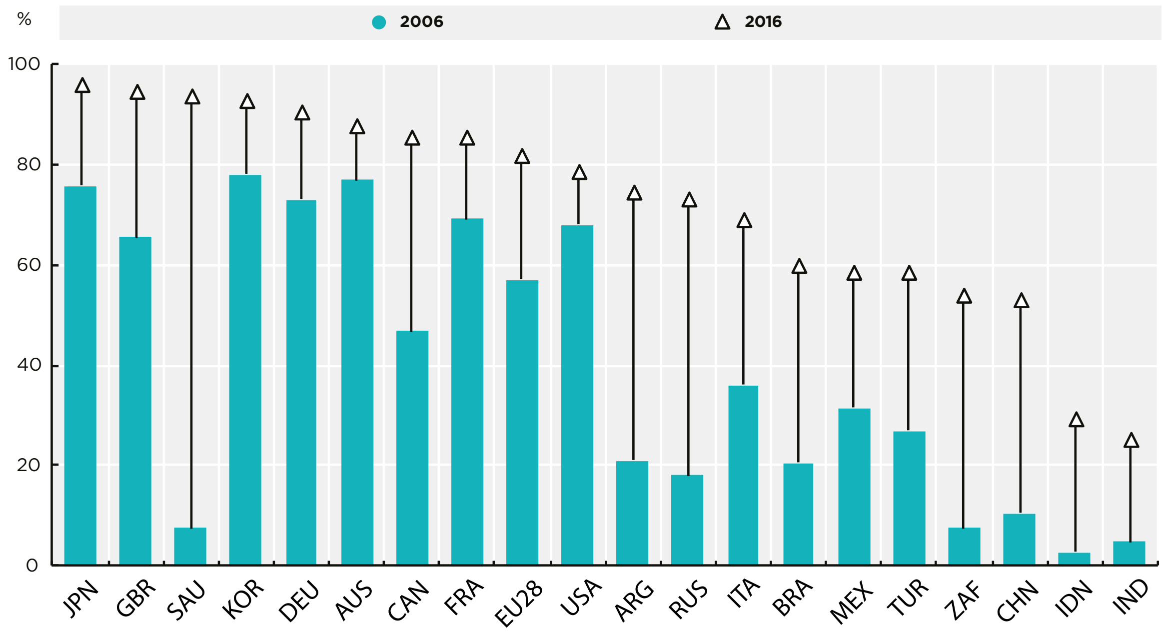
Today's digital economy is characterised by connectivity between users and between devices, as well as the convergence of formerly distinct parts of communication ecosystems such as fixed and wireless networks, voice and data, and telecommunications and broadcasting. The Internet and connected devices have become a crucial part of most individuals' everyday life in G20 economies.

The share of individuals using the internet in G20 countries increased threefold on average between 2006 and 2016, with considerable increases seen in Saudi Arabia, France, Argentina, Russia, Mexico, South Africa, China, and Indonesia - narrowing the gap among G20 economies. Some G20 economies are reaching saturation (uptake by nearly 100% of individuals), while there remains significant potential for catch-up in others.

Differences in Internet uptake are linked primarily to age and educational factors, often intertwined with income levels.

Internet users, G20, 2006 and 2016

As a percentage of 16-74-year olds



Notes: Internet users are defined for a recall period of 3 months except for: Australia, Canada and Japan (12 months); the United States (6 months for 2015 data point and no time period specified in 2006); Korea (12 months in 2006); China, India, and South Africa (no recall period specified). Data for India, South Africa, Indonesia (2006 only), and Saudi Arabia (2006 only) are ITU estimates. Australia data refer to the fiscal years 2006/07 ending on 30 June and 2015/16. Brazil data refer to 2008 and 2016. Canada data refer to 2007 and 2012 and in 2007, data refer to individuals aged 16 and over instead of 16-74. Indonesia data relates to individuals aged 5 or more. Japan data relate to individuals aged 15-69. Saudi Arabia data relate to individuals aged 10 to 74. Korea data refer to 2015 instead of 2016. Turkey data refer to 2007 instead of 2006. United States data refer to 2007 and 2015.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; based on OECD, ICT Access and Usage by Households and Individuals Database, http://oe.cd/hhind; ITU, World Telecommunication/ICT Indicators Database and national sources, June 2018.

Who is an Internet user?

In order to identify "internet users" it is first necessary to define how recently an individual must have used the internet in order to be counted. A recall period of 3 months (meaning the respondent should have used the internet in the 3 months prior to being surveyed) is recommended. Nevertheless, some countries use longer recall periods or have no recall period at all; such methodological differences impact the ability to make international comparisons.

These data are generally gathered through direct surveys of ICT use in households and by individuals or using questions on broader household surveys. Even among European countries, where indicators are fully harmonised, data collection practices differ. In some cases data are collected through Labour Force Surveys or general surveys of living conditions (e.g. in Italy and the United Kingdom).

3.11 People's use of the Internet

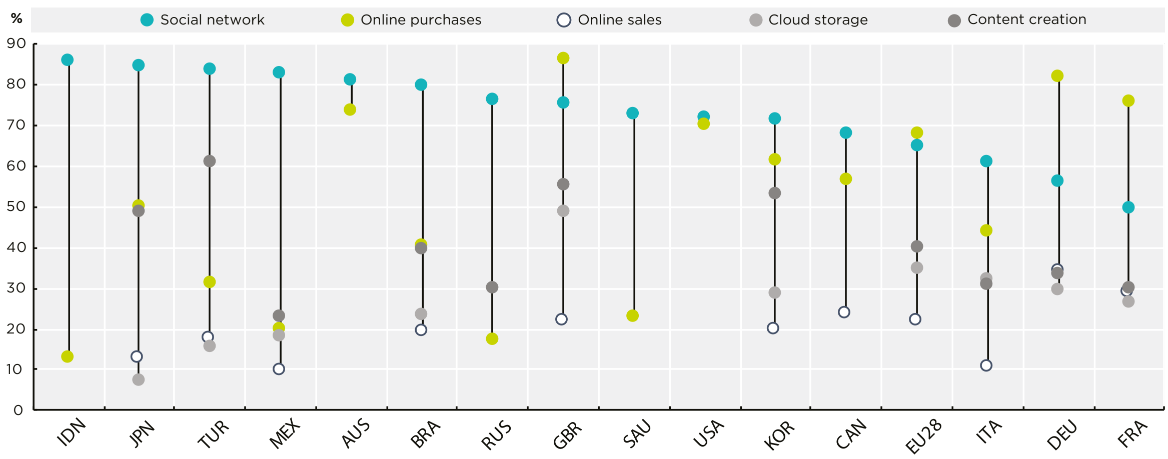
The types of activities carried out over the Internet vary widely across G20 countries as a result of different institutional, cultural, and economic factors including age and educational attainment. Likewise, country uptake for more sophisticated activities also varies and be impacted by factors such as familiarity with online services, trust, and skills.

In all G20 countries, participating in social networks is one of the main activities of Internet users; only in the United Kingdom, Germany, and France is e-commerce even more popular. In nearly all countries, the share of online purchasers in 2016 was higher than in 2010. In some countries starting with a lower level of uptake, such as Mexico, shares more than doubled.

In general, internet users are considerably more likely to make purchases online than to engage in selling online: on average 55% of internet users in countries for which data are available made online purchases but only 20% sold goods or services online. In Turkey and Mexico the shares are more similar – 32% purchasing compared to 18% selling online in Turkey and 20% purchasing compared to 10% selling in Mexico – though shares for both activities are relatively low in these countries compared to most others.

Diffusion of selected online activities among Internet users, 2017

As a percentage of internet users



Notes: Australia, Brazil, Indonesia, Russian Federation and Saudi Arabia data relate to 2016, likewise for Japan with the exception of cloud storage which refers to 2015. United States data relate to 2015. Canada data relate to 2012. The recall period is the last 3 months for all activities except online purchases and: for Australia and the United States, the recall period is the last 3 months for all activities. For Canada, Japan and Korea, the recall period is the last 12 months for all activities. For Mexico, the recall period for online sales is the last 12 months.

Source: OECD, ICT Access and Usage by Households and Individuals Database, http://oe.cd/hhind; European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI); and ITU World Telecommunication/ICT Indicators Database, June 2018.

Measurability

These data are typically gathered through direct surveys of households' ICT usage in the same way as data on internet usage – by asking if the respondent has undertaken a specific activity during the recall period. The OECD Model Survey on ICT Access and usage by Households and Individuals (OECD, 2015b) proposes a wide range of activities for investigation also including e-government, e-banking, job search, reading online news, downloading software, and many more. A recall period of 3 months (meaning the respondent should have undertaken the online in the 3 months prior to being surveyed) is recommended; nevertheless, some countries use longer recall periods or have no recall period at all; such methodological differences impact the ability to make international comparisons. Cloud storage relates to using the internet as a storage space to save files for private purposes. Content creation relates to uploading self-created content on sharing websites such as YouTube, Facebook, and Spotify.

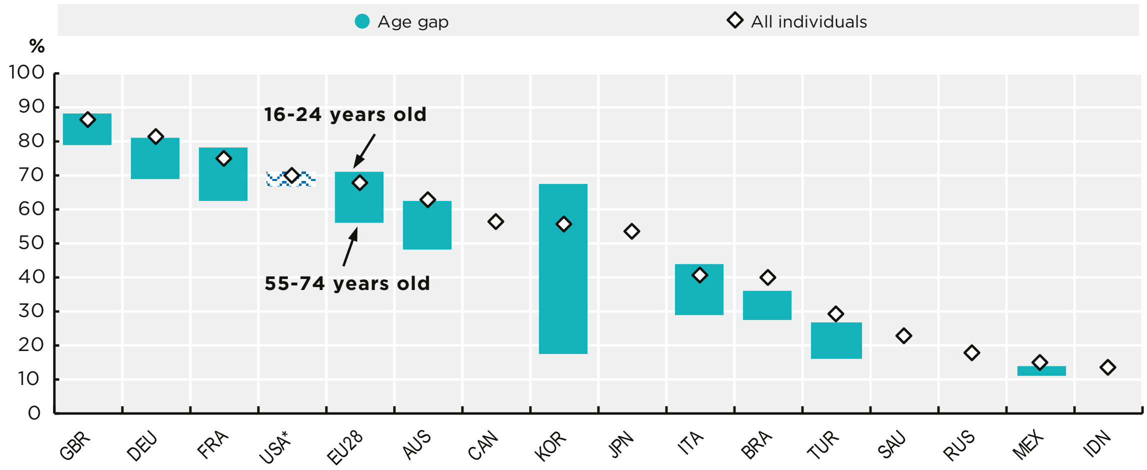
3.12 E-consumers

E-commerce can substantially widen choices and convenience for consumers. In nearly all countries, the share of online purchasers in 2016 was higher than in 2010. In some countries starting with a lower level of uptake, such as Mexico, shares more than doubled. In 2016, 49% of all Internet users in G20 countries made a purchase online, but the proportion of online purchasers among users aged 16-24 was, on average, over 14 percentage points higher than among users aged 55-74.

The "age gap" between the share of 55-74 year olds and those aged 16-24 undertaking e-commerce transactions is particularly pronounced in Korea (17% compared to 68%). Meanwhile, in the United States the older age group are slightly more likely to make purchases online than 16-24 year olds, suggesting that the older generation are highly integrated in the digital economy.

Individuals who purchased online in the last 12 months, G20, by age, 2016

As a percentage of Internet users in each age group



*Note: * for the United States, the age gap is the opposite of other countries: individuals aged 55-74 have a slightly higher propensity to purchase online than individuals aged 16-24. For differences in recall period, reference period of data collection and age brackets see notes in data file.*

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; based on OECD ICT Access and Usage by Households and Individuals Database, http://oe.cd/hhind and ITU, World Telecommunication/ICT Indicators Database, June 2018.

What is an e-commerce transaction?

An e-commerce transaction describes the sale or purchase of goods or services conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders (OECD, 2011).

Internet users are individuals who have accessed the Internet within the last three months prior to surveying however different recall periods have been used in some countries. Online purchases are usually measured with respect to a 12-month recall period, taking into consideration that this is not always a high-frequency activity.

These data are typically gathered through direct surveys of households' ICT usage. Data collection on ICT usage by individuals is uneven across countries, due to differences in the frequency and nature of surveys. For online purchases, issues of comparability may be linked to several factors. Differences in age limits play a role – data for Japan and the United States refer to all individuals aged 6 and over instead of 16-74 year olds, which might reduce overall rates. Differences in recall periods the definition of e-commerce applied, and in survey methodology (e.g. techniques, time of year, etc.) also have an impact.

Data on mobile commerce (purchase via a handheld device) are also usually collected within these surveys, as well as the types of products that are being purchases (e.g. travel, films, music, books, food, tickets for events, etc.).

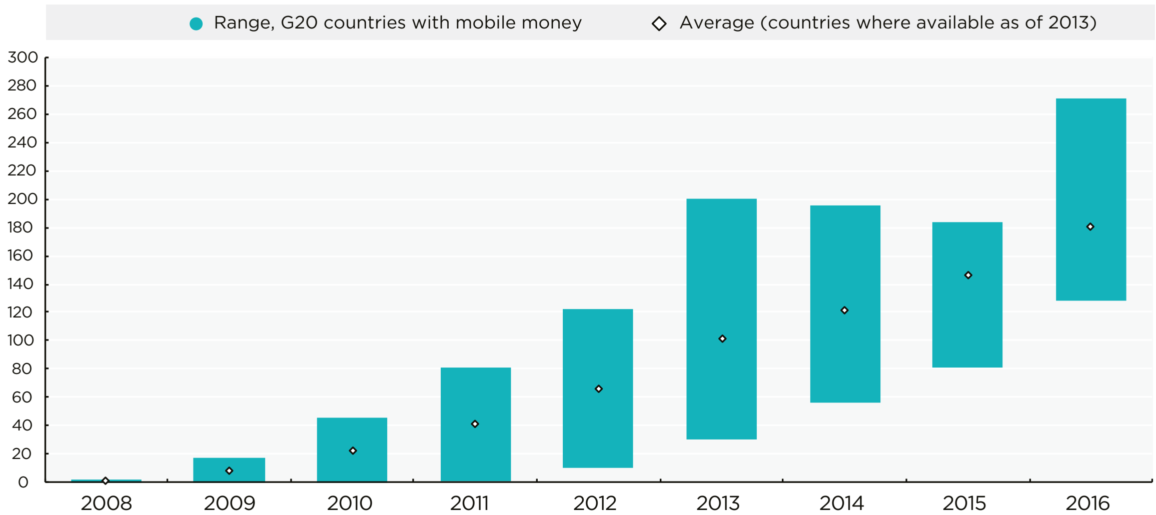
3.13 Mobile Money

Mobile money accounts are among the types of financial services considered in the IMF's Financial Access Survey. Mobile money is a store of value and means of payment accessible via a mobile phone. Its convenience and low costs give mobile money an important role in fostering financial inclusion. Mobile money services are often available close to home in areas with few or no banks, and less documentation is required to open a mobile money account than a bank account.

Mobile money is available in some G20 countries, and in many developing countries. As a substitute for a deposit account at a bank, it tends to be more popular in economies with fewer bank accounts per capita.

Mobile Money Account Penetration

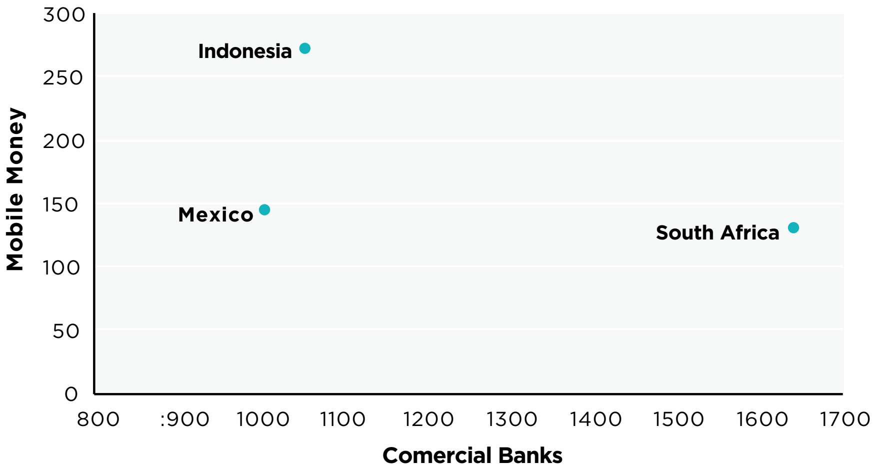
Registered Mobile Money Accounts per 1000 adults, 2007-16, G20 countries where available as of 2013



Source: IMF Financial Access Survey. http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34.

Mobile Money vs. Bank Accounts, per 1000 Adults, 2016

Registered Mobile Money Accounts per 1000 adults, 2007-16, G20 countries where available as of 2013



Source: IMF Financial Access Survey. http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C

Note: Accounts at commercial banks refer to deposit accounts

About the Data

Registered mobile money accounts include inactive accounts; active accounts and transactions tend to show faster growth. Estimates are based on administrative data from mobile money service providers.

3.14 Citizens interacting with government

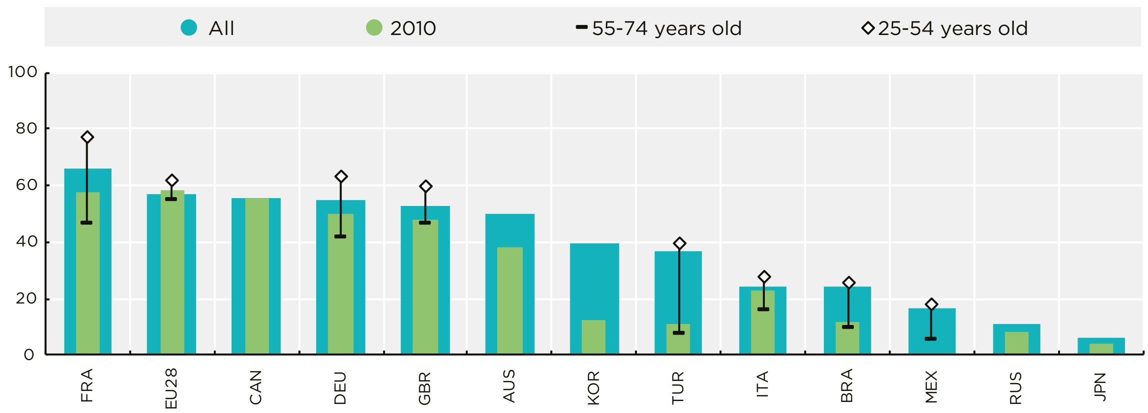
ICTs can play a considerable role in simplifying interactions with public authorities, thanks to the digitisation and automation of many processes. For both individuals and businesses, online interactions can include simple document browsing, downloading forms or completion of administrative procedures. The share of individuals using the Internet to interact with public authorities in the G20 countries for which data are available has increased in recent years, from 29% in 2010 to 39% in 2016. Korea and Turkey saw particularly pronounced increases from less than 13% in 2010 to nearly 40% in 2016.

Inter-country differences remain large, however, ranging from over 55% in France and Canada to 6% in Japan. Use by individuals aged 55-74-years remains markedly lower than average in these countries. Inter-country differences may reflect differences in internet usage rates, the supply of e-government services and the propensity of users to perform administrative procedures online, as well as limited data comparability. On average, less than 4% of EU citizens who needed to submit a completed form to public authorities in 2016 reported being unable to submit online because the service was unavailable. The share was much higher in Germany (13%).

Concerns about protection and security of personal data are also frequently reported as a reason for not submitting official forms online. In 2016, 21% of people in the EU chose not to submit completed forms to public authorities and, on average, 22% among those cited privacy and security concerns as a reason for not doing so. This was also particularly the case in Germany (38%).

Individuals using the Internet to interact with public authorities, G20, by age, 2016

As a percentage of population in each age group



Notes: Unless otherwise stated, data refer to the respective online activities in the last 12 months. For Australia, data refer to the fiscal years 2010/11 ending on 30 June and 2012/13. For Korea and the Russian Federation, data refer to 2013 and 2009. Brazil data refer to 2015, Canada, data to 2012. Japan data refer to individuals aged 15-69 instead of 16-74 using the Internet for sending filled forms via public authority websites in the last 12 months. For Mexico, using e-government services includes the following categories: "communicating with the government", "consulting government information", "downloading government forms", "filling out or submitting government forms", "carrying out government procedures" and "participating in government consultations". For "sending forms", data correspond to the use of the Internet in the last 3 months.

Sources: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; based on OECD, ICT access and use database, http://oe.cd/hhind; ITU World Telecommunication/ICT Indicators database (June 2018).

Measuring people's online interactions with government

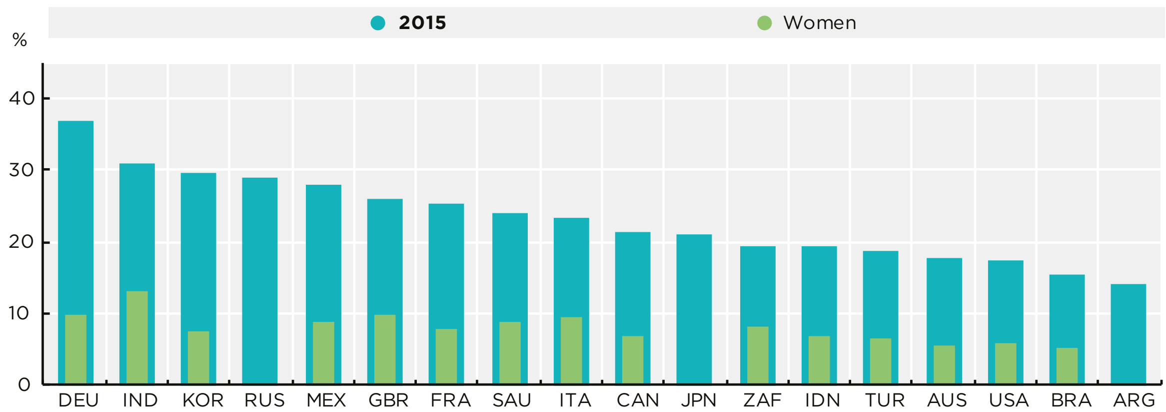
Individuals' online interactions with public authorities range from the simple collection of information on government websites to interactive procedures where completed forms are sent via the internet – excluding manually typed e-mails (for individuals). Public authorities refer to both public services and administration activities. These may be authorities at the local, regional, or national level. E-government can be measured by collecting information on electronic services offered by government entities (supply-side approach) or on the use of these services by businesses and individuals (demand-side approach). In recognition of the statistical difficulties of the supply-side approach, the OECD and other international organisations have adopted a demand-side approach. Such an approach is not without difficulties, however, as the same services (e.g. transport, education, health) can be provided by government and/or by public or private sector businesses with the precise mix varying between countries; the scope for e-government service use by individuals and firms will therefore differ between countries. These structural differences are likely to affect not only international comparability, but also comparability over time within countries.

3.15 Education in the digital era

Tertiary education has expanded worldwide to support the supply of highly educated individuals and meet rising demand for cognitive skills. Policy makers are particularly interested in the supply of scientists, engineers, and ICT experts because of their direct involvement in technical change and the ongoing digital transformation. In 2015, around 23% of students graduating at tertiary level within G20 Countries did so with a degree in the natural sciences, engineering, and information and communication technologies (NSE & ICTs). In spite of perceived shortages in this area, this remains similar to the share in 2005. However, women account for only 34% of all NSE & ICT graduates on average in 2015, with shares ranging from 26% in Korea to 41% in South Africa and Italy, and 42% in India. India contributed the largest number of ICT graduates at nearly 585 000 as well as being the country closest to gender parity in this field.

Tertiary graduates in the natural sciences, engineering and ICTs (NSE & ICT), G20, 2005 and 2015

As a percentage of all tertiary graduates



Notes: 2005 data points estimated by UNESCO Institute for Statistics to align available ISCED1997 data with the ISCED2011 and ISCED-F 2013 revisions; other data accords with ISCED2011 and/or ISCED-F 2013.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; based on OECD (2017), Education at a Glance 2017: OECD Indicators and OECD (2007), Education at a Glance 2007: OECD Indicators, OECD Publishing, Paris; and UNESCO Institute for Statistics (accessed June 2018).

Measuring fields of education

The natural sciences, engineering and ICT fields correspond to the following fields in the ISCED Fields of Education and Training 2013 (ISCED-F 2013) classification: 05 Natural sciences, mathematics, and statistics; 06 Information and Communication Technologies; and 07 Engineering, manufacturing and construction.

Indicators on graduates by field of education are computed on the basis of annual data jointly collected by UIS/OECD/European Commission. This data collection process aims to provide internationally comparable information on key aspects of education systems in more than 60 countries worldwide (http://www.oecd.org/education/database.htm).

The implementation in this data collection of the 2011 revision of the International Standard Classification of Education (ISCED-11) and the ISCED 2013 2013 Fields of Education and Training classification impacts the comparability with data obtained in earlier collections. For this reason, UNESCO Institute for Statistics (UIS) estimations which aim to align back-series data based on the earlier ISCED1997 classification with the ISCED2011 revision are used for earlier periods.

3.16 Individuals with ICT skills

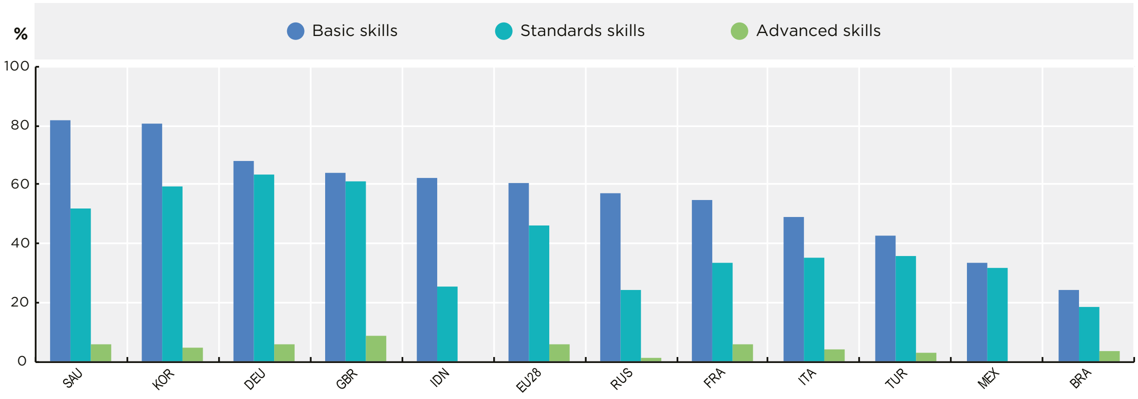
ICT skills are a key determinant of the ability to make effective use of ICTs. Currently, there is little data available for measuring ICT-specific skills, and hence researchers and policy-makers must rely on proxy indicators to measure this important enabler of ICT development. Individuals with ICT skills is one relevant indicator, also used to monitor SDG Target 4.4[2].

Fairly high shares of Internet users are observed to have basic skills and – to a lesser extent – standard skills across G20 countries. For advanced skills, however, which is the proportion of Internet users who have written a computer program using a specialized programming language in the last three months, values are uniformly low. While this only provides a partial picture – for example, it is possible that individuals who haven't programmed in the last three months do possess programming or other advanced ICT skills – it is an area of concern for policy makers, especially in an environment where the demand for people with advanced ICT skills is growing and will continue to do so for the foreseeable future.

[2] *By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.*

Individuals with ICT skills, by type of skills, 2017

As a percentage of Internet users



Notes: Data for Germany, the United Kingdom, Italy and Brazil refer to 2016. The values for the EU are the unweighted averages of basic/standard/advanced skills of the 28 individual EU countries.

Source: ITU World Telecommunication/ICT Indicators database (June 2017).

Measurability

The indicator individuals with ICT skills is collected through household ICT surveys, where individuals are asked whether they have undertaken nine computer-related activities in the last three months. Computer-related activities used to measure ICT skills are as follows:

1. Copying or moving a file or folder;
2. Using copy and paste tools to duplicate or move information within a document;
3. Sending e-mails with attached files (e.g. documents, pictures, a video);
4. Using basic arithmetic formulae in a spreadsheet;
5. Connecting and installing new devices (e.g. a modem, camera, printer);
6. Finding, downloading, installing and configuring software;
7. Creating electronic presentations with presentation software (including text, images, sound, video or charts);
8. Transferring files between a computer and other devices;
9. Writing a computer program using a specialized programming language.

These nine activities are aggregated into three skill levels. An individual has basic skills if (s)he has undertaken any of the activities numbered 1-3 and 8 of the list above, standard skills if (s)he has undertaken any of the activities numbered 4-7 and advanced skills if (s)he has undertaken activity 9. The indicator is currently being revised because it needs to consider skills beyond computer-related skills. The indicator will also be aligned with the EU Digital Competence Framework for Citizens by adopting its five competence areas (Information and data literacy, Communication and collaboration, Digital content creation, Safety, and Problem solving.)

INNOVATION AND TECHNOLOGY ADOPTION

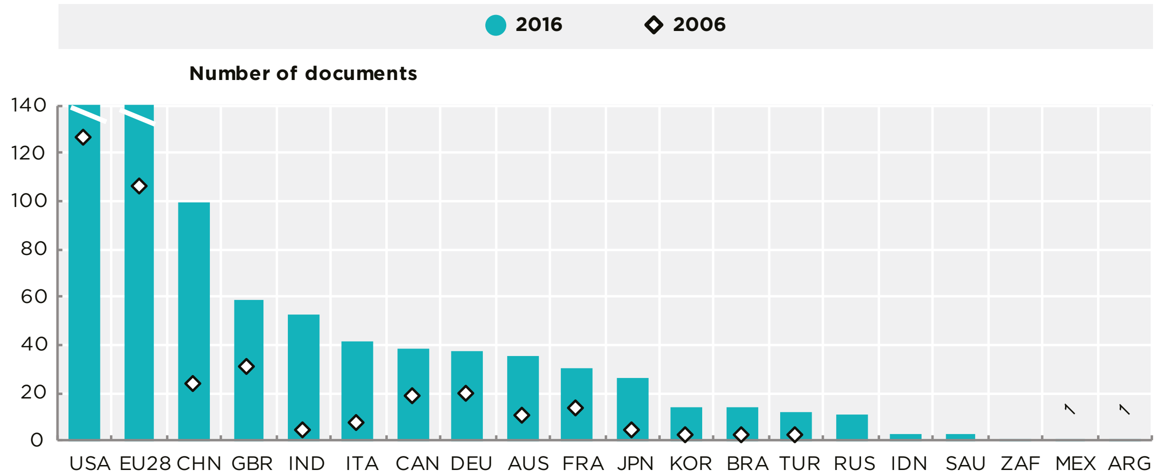
3.17 Research in machine learning

The global volume of scientific production is growing significantly over time. Indicators of "scientific excellence" focus on the contribution of economies to the top cited publications. For example, China has increased its production of highly-cited scientific output and so its share in the world's top 10% most-cited publications from less than 4% in 2005 to 14% in 2016, making it the second largest contributor to "scientific excellence" after the United States (OECD, 2017a). Among the research fields with greatest potential to revolutionise production as well as to contribute to tackling global challenges is research in the field of artificial intelligence (AI), which has aimed for decades to allow machines to perform human-like cognitive functions. Breakthroughs in computational power and systems design have raised the profile of AI, with its outputs increasingly resembling those of humans.

A key driver has been the development of machine learning (ML) techniques. ML deals with the development of computer algorithms that learn autonomously based on available data and information. Drawing on the power of "big data" sources, algorithms can deal with more complex problems that were previously assailable only to human beings. Bibliometric analysis shows remarkable growth in scientific publications related to ML, especially during 2014-15. The United States and the European Union lead in this area of research both in terms of total and top cited publications. Also worthy of note is the rapid growth in publications from China and India, now the second and fourth largest countries producing high quality scientific documents on ML.

Top science in Machine Learning, G20, 2006 and 2016

G20 economies with the largest number of ML documents among the 10% most cited, fractional counts



Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; calculations based on Scopus Custom Data, Elsevier, Version 4.2017; and 2015 Scimago Journal Rank from the Scopus journal title list (accessed June 2017), July 2017.

Interpreting scientific excellence

The indicator of scientific excellence indicates the percentage of a unit's scientific output that is included in the global set of the top-10% of cited papers in their respective scientific fields. The indicator is based on fractional counts of documents (articles, reviews and conference proceedings) by authors affiliated to institutions in each economy. In order to identify documents related to Machine Learning, a search for the text item "*machine learn*" has been performed in the abstracts, titles and keywords of documents published up to 2016 and indexed in the Scopus database. The accuracy of this approach depends on the comprehensiveness of abstract indexing, which implies a bias towards English-speaking journals.

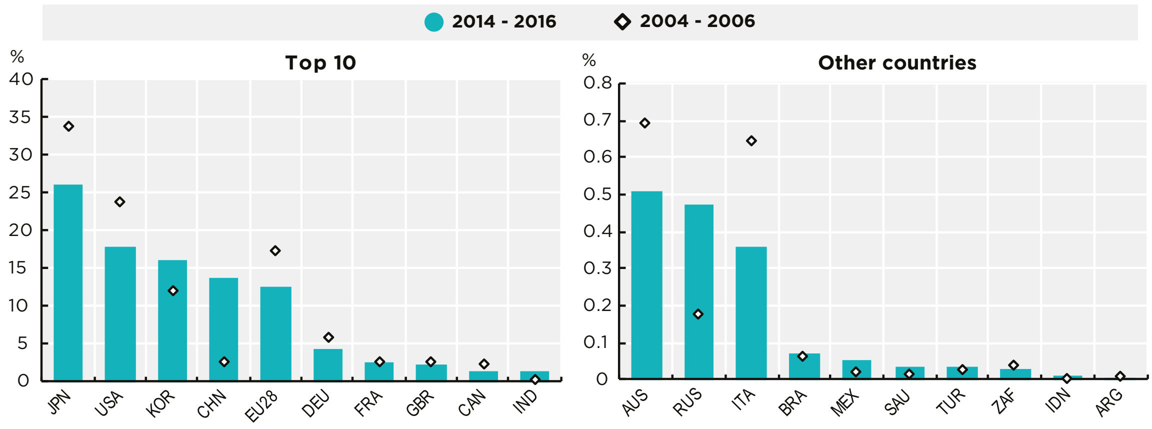
3.18 AI-related technologies

Disruptive technologies displace established ones and affect production processes, the entry of new firms, and the launch of ground-breaking products and applications. 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.

Among disruptive technologies, Artificial Intelligence (AI) holds the promise of contributing to tackling global challenges related to health, transport and the environment. AI is a term used to describe machines performing human-like cognitive functions (e.g. learning, understanding, reasoning or interacting). The development of AI-related technologies, as measured by inventions patented in the five top IP offices (IP5, i.e. the patent offices of the United States, China, Japan, Korea and Europe), increased by 6% per year on average between 2010 and 2015, twice the average annual growth rate observed for patents in every domain. In 2016, 26 000 IP5 patent families related to AI were filed worldwide. Japan, Korea and the United States accounted for over 60% of AI-related patent applications during 2014-16. Among the G20 economies, Korea, China and the Russian Federation increased considerably their number of AI-related patents compared to 2004-06, and India now also features among the top 10 G20 economies leading in this field. AI technological breakthroughs such as "machine learning" coupled with emerging technologies such as big data and cloud computing are strengthening the potential impact of AI.

Patents in artificial intelligence technologies, 2004-06 and 2014-16

G20 inventors' countries, shares in IP5 patent families



Notes: Data refer to the number of IP5 patent families in artificial intelligence (AI), by filing date and inventor's country, using fractional counts. Data for 2015 and 2016 are incomplete.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; based on OECD STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats, June 2018.

Defining AI-related technologies

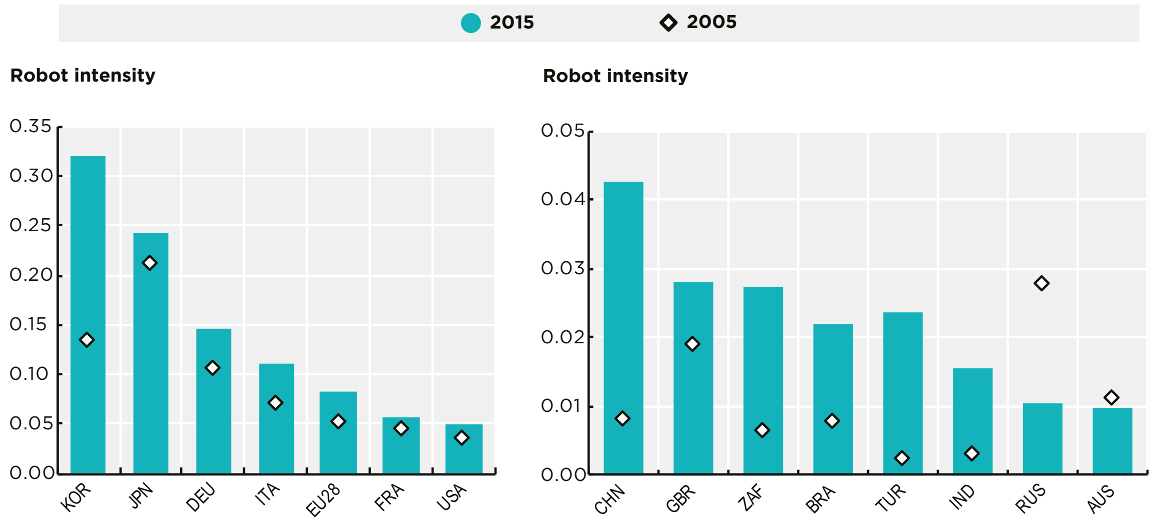
Measuring the development of AI technologies is challenging as the boundaries between AI and other technologies blur and change over time. The indicators presented here make use of technology classes (i.e. the International Patent Classification, IPC, codes) listed in the patent documents to identify AI-related inventions. All inventions belonging to the "Human interface" and "Cognition and meaning understanding" categories listed in the 2017 OECD ICT taxonomy (see Inaba and Squicciarini, 2017), as well as those related to G06N code of the International Patent Classification (IPC) are here considered as being AI-related. The OECD is working to refine further its operational definitions of AI technologies and scientific outputs, mining the bibliometric and patent data hosted in its Micro-data Lab infrastructure. Advanced search strategies are being implemented to identify scientific publications in AI, based on keywords in peer-reviewed articles, citations linked to pioneer studies etc. In parallel, refinements of the operational definition of AI-related inventions are being undertaken in consultation with experts and leading actors in the field. Both approaches can shed light on the emergence of AI-fields, topics and applications, and the science-technology links in AI. The indicators presented here rely on patent families (patents applied at the same time to at least two of the five largest IP offices - IP5).

3.19 Robotisation in manufacturing

Production is being transformed by advances in fields such as big data, 3D printing, machine-to-machine communication, and robots. Comparable and representative data for 2015 on the deployment of industrial robot technologies, for example, show that Korea and Japan lead in terms of robot intensity (i.e. the industrial stock of robots over manufacturing value added) these rates are considerably higher than the average for these G20 countries (0.8%). Robot intensity has increased by 54% in the EU28 since 2005, and has also increased in most other G20 economies; in particular, robot intensity in China increased from 23% to 88% of that of the United States. Meanwhile, robot intensity has fallen in the Russian Federation and Australia. However, these figures should be interpreted with caution, since the indicators are based on the quantity of robots active in an economy at a specific moment and do not capture changes in the effectiveness or quality of robots over time.

Top robot-intensive G20 economies, 2005 and 2015

Industrial robot stock over manufacturing value added, millions USD, current values



Notes: Robot use collected by the International Federation of Robotics (IFR) is measured as the number of robots purchased by a given country/industry. Robot stock is constructed by taking the initial IFR stock starting value, then adding to it the purchases of robots from subsequent years with a 10% annual depreciation rate. Figure covers all manufacturing, mining and utilities sectors. Data for Australia are extrapolated for the years 2014 and 2015 due to a lack of data availability. Due to lack of available data, the OECD average excludes Canada, Israel, Luxembourg, and Mexico.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard; OECD calculations based on International Federation of Robotics data, and the World Bank, Word Development Indicators Database, September 2017.

Defining robots

An industrial robot is defined by ISO 8373:2012 as “an automatically controlled, reprogrammable, multipurpose manipulator programmable on three or more axes, which can be either fixed in place or mobile for use in industrial automation applications”. The International Federation of Robotics (IFR) collects information on shipments (counts) of industrial robots from almost all existing robot suppliers worldwide. The measure of the stock of robots displayed above has been calculated by taking the first-year stock value from the IFR, adding the sales of robots for subsequent years and assuming an annual depreciation rate of 10%. As a consequence, these metrics do not capture increases in the value of robots or their ability to perform tasks (i.e. no equivalent for “horsepower” in engines exists for robots). These figures are restricted to manufacturing, mining, construction and utilities, as IFR data obtained by the OECD do not include robots used in services industries other than the R&D industry.

3.20 R&D in information industries

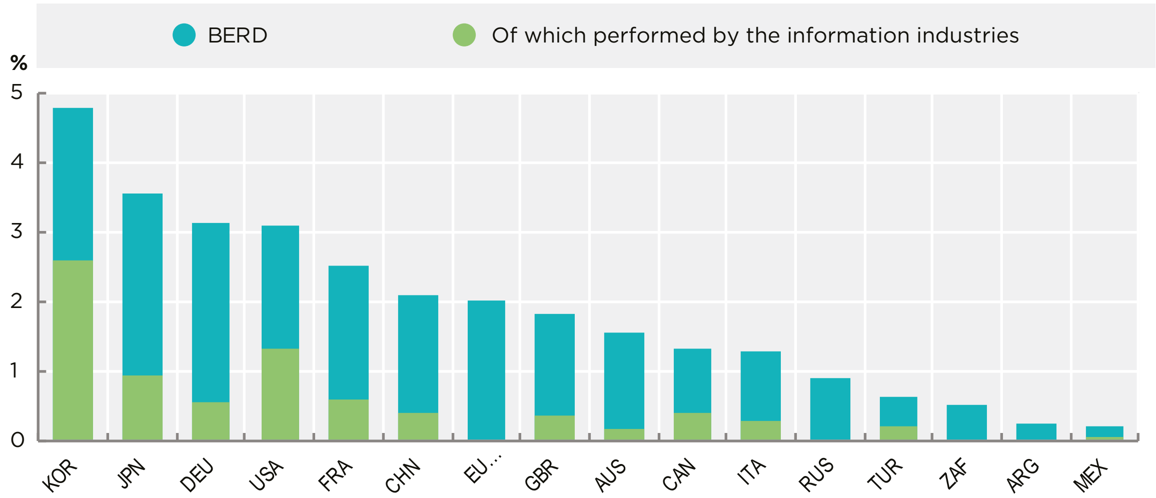
Investment in R&D is key to innovation. The United States performs the most R&D, with over USD 500 billion of domestic R&D expenditures in 2015. This exceeds by about one-quarter the amount of R&D performed in China, the second-largest performer, which overtook the combined EU28 area in 2015. Among the G20, Korea has the highest ratio of R&D expenditures to GDP owing to rapid increases in recent years. Emerging G20 economies account for a growing share of the world’s R&D.

Increasing national investment in R&D requires the combination of public and private efforts. In the more developed economies, the business sector accounts for the largest share of R&D spending, with much of this directed towards developing new products (and associated business processes) to introduce in the market – that build on existing knowledge or involve developing new knowledge.

In the G20, the industrial structure varies considerably from service-based economies to manufacturing or resource-based ones. Industries such as “ICT equipment” and “information services” are among the most R&D intensive. On average, the “information industries” account for about one third of business enterprise expenditure on R&D (BERD) in the G20 countries for which data are available; this reaches over half in Korea and more than 40% in the United States. Business R&D expenditure in the ICT industries alone represents about 0.8% to 1.9% of GDP in these countries, reflecting the high research intensity of these economies and the ICT sector itself.

Business enterprise expenditure on R&D and information industries, G20, 2015

As a percentage of value added in industry



Notes: information industries share for same reference year as BERD if available, otherwise based on shares for the most recent available year: Australia (2011), China (2009) and France (2013). Value Added (VA) in industry is calculated as the total VA excluding "real estate activities" (ISIC Rev.4 68), "public administration and defence; compulsory social security and education" (ISIC Rev.4 84 to 85), "human health and social work activities" (ISIC Rev. 4 86 to 88) and "activities of households as employers" (97 to 98).

Source: OECD calculations based on ANBERD, http://oe.cd/anberd, and Main Science and Technology Indicators Database, http://oe.cd/msti, July 2018.

What do we mean by R&D?

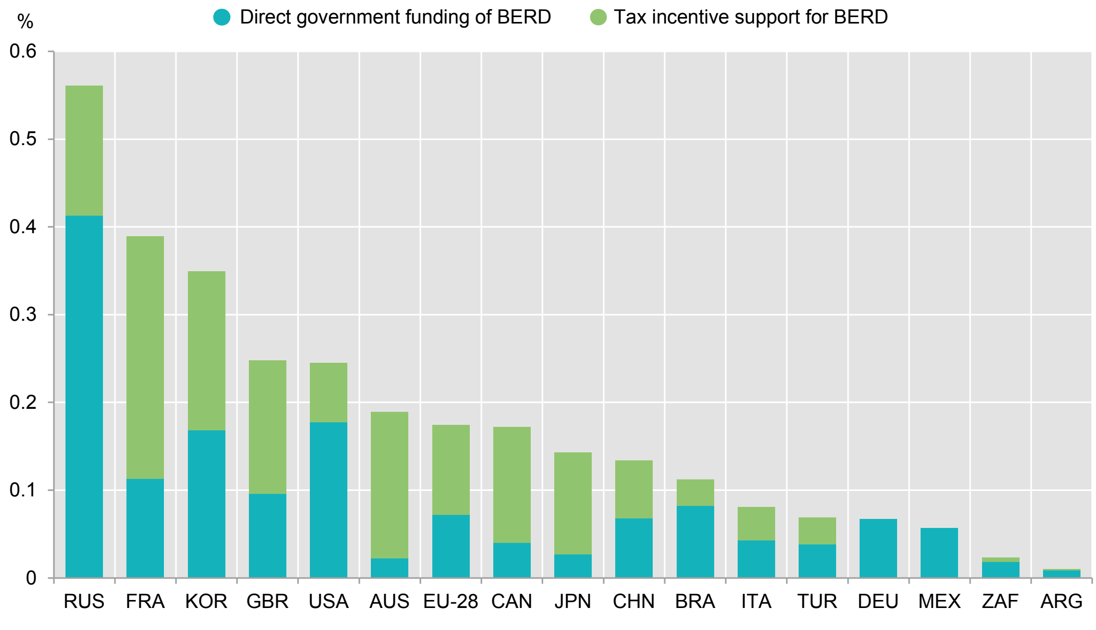
As defined in the OECD Frascati Manual (OECD, 2015 http://oe.cd/frascati), R&D comprises basic research (aimed at creating new knowledge with no specific application in view), applied research (new knowledge towards a specific practical aim) and experimental development (to develop new products or processes). Business expenditure on R&D (BERD) includes all expenditure on R&D performed by business enterprises, irrespective of funding sources. Expenditures are classified according to the main source of value added of the enterprise. Differences exist in the ways economies collect and report R&D data by economic activity. Interpretation may vary depending on whether data are collected on the basis of the main activity of the R&D performer, the industry or product to which the R&D is targeted, or a mix of the two. The Frascati Manual advocates separate reporting of both types of data. A specific effort is also made to encourage the separate reporting of software-related R&D to understand the overlap between R&D and software investment statistics. The proliferation of software R&D within all sectors (e.g. automotive) may also explain the apparent lack of growth in the share of information industries' BERD.

3.21 Supporting business R&D

Given the importance of information industries in overall business R&D expenditure, these industries can be key beneficiaries from Government R&D support measures. Government support for business R&D seeks to encourage firms to invest in knowledge that can result in innovations that transform markets and industries and result in benefits to society. Public support for business R&D is typically justified as a means of overcoming a number of market and institutional failures. In addition to providing direct R&D support such as grants or contracts, many governments also incentivise firms' R&D through tax relief measures. In 2017, 16 G20 economies gave preferential tax treatment to business R&D expenditures. Korea, the Russian Federation, and France provided the most combined support for business R&D as a percentage of GDP in 2015, while the United States, France, and China provided the largest volumes of tax support. The relative importance of tax incentives has increased across a majority of G20 economies, although this is by no means universal. Germany and Mexico do not provide R&D tax incentives. The optimal balance of direct and tax support for R&D varies from country to country and can evolve over time, as each tool addresses different market failures and stimulates different types of R&D under changing conditions.

Direct government funding of business R&D and tax incentives for R&D, G20, 2015

As a percentage of GDP



Source: OECD, R&D Tax Incentive Indicators, http://oe.cd/rdtax, Main Science and Technology Indicators 2017/2, April 2018.

How to measure R&D tax incentives

Tax incentives for business R&D include allowances and credits, as well as other forms of advantageous tax treatment of business R&D expenditure. Estimates exclude income-based incentives (e.g. preferential treatment of incomes from licensing or asset disposal attributable to R&D or patents) and incentives to taxpayers other than firms. While typically non-discretionary and demand-driven, some countries require pre-approval of R&D projects or accreditation. Budget limits may apply at the country level. In this figure, estimates of the cost of R&D tax incentives at the national or federal level have been combined with data on direct R&D funding (R&D grants and purchases), as reported by firms, to provide a more complete picture of government efforts to promote business R&D. The latest edition of the Frascati Manual summarizes the guidance on reporting data on tax relief for R&D. See *http://oe.cd/frascati*.

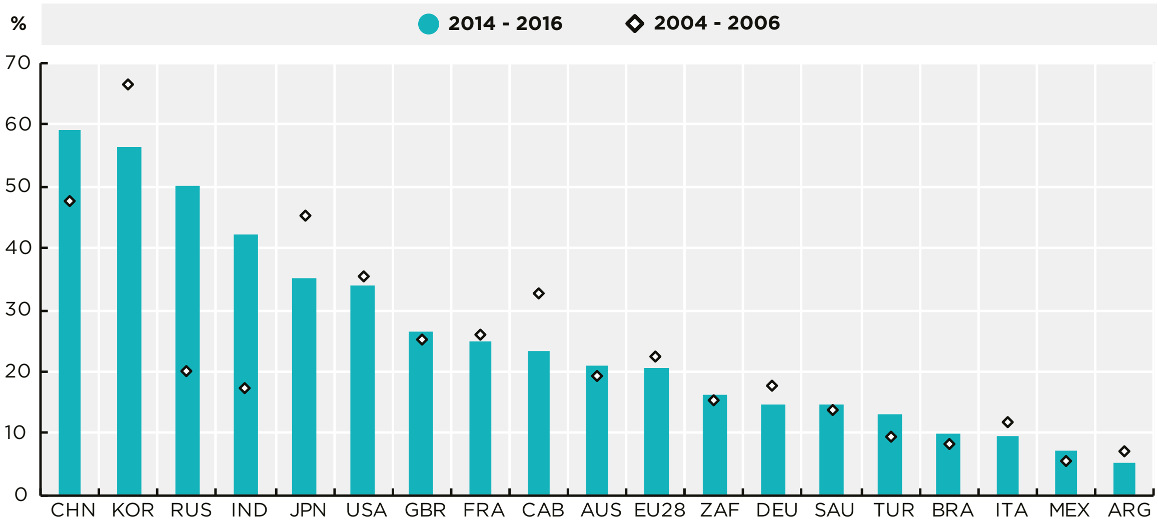
3.22 ICT-related innovations

Competing in Information and Communication Technology (ICT) markets worldwide requires innovations and technological developments to be bundled with appealing designs, while making consumers able to recognise the new and often complex products on offer. Over 2012-15, ICT patents accounted for about 26% of all IP5 patent families filed by G20 countries – 2 percentage points more than observed a decade earlier (2004-6). In contrast, China increased its share by 40% and its IP5 patent portfolio became the most specialised in ICT.

Patents are not the only form of intellectual property that can be leveraged in relation to ICT products. Some countries seem to progressively move towards ICT IP bundle strategies which put less emphasis on technological innovation (patents) and leverage more on the look and feel of products (design) and on extracting value from branding (trademarks). Meanwhile, some G20 countries - notably BRIICS countries - are seemingly pursuing technological catch-up strategies, while ring-fencing their products through designs and brands.

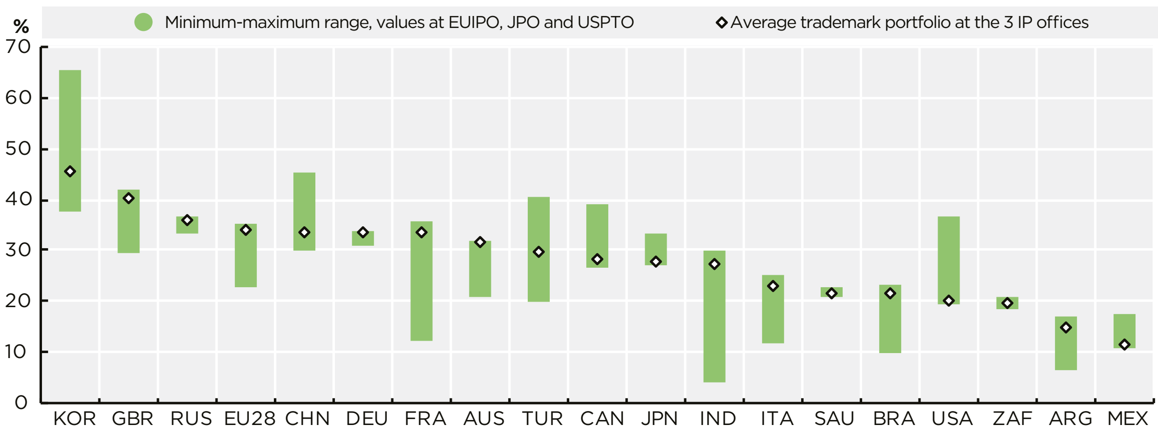
ICT-related patents, 2004-06 and 2014-16

As a percentage of total IP5 patent families owned by countries



ICT-related trademarks, 2012-15

As a percentage of total trademarks, EUIPO, JPO, and USPTO



Source: OECD, STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats, June 2018.

Measuring innovation with IP statistics

Patents protect technological inventions, i.e. products or processes providing new ways of doing something or new technological solutions to problems. IP5 patent families are patents within the world's five major IP offices (IP5). Patents in ICT are identified using the International Patent Classification (IPC) codes (see Inaba and Squicciarini, 2017). Trademarks are distinctive signs, e.g. words and symbols, used to identify the goods or services of a firm from those of its competitors. ICT-related designs and trademarks are identified following an experimental OECD approach based on Locarno and Nice Classifications, respectively, combining a normative approach with ICT-related keywords.

Intellectual property (IP) rights follow a territoriality principle. Patents, designs and trademarks are protected only in the countries where they are registered. Using information on the priority date of patents, i.e. the date of the first filing of a patent whose protection has subsequently been extended to other IP jurisdictions, allows reconstructing patent families and avoiding duplications when counting IP assets.

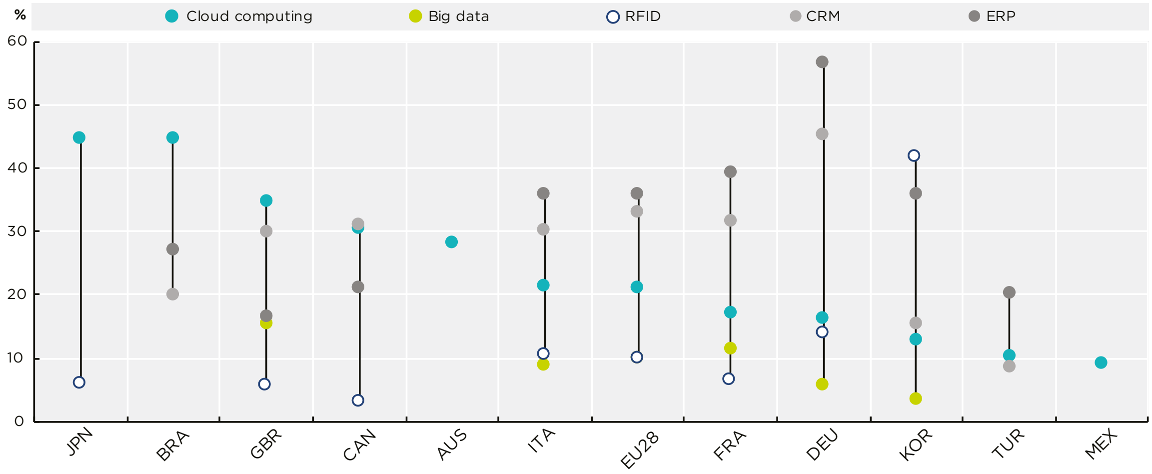
3.23 ICT Use by businesses

Almost no business today is run without ICTs of some sort (including mobile phones), but the extent to which ICT tools are integrated into business processes tends to vary across countries in line with firm and industry composition. This indicator illustrates the differing extent to which selected and more sophisticated ICT tools have been adopted in different countries. These are key tools in many economies but in some cases, especially in developing countries, it would be important to consider such fundamental aspects as having a computer, having a web presence, placing orders and receiving orders over the Internet, or access to broadband.

The G20 countries for which data are available exhibit considerable variation in the take-up of ICTs by business. Japan and Brazil had the greatest proportion of enterprises using cloud computing in 2016 (45%), but uptake of radio frequency identification (RFID) was lower than other countries (except Canada) in Japan (6%) and uptake of Customer Relationship Management (CRM) tools was relatively low in Brazil (20%). Similarly, use of cloud services in Germany (16%) is lower than in the average G20 country (25%), but German enterprises account for the highest uptake of electronic resource planning (ERP, 57%) and the second highest usage of CRM (45%). Korea has the highest proportion of enterprises using RFID (42%), but the lowest uptake of big data analytics (4%).

Diffusion of selected ICT tools and activities among enterprises, by technology, G20, 2016

As a percentage of enterprises with 10 or more persons employed



Notes: unless otherwise stated, only enterprises with ten or more persons employed are considered. Data for ERP relate to 2015 for all countries except Canada (2013), Iceland (2014) and Sweden (2014). Data for CRM relate to 2015. Data for RFID relate to 2014. Cloud computing: For Canada, data refer to 2012 and to enterprises that have made expenditures on "software as a service" (e.g. cloud computing). For Mexico, data refer to 2012. "For countries in the European Statistical System, data on e-purchases and e-sales refer to 2015. For Australia, data refer to the fiscal year 2014/15 ending on 30 June. For Canada, data refer to 2013 except cloud computing (2012). For Japan, data refer to 2015 and include businesses with 100 or more employees instead of ten or more. For Korea, data refer to 2015 except cloud computing (2013).

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, ICT Access and usage by Businesses Database, http://oe.cd/bus, and European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI June 2018)

Measuring ICT use by businesses

These data are gathered through direct surveys of business' ICT usage. Aside from differences in the survey vehicle, the majority of indicators correspond to generic definitions that proxy the functionalities and potential uses of ICT tools. For example, various software with different functionalities are within ERP, and there are substantial differences in the sophistication of ERP systems and their degree of implementation. Cloud computing services and big data raise similar issues. Enterprise resource planning (ERP) systems are software-based tools for managing internal information flows. Customer relationship management (CRM) is software for managing a company's interactions with customers, employees and suppliers. Cloud computing refers to ICT services over the Internet to access server, storage, network components and software applications. Big data refers to the analysis of vast amounts of data generated by activities carried out electronically and through machine-to-machine communications.

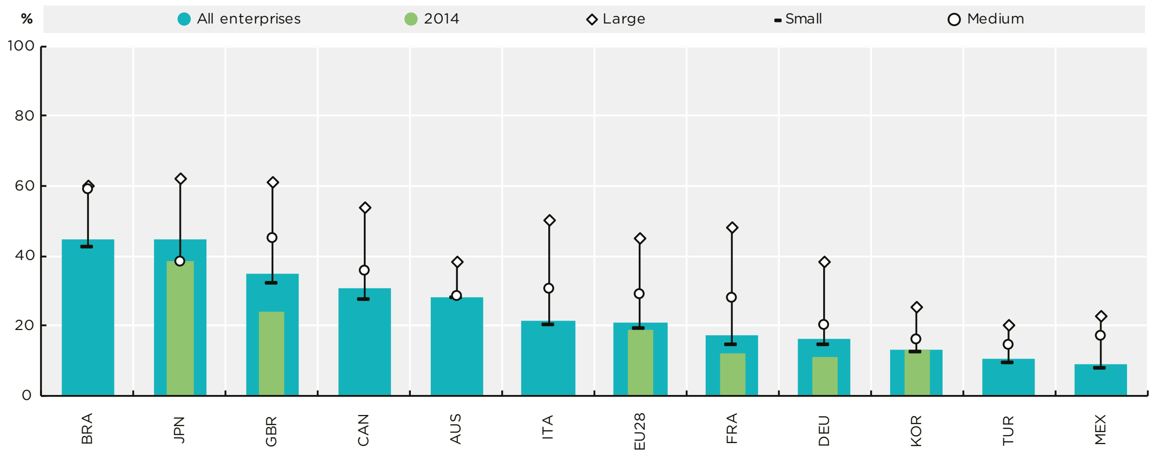
3.24 Cloud computing services

Electronic business (e-business) can help drive business growth by expanding market reach, saving on costs and meeting customised demand. Cloud computing, in particular, is opening up an array of new business processes, as it allows firms, particularly young ones, to use and pay for on-demand computing services. On average, 25% of businesses in the G20 countries for which data are available reported using such services in 2016, up from 23% in 2014. Intensity of use of cloud computing varies considerably among countries and sectors, as well as between small and large firms. On average, only 21% of small firms in these G20 countries use cloud services, compared to 30% of medium firms and 43% of large ones.

Differences across sectors and among the same sector in different countries can be large as well. Over 40% of businesses in Brazil and Japan use cloud computing services; more than twice the share of businesses in France, Germany, Korea, Turkey, and Mexico. France exhibits the greatest disparity between use by businesses of different sizes: 48% of large firms use cloud services in France compared to just 14.5% of small businesses.

Enterprises using cloud computing services, by size, G20, 2016

As a percentage of enterprises in each employment size class



Notes: unless otherwise stated, only enterprises with ten or more persons employed are considered. Size classes are defined as: small (from 10 to 49 persons employed), medium (50 to 249) and large (250 and more). Australia data refer to the fiscal year 2014/2015 ending on 30 June. Brazil data refer to 2015. For Canada, data refer to 2012 and to enterprises that have made expenditures on "software as a service" (e.g. cloud computing). Medium-sized enterprises have 50-299 employees. Large enterprises have 300 or more employees. Japan data refer to 2015 instead of 2016 and to businesses with 100 or more employees, where medium-sized enterprises have 100-299 employees and large enterprises have 300 or more employees. Korea data refer to 2015 instead of 2016, and Mexico to 2012.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, ICT Access and usage by Businesses Database, http://oe.cd/bus, and European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI) June 2018.

Measuring the use of cloud computing

Cloud computing refers to ICT services provided over the Internet such as access to servers, storage, network components, and software applications. Size classes are defined as small (10 to 49 persons employed), medium (50 to 249), and large (250 and more). Not all countries undertake specific surveys on ICT usage by businesses. Aside from differences in the survey vehicle, the majority of indicators correspond to generic definitions, which can only proxy ICT tools' functionalities and potential uses. One of the main challenges faced when measuring usage is the ability to make a clear distinction between cloud computing and other online services. Other issues include differences in sectoral coverage of surveys. Convergence of technologies brings additional challenges for the treatment (and surveying) of emerging technologies and applications.

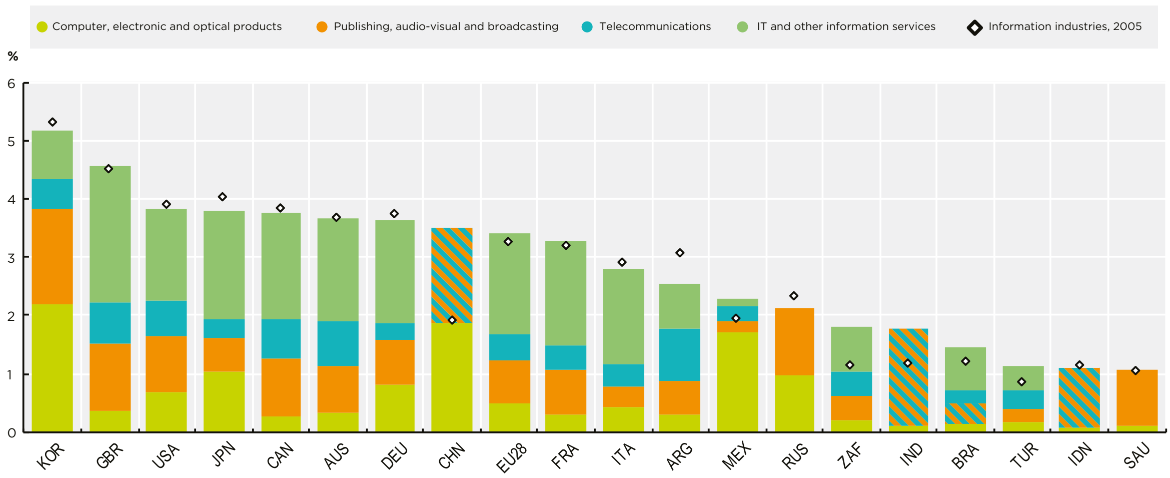
3.25 Jobs in the Information Industries

The information industries are considered an important source of economic and job growth despite accounting for a small share of business sector employment. On average, employment in information industries accounted for 2.8% of total employment in G20 countries in 2015, slightly more than in 2005 (2.7%). By country, shares (and trends) in employment are similar to those reported for value added although in general much lower, given the comparatively high level of labour productivity in these industries. The share was above 4% in Japan and the United Kingdom and just over 1% in Saudi Arabia and Indonesia. In nearly all countries, IT and other information services has become the largest information industry in employment terms.

Overall, the employment share of information industries was largely stable between 2005 and 2015 in a majority of countries; though Japan, Argentina, and Russia saw marked declines while China, South Africa, India, and Turkey experienced considerable increases.

Employment in information industries, G20, 2005 and 2015

As a percentage of total employment



Notes: For Chile, data refer to 2014 and 2013. For Korea, data refer to 2015 and 2006. For Turkey, data refer to 2015 and 2009. For Indonesia, India and Russian Federation data refer to 2014 and 2005. For Saudi Arabia, data refer to 2015 and 2013.

Source: OECD, estimates based on STAN Database, ISIC Rev.4, oe.cd/stan and European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), National Accounts Statistics, SBDS ISIC Rev. 4., Labour force surveys, WIOD (World Input-Output Databases).

Defining information industries

The OECD has defined information industries (OECD, 2011) as the aggregate combining ICT and digital media and content industries in the current version of the International Standard Industry Classification (ISIC Rev.4). This aggregate covers ICT manufacturing: “Computer, electronic and optical products” (Division 26) and information services: ISIC Rev.4 Divisions 58 to 60 (“Publishing, audio-visual and broadcasting activities”), 61 (“Telecommunications”) and 62 to 63 (“IT and other information services”). The business sector corresponds to ISIC Rev. 4 Divisions 05 to 66 and 69 to 82 (i.e. Total economy excluding “Agriculture, forestry and fishing” (Divisions 01 to 03), “Real estate activities” (68), “Public administration” (84), “Education” (85), “Human health and social work activities” (86 to 88) and “Arts, entertainment, repair of household goods and other personal services” (90 to 99)). Employment data are drawn mostly from National Accounts (SNA) sources and are measured in terms of persons, except for Canada, Japan and Mexico, which provide figures for jobs. Care should be taken when comparing changes in structural employment in these three countries with the other economies.

Employment-by-industry data are usually collected through Labour Force Surveys; Census data can also be of use. These ask respondents to identify the industry in which they work from a standardised list. Nevertheless, individual respondents’ declared industries may not always match the industry to which their employer is actually classified in economic statistics.

3.26 Jobs in ICT occupations

Statistics on ICT-related occupations and on employment in information industries offer complementary perspectives on the importance of ICT activities.

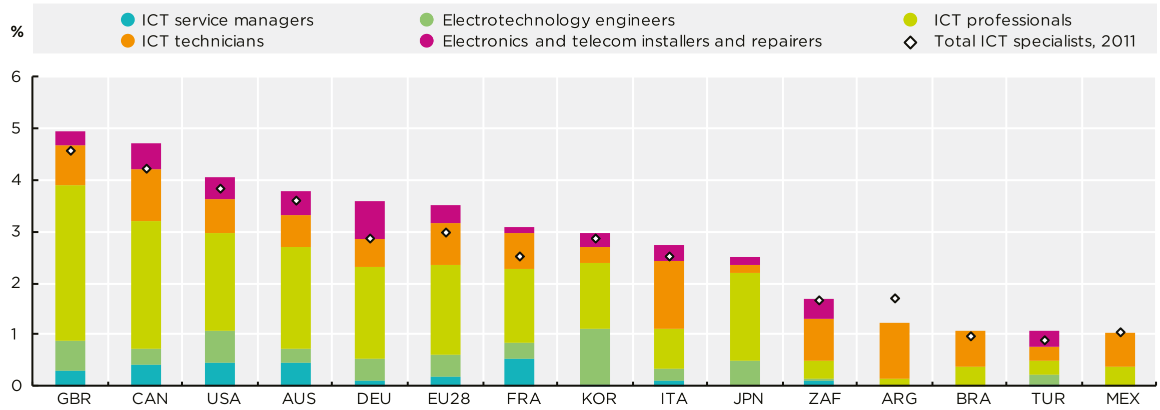
ICT specialists have been among the most dynamic occupations in recent years. They include all individuals employed doing tasks related to developing, maintaining and operating ICT systems and where ICTs are the main part of their job. In 2016, ICT specialists accounted for 3.3% of all workers in G20 countries for which data were available. Between 2011 and 2016 the share of workers who are ICT specialists grew in almost all these G20 countries, most notably in Germany and France, but has fallen markedly in Argentina.

ICT professionals and technicians make up the bulk of ICT specialists – around 70% on average; in some countries only these categories are available. In Korea, over one in three ICT specialists are electrotechnology engineers, compared to one-in-five in the United States and Turkey.

Some forecasts predict a significant shortage of ICT specialists (EC, 2014; OECD, 2014b) over the next 5 to 15 years. These forecasts rely on a scenario-based approach which, by its very nature, is challenging to validate. Unfortunately, available statistics do not yet allow a thorough investigation of the issues.

Employment of ICT specialists across the economy, G20, 2016

As a percentage of total employment, by category



Notes: Data for Canada and the United States refer to 2015. Data for Mexico relate to 2013 and for Brazil relate to 2012. ICT = information and communication technology.

Source: International Labour Organzation calculations based on Australian, Canadian, European, Korean and South African labour force surveys, Japanese 2015 Census, the United States Current Population Survey, alongside International Labour Organization data.

Defining ICT occupations

Employment by occupation data are usually collected through Labour Force Surveys; these ask respondents to identify their occupation from a standardised list. Census data may also be of use. Data for the United States are based on the Current Population Survey.

ICT specialists are defined as those individuals employed in "tasks related to developing, maintaining and operating ICT systems and where ICTs are the main part of their job". Based on the operational definition based on ISCO-08 3-digits which includes occupations: 133, 215, 25, 35, 742 (for further details see OECD [2004; 2015]). National classifications of occupations are not easily comparable across countries and are not always consistent with ISCO. The latest revision (ISCO-08) allows for a better description of ICT occupations. However, the lack of a direct correspondence with several occupational categories in the previous edition (ISCO-88) has resulted in a break in time series that the OECD is currently addressing.

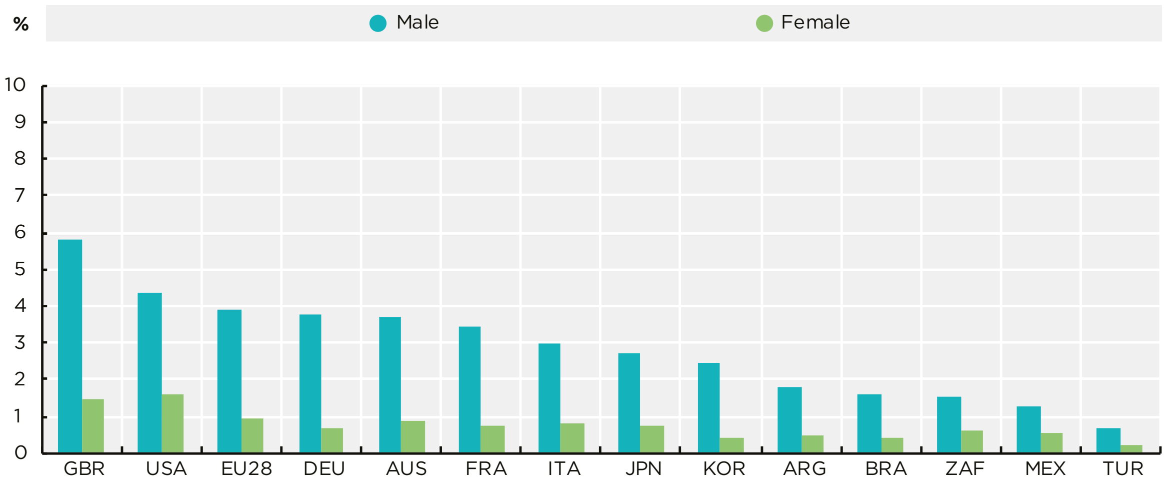
3.27 ICT workers by gender

There are large differences between the numbers of men and women employed as ICT specialists. This indicator presents the gender breakdown for the two main categories of ICT specialists shown above: ICT professionals and ICT technicians, which comprise around 70% of ICT specialists on average. While 2.9% of male workers in G20 countries are ICT professionals and technicians on average, this proportion is just 0.8% for female workers. Of the G20 countries for which data are available, the United Kingdom has the highest share of ICT professionals and technicians in total workers, but has a lower share of women than the United States (1.5% compared to 1.6%); in both cases this is well below the shares for men: 5.8% and 4.3% respectively.

ICT professionals and technicians make up a much lower share of workers in South Africa and Mexico but gender disparity is lower than in other countries presented; nevertheless, the male share is still more than double that of women.

ICT professionals and technicians by gender, 2016

As a percentage of all male and female workers



Notes: Notes: ISCO-08 occupations 25 and 35. Data for Japan refer to 2015.

Source: International Labour Organization estimates based on Australian, European, Korean and South African labour force surveys, Census of Japan 2015, the United States Current Population Survey, alongside International Labour Organization data.

Measuring ICT occupations

Employment by occupation data are usually collected through Labour Force Surveys; these ask respondents to identify their occupation from a standardised list. Data for the United States are based on the Current Population Survey.

Here, International Classification of Occupations 2008 (ISCO-O8) classes 25 and 35 only are presented as this gives greater country coverage compared to taking all ICT Specialist occupations when also breaking down by gender.

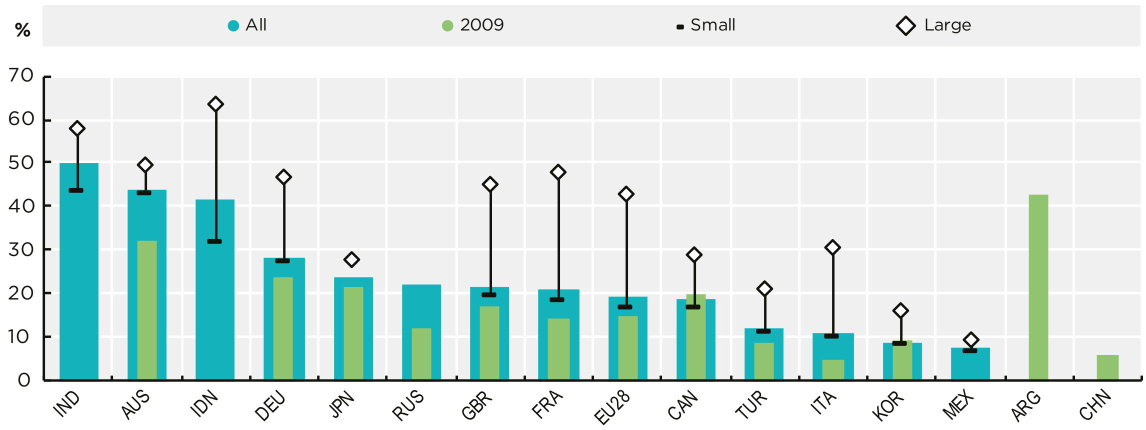
National classifications of occupations are not easily comparable across countries and are not always consistent with ISCO. The latest revision (ISCO-08) allows for a better description of ICT occupations. However, the lack of a direct correspondence with several occupational categories in the previous edition (ISCO-88) has resulted in a break in time series that the OECD is currently addressing.

3.28 E-Commerce

On average, 20% of enterprises in G20 countries for which data are available made sales via e-commerce in 2015, representing an increase of 3 percentage points since 2009. Differences among countries remain large. In Australia, over 40% of enterprises reported making sales via e-commerce, compared to less than one in ten firms in Korea and Mexico. Non-harmonised definitions of e-sales may explain some of these differences, but the main cause appears to be differing shares of smaller firms in different economies. In France, 48% of large businesses engage in e-commerce but only 21% of small businesses do so, similar to the pattern seen in the United Kingdom. Indonesia has the highest share of large firms engaging in e-sales at 64%, followed by India at 58% (though the data for India relate only to manufacturing firms). On average, 33% of larger firms engaged in e-sales in 2015, compared to only 18% of small enterprises.

Enterprises engaged in sales via e-commerce, by size, 2015

As a percentage of enterprises in each employment size class



Notes: For Australia, data refer to the fiscal years 2010/11 ending on 30 June and 2014/15. For Argentina data refer to 2006 and manufacturing sector only. For Canada, data refer to 2012 and 2013. Medium-sized enterprises have 50-299 employees and large firms have 300 or more employees. Sales online over the Internet may include EDI sales over the Internet as well as website sales, but do not include sales via manually typed e-mail or leads. For China, data relate to 2005 and includes businesses with fewer than 10 employees. For India data refer to 2013 and manufacturing sector/factories only including businesses with fewer than 10 employees. For Japan, data refer to 2010 instead of 2009 and to businesses with 100 or more employees instead of ten or more. Medium-sized enterprises have 100-299 employees and large firms have 300 or more employees. For Korea, data refer to 2010 instead of 2009. For Mexico, data refer to 2012 and to businesses receiving orders via the Internet instead of over computer networks. For the Russian Federation data relate to 2008 rather than 2009 and to legal entities except for small business entities.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, ICT Access and usage by Businesses Database, http://oe.cd/bus, European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), and UNCTAD enterprise use of ICT statistics (June 2018).

Measuring e-commerce sales

An e-commerce transaction describes the sale or purchase of goods or services conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders (OECD, 2011). The goods and services are ordered by these methods, but the payment and ultimate delivery of the goods and services do not have to be conducted online. For enterprises, e-commerce sales include all transactions carried out over webpages, extranet or Electronic Data Interchange (EDI) systems. Measurement of e-commerce presents methodological challenges that can affect the comparability of estimates, such as the adoption of different practices for data collection and estimations, as well as the treatment of outliers and the extent of e-commerce carried out by multinationals. Other issues include differences in sectoral coverage of surveys and lack of measures concerning the actors involved (B2B, B2C, etc.). These data are gathered through direct surveys of households' and individuals' ICT usage though not all G20 countries conduct these surveys.

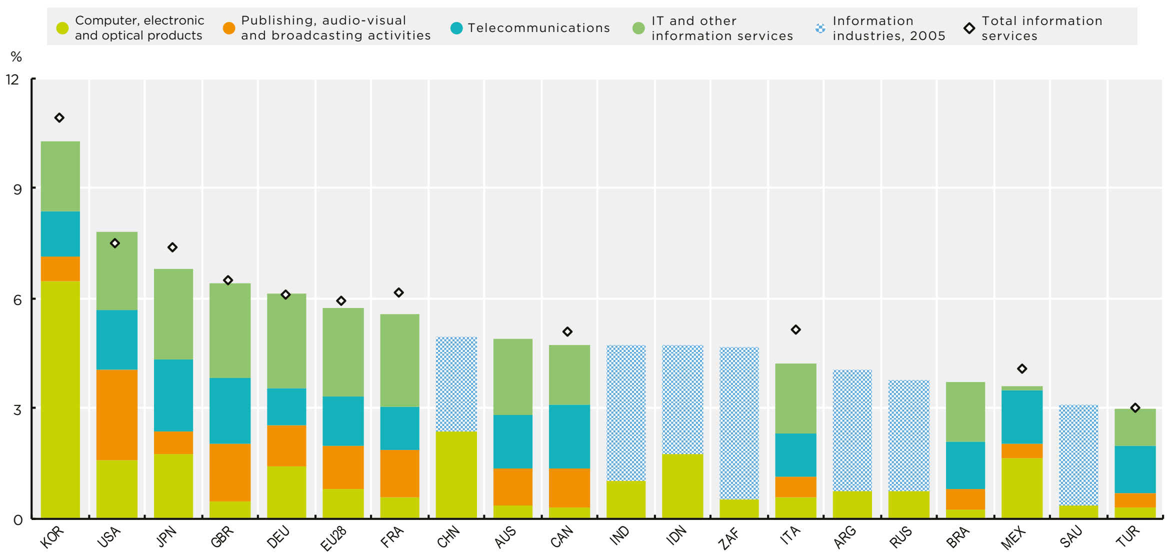
3.29 Value added in information industries

Demand for information and communication products has increased continuously since 2005. In most G20 economies, however, the share in value added by information industries remained the same or diminished – with the average decreasing slightly, to less than 6% of GDP. This overall trend hides important changes in the composition of the aggregate, as well as some country-specific patterns. Computer and electronics manufacturing and, to a lesser extent, telecommunication services saw their weight in total value added diminish in advanced economies as production shifted to emerging economies, and unit prices fell as a result of productivity growth and increased competition.

On average, the share of ICT manufacturing activities in G20 countries for which data are available is 1.2% of total value added and the share of telecommunication services is 1.4% on average with both down compared to 2005, and even further compared to the 2003-04 peak, as a result of a steep fall in prices. Meanwhile, the share of publishing and media activities in total value added is 1%, while the share of IT services has risen in many economies to 1.9% on average, largely offsetting decreases in the other ICT sectors. Despite the increasing importance of IT services, country differences in the overall weight of the information industries are mainly driven by the relative importance of ICT manufacturing industries and, to a lesser extent, publishing, audio-visual and broadcasting activities.

Value added of information industries, G20, 2005 and 2015

As a percentage of total value added at basic prices



Notes: Investment refers to Gross Fixed Capital Formation (GFCF) as defined by the System of National Accounts 2008 (SNA08). For Canada, data refer to 2014.

Source: OECD, STAN Database (http://oe.cd/stan), Annual National Accounts Database and Inter-Country Input-Output (ICIO) database (provisional), June 2018.

Measurability

Value added consists of the value of production net of the costs of intermediate inputs. In practice, it includes both gross profits and wages, and at the country level is equivalent to GDP. The OECD defines the information economy sector (see the OECD Guide to Measuring the Information Society 2011) as the aggregate combining ICT and digital media and content industries in the current version of the International Standard Industry Classification (ISIC Rev.4). Here these are referred to as "information industries". This aggregate includes ISIC Rev.4 Division 26 (Manufacture of computer, electronic and optical products) and Section J (Information and communication services), consisting of Divisions 58-60 (Publishing and broadcasting industries), 61 (Telecommunications) and 62-63 (Computer programming and information services). ICT trade and repair activities (in Groups 465 and 951) are also included, but are not considered here due to issues of data availability. However, it is not always possible to isolate ICT activities or obtain a comprehensive overview, as data are often made available only at the Division level (2 digits). In particular, software publishing (Group 582) is included under Division 58 on publishing (although part of IT services), while news agencies and other information services activities (Group 639) are found under Division 63 on IT services, although they belong to media and content industries.

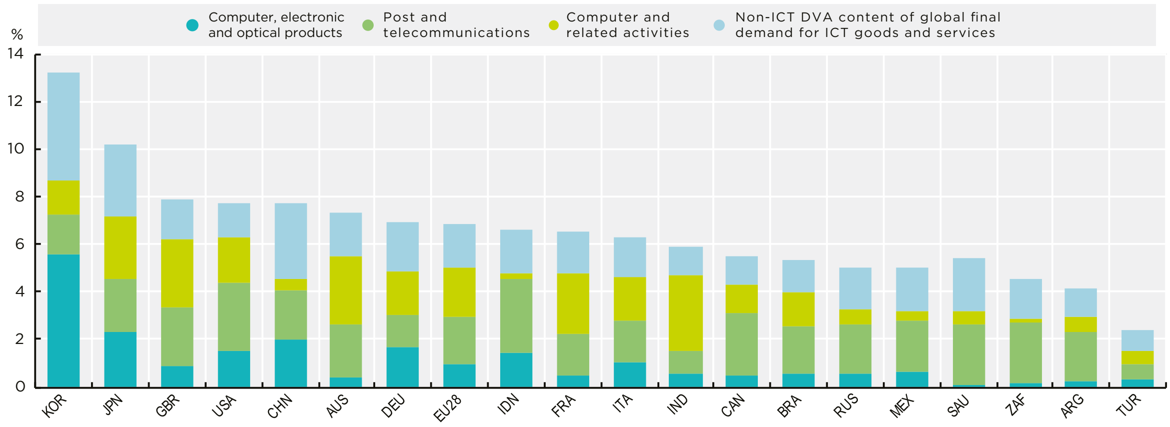
3.30 The extended ICT footprint

The importance of ICT activities can be illustrated by considering ICT-related domestic value added as a share of total economy value added (or GDP). This extended ICT measure reveals that ICT value added represented over 13% of GDP in Korea, which is a G20 economy particularly reliant on the manufacture of ICT goods, and 10% in Japan, where the main contribution came from ICT service activities - as was the case for most other G20 countries. By contrast, in South Africa, Argentina and Turkey, the extended ICT sector accounts for less than 5% of GDP.

The relative importance of the different sub-sectors varies between countries: computer, electronic, and optical products account for almost half of ICT-related domestic value added in Korea but is also relatively large in Japan and China (over 2%), Germany (1.7%), and Indonesia (1.4%). Meanwhile, post and telecommunications also makes a considerable contribution in countries such as Indonesia (3.2%), Canada and Saudi Arabia (2.6%) and "computer related activities" is a key component in India (3.2%) and the United Kingdom (2.8%). This shows that although ICT-related value added is an important contributor to the performance of G20 economies, countries exhibit strengths in different areas.

ICT-related domestic value added, 2011

As a percentage of GDP



Notes: Information and communication technology (ICT) industries are defined according to ISIC Rev.3 and consist of Computer, electronic and optical products (Divisions 30, 32 and 33), Post and telecommunications services (Division 64), and Computer and related activities (Division 72). Value added of domestic ICT industries is embodied in a wide range of final goods and services meeting final demand both at home and abroad. Similarly, domestic value added (DVA) from other industries ("non-ICT") can be embodied in final ICT goods and services consumed globally.

Source: OECD, Inter-Country Input-Output (ICIO) Database, http://oe.cd/icio, and Trade in Value Added (TiVA) Database, http://oe.cd/tiva, July 2017.

Measurability

Due to ongoing development of the OECD's Inter-country Input-Output (ICIO) database, the concept of extended ICT footprints can be further examined and improvements made to measurement. Notably, the use of an ISIC Rev.4-based industry list and, hence, a "refined" definition of ICT industries and ICIO tables for the years after 2011 to provide more timely indicators. Estimates of capital flow matrices, currently absent from the ICIO infrastructure, could also allow for the inclusion of non-ICT content of capital investment by ICT industries, such as the machinery and equipment used for manufacturing ICT parts and components. This would increase the size of ICT-EF. The ICT content of capital goods is already implicit in the analysis presented here.

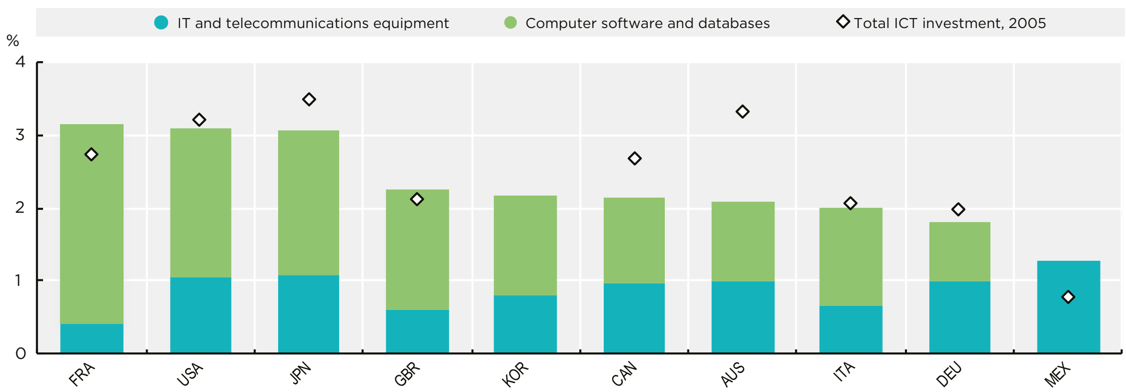
3.31 ICT Investment

Despite the ongoing digital transformation, from 2005 to 2015 investment in ICT assets across G20 countries for which data are available remained unchanged at 2.5% of GDP. Despite this, several G20 countries have seen marked declines in the share of GDP being spent on ICT investment including Japan, Canada, and Australia – where ICT investment is around one third lower in 2005 compared to 2015. These trends might be explained in part by substitution between capital investment and purchases of ICT services including increased penetration of cloud-based services, and the rapid decline in prices for ICT equipment.

France, the United States, and Japan, spend just over 3% of GDP on ICT investment, around one third more than other G20 countries for which data are available. There is also considerable disparity in the proportion of ICT investment accounted for by computer software and databases, which in 2015 ranged from about 40% in Germany to over 80% in France.

ICT investment by asset, 2015

As a percentage of GDP



Notes: Investment refers to Gross Fixed Capital Formation (GFCF) as defined by the System of National Accounts 2008 (SNA08). Data for Korea are OECD calculations based on detailed national Input-Output Tables supplied by the Bank of Korea and OECD Annual National Accounts SNA08.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, Annual National Accounts Database, http://www.oecd.org/sdd/na, European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), and national sources, July 2017.

Measurability

ICT investment refers to gross fixed capital formation (GFCF) of "information and communication equipment" and "computer software and databases", as defined by the System of National Accounts 2008 (SNA08). These data are compiled by countries in the course of producing National Accounts and give just a very partial view on the digital transformation. The OECD is working to develop a framework for a "Digital Economy Satellite Account" that will build upon the SNA framework and aims to give a multi-dimensional view on aspects such as data assets and transactions, the online platform-enabled economy, the substitution of ICT investments with payments for cloud services and more.

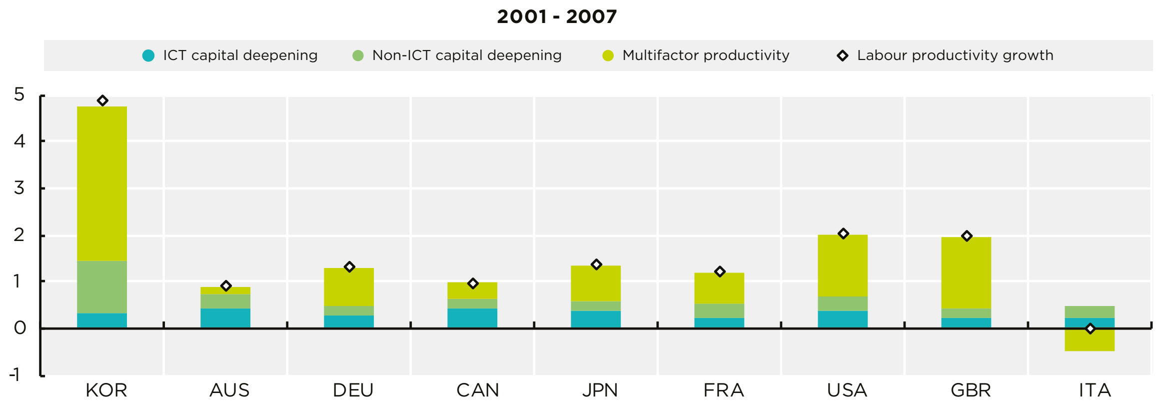
While the measurement of physical investment (in current prices) in ICT assets such as information technology and telecommunication equipment is relatively well established, measuring software and databases is considerably more challenging. Evidence highlights significant differences in measurement approaches in the case of software (particularly own-account software). In the case of databases, the SNA08 recommends including only the costs of physical maintenance and construction of databases as produced capital, rather than the earnings potential of the data embedded in the database itself (see Ahmad and Schreyer, 2016).

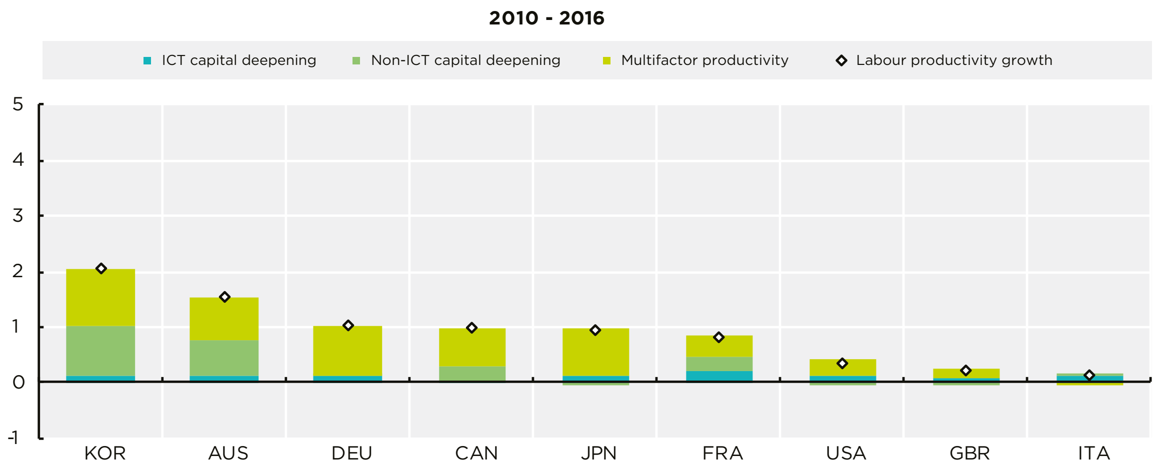
3.32 ICT and productivity growth

Labour productivity growth represents a higher level of output for every hour worked. This can be achieved if more capital per labour unit, i.e. capital deepening, is used in production, or by improving the overall efficiency with which labour and capital are used together, i.e. higher Multi-Factor Productivity (MFP). ICT capital deepening has been a persistent positive contributor to growth in all G20 countries for which data are available over the periods from 2001-2007 and 2010-2016. The contribution was especially pronounced in the earlier period, particularly in Australia, Canada, Japan, and the United States; in the later period the contribution was strongest in France and Italy.

ICT contribution to labour productivity growth, G20, 2001-07 and 2010-16

Total economy, annual percentage point contribution





Source: OECD Productivity Statistics (database), February 2018.

Decomposing labour productivity growth

Labour productivity growth is defined as the rate of growth in real value added per hour worked. Differences in labour productivity growth across sectors may relate, for instance, to the intensity with which sectors use capital (including knowledge-based capital) and skilled labour in their production, the scope for product and process innovation, the degree of product standardisation, the scope for economies of scale and their involvement in global value chains. By reformulating the growth accounting framework, labour productivity growth can be decomposed into the contribution of capital deepening and multi-factor productivity. Capital deepening is defined as changes in the ratio of the total volume of capital services to total hours worked. Its contribution to labour productivity growth is calculated by weighting it with the share of capital costs in total costs.

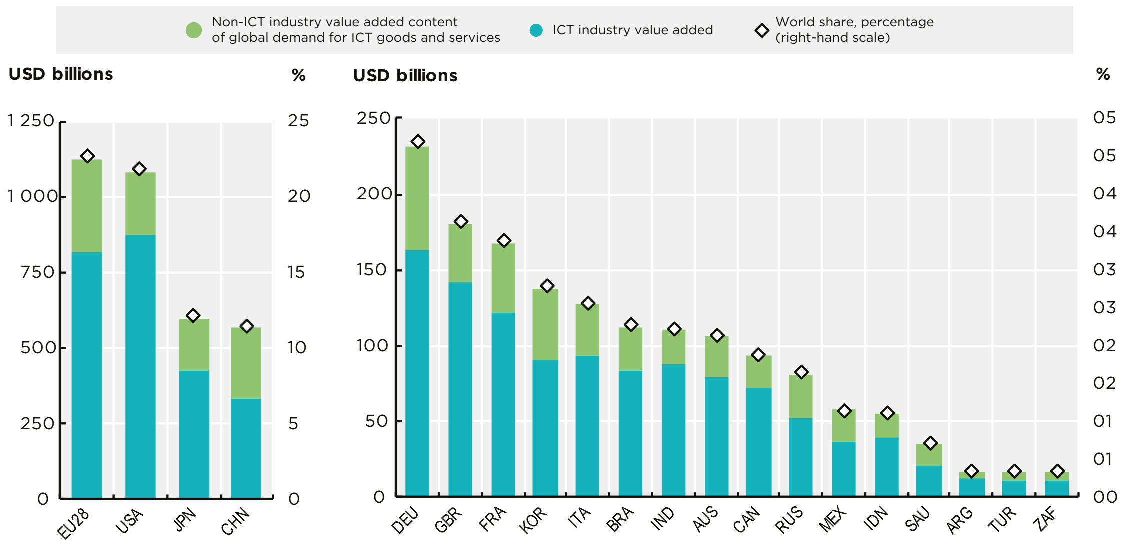
The comparability of productivity growth across industries and countries may be affected by problems in measuring real value added. For example, most countries assume no change in labour productivity for public administration activities; this sector is not included here. Real estate services are also excluded, as the output of this sector reflects mainly the imputation made for the dwelling services provided and consumed by home owners. In addition, sectors such as construction and several services (for example, hotels and restaurants) are characterised by a high degree of part-time work and self-employment, which can affect the quality of estimates of actual hours worked. See OECD (2017b) for more extensive discussion of measurement issues related to productivity growth.

3.33 ICT and Global Value Chains

Measuring the value added generated by information and communication technology (ICT) industries only provides a partial view of the importance of ICT to a country's economy. In addition to final ICT products, the output from domestic ICT industries is also embodied (via intermediate products) in a wide range of goods and services meeting final demand (business capital investment, household and government consumption), both domestically and abroad. Similarly, the output from domestic non-ICT industries is present in many ICT goods and services consumed worldwide through domestic interconnections and participation in global value chains (GVCs). Global demand for ICT goods and services through international trade and investment can drive the activities of many upstream domestic non-ICT industries. Combining the value added generated by domestic ICT industries with the domestic non-ICT industry value added embodied in global demand for ICT goods and services could be a first step towards defining an extended ICT footprint, or "ICT-EF". In 2011, the United States, Japan and China together accounted for about 45% of the world's extended ICT footprint. The European Union as a whole accounted for 23%, a share only marginally higher than that of the United States. Neglecting the value added generated in other sectors of the economy to meet global demand for ICT final goods and services can result in under-estimation of the role played by the "digital" economy.

Extended ICT domestic value added footprint, 2011

USD billions and world share, percent



Notes: In this analysis, information and communication technology (ICT) industries are defined according to ISIC Rev.3 and consist of Computer, electronic and optical products (Divisions 30, 32 and 33), Post and telecommunications services (Division 64), and Computer and related activities (Division 72). The underlying ICIO database is constructed from contemporaneous SNA93 National Accounts statistics and, hence, the figures for ICT value added presented here may not match the latest equivalent SNA08, ISIC Rev.4, ICT value added statistics.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, based on OECD, Inter-Country Input-Output (ICIO) Database, http://oe.cd/icio, and Trade in Value Added (TiVA) Database, http://oe.cd/tiva, July 2017.

Measurability

In this analysis, information and communication technology (ICT) industries are defined according to ISIC Rev.3 and consist of "Computer, electronic and optical products" (Divisions 30, 32 and 33), "Post and telecommunications services" (Division 64), and "Computer and related activities" (Division 72). Due to data availability this definition represents an approximation of the more detailed ISIC Rev.3 definition given in OECD (2011). While ICT industry value added is generally available from official National Accounts (SNA) statistics, tracking the country and industry origins of value added embodied in final ICT goods and services requires the use of TiVA indicators, such as the "Origin of value added in final demand", based on the OECD's ICIO database. This provides estimates of inter-country, inter-industry flows of intermediate and final goods and services that allow for the development of a range of indicators to provide insights into countries' participation in the global economy. Such indicators are not otherwise apparent from conventional official statistics such as reported "gross" trade in goods and services and national Input-Output or Supply and use tables. Due to ongoing development of the OECD's ICIO, the concept of extended ICT footprints can be further examined and improvements made to measurement. Notably, the use of an ISIC Rev.4-based industry list and, hence, a "refined" definition of ICT industries and ICIO tables for the years after 2011 to provide more timely indicators. Estimates of capital flow matrices, currently absent from the ICIO infrastructure, could also allow for the inclusion of non-ICT content of capital investment by ICT industries, such as the machinery and equipment used for manufacturing ICT parts and components. This would increase the size of ICT-EF. The ICT content of capital goods is already implicit in the analysis presented here.

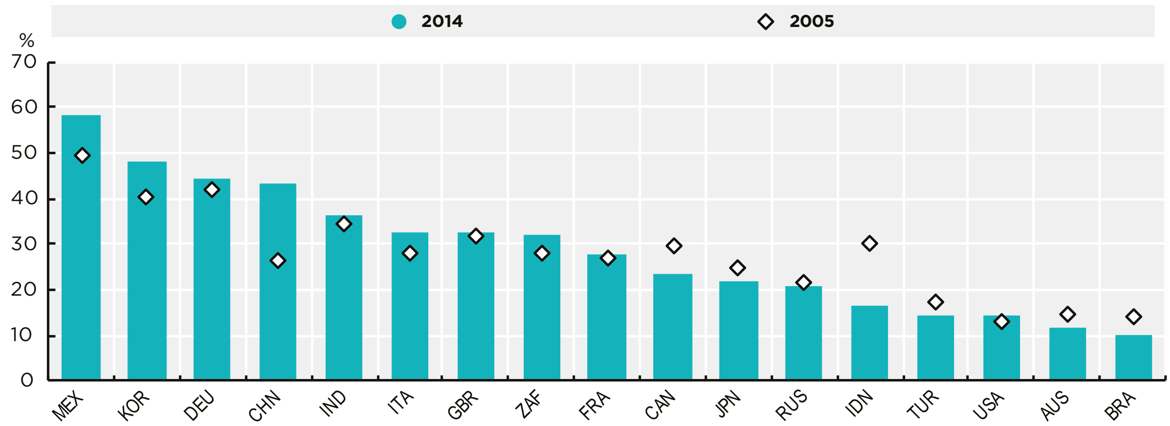
3.34 Trade and ICT Jobs

Estimates of jobs embodied in foreign final demand can reveal the extent to which a country is integrated into the global economy. As the number of firms specialising in particular stages of global production increases, dependencies between economies deepen. The ability of economies to meet foreign final demand increasingly determines the evolution of job markets. Traditional statistics are unable to reveal the full nature of these interdependencies – notably, how consumers in one country may drive production and sustain jobs in countries further up the value chain. New indicators, based on OECD's Inter-country Input-Output (ICIO) database, can shed light on these relationships.

In countries such as China, Germany, Korea, and Mexico, the share of jobs in information and communication industries meeting foreign demand was notably higher than in other industries in 2014. Between 2005 and 2014, China experienced a particularly large (64%) increase in its share of jobs in information industries sustained by foreign final demand.

Jobs in information and communication industries sustained by foreign final demand, 2005 and 2014

As a percentage of total jobs in information and communication industries



Notes: The information and communication industries correspond to ISIC Rev.3 Divisions 30, 32, 33, 64 and 72.

Source: OECD, Science, Technology, and Industry Scoreboard 2017, OECD publishing, http://oe.cd/sti-scoreboard, OECD calculations based on Inter-Country Input-Output (ICIO) Database, Annual National Accounts Database, Structural Analysis (STAN) Database, Trade in Employment (TiM); World Input-Output Database (WIOD) and national sources, June 2017.

Measurability

The goods and services people buy are composed of inputs domestically produced or imported from various countries around the world. However, the flows of goods and services within these global production chains are not always apparent from conventional international trade statistics, or from national Input-Output or Supply and Use tables, which reveal flows of intermediate goods and services between industries (or product groups) within a country for production to meet domestic and foreign demand. Building on these data sources and other sources, the OECD's Inter-Country Input-Output (ICIO) database provides estimates of flows of goods and services between 63 economies and 34 economic activities (based on ISIC Rev.3 and including 16 manufacturing and 14 service sectors) for 1995-2011. In this analysis, ICT industries are defined according to ISIC Rev.3 and consist of "Computer, electronic and optical products" (ISIC Rev.3 Divisions 30, 32 and 33), "Post and telecommunications services" (Division 64), and "Computer and related activities" (Division 72). The most visible use of the ICIO is the development of Trade in Value Added (TiVA) indicators, which highlight the value-added origin (both domestic and foreign) of countries' exports and final demand. Estimates of jobs embodied in (or sustained by) foreign final demand, can be calculated in a manner similar to estimates of domestic value added embodied in foreign final demand. However, experimental jobs-related indicators rely on some broad assumptions. In particular, they assume that within each industry labour productivity in exporting firms is the same as firms producing goods and services for domestic use only, and that all firms use the same share of imports for a given output, whether exporters or domestic producers only. However, evidence suggests that exporting firms have a higher level of labour productivity and use more imports in production. More effort is required to account for firm heterogeneity within the ICIO framework, in order to reduce the potential upward biases resulting from these current assumptions.

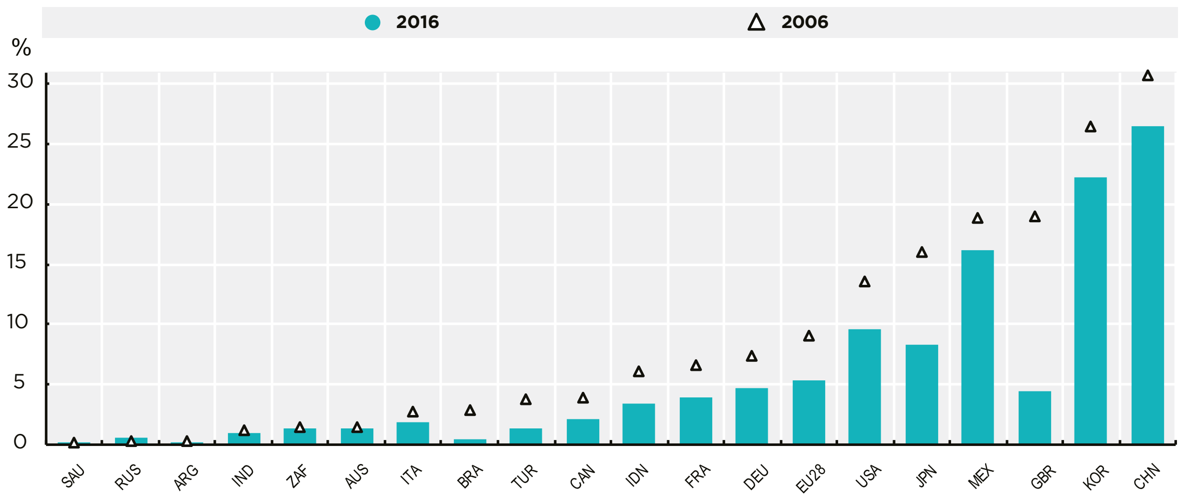
3.35 ICT goods as a percentage of merchandise trade

International trade in ICT goods covers the sale and purchase from abroad of goods that are the main product of the ICT sector. Five broad categories of ICT goods are covered: (a) computers and peripheral equipment, (b) communication equipment, (c) consumer electronic equipment, (d) electronic components and (e) other ICT goods. These all represent important inputs to the digital economy.

The share of ICT goods as a proportion of merchandise exports declined in almost all G20 countries, in 2016 as compared to 2006, except for Saudi Arabia and Russia where it increased slightly albeit from low values of less than 1%. With 27% China had the highest value, followed by the Republic of Korea and Mexico, with 22% and 16%, respectively. In ten countries from the G20 group, ICT goods represent less than 3% of the merchandise exports, attesting to the high degree of industry localisation for the ICT sector.

ICT goods as a percentage of merchandise trade, 2006-16

Exports, G20 countries

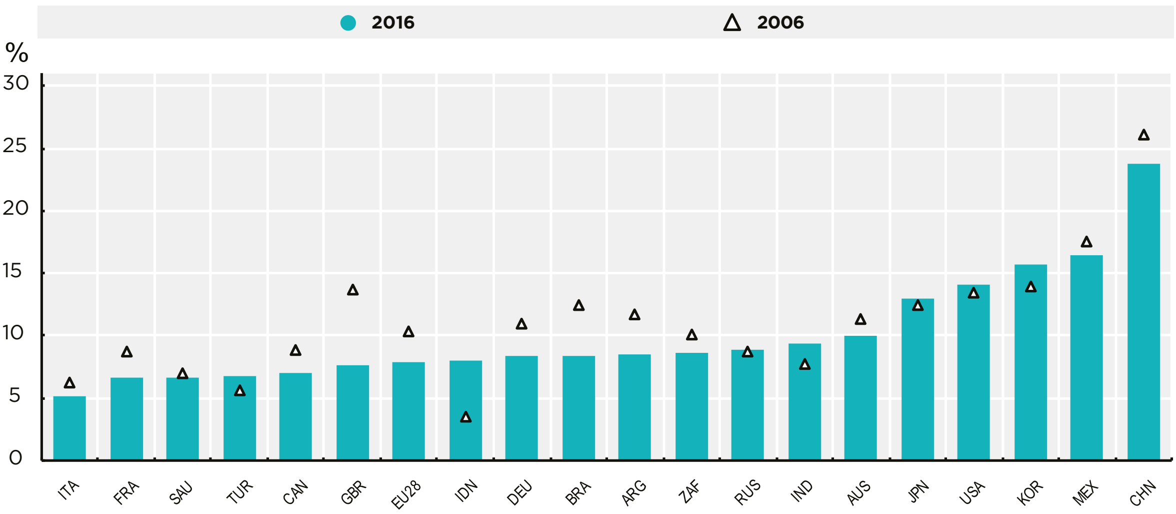


Source: UNCTAD calculations based on UNCOMTRADE, January 2018.

In comparison, on the import side, the values are more homogeneous as most G20 countries import a high proportion of the ICT goods used throughout their economies. ICT goods represented more than 8% in merchandise imports in twelve G20 countries. China, the Republic of Korea and Mexico again top the chart in relative ICT goods imports, but they are closely followed by Japan, the United States and Australia. Between 2006 and 2016 Indonesia has seen the largest increase in ICT goods imports, from 3.5 to 8%, to the benefit of upstream industries and consumers.

ICT goods as a percentage of merchandise trade, 2006-16

Imports, G20 countries



Source: UNCTAD calculations based on UNCOMTRADE, January 2018.

Measurability

All G20 countries compile and report to UNCOMTRADE detailed merchandise trade data at the 6-digit level of the HS classification, various revisions. Data availability on exports and imports of ICT goods is generally very good for both developed and developing countries, albeit with a time lag. In January 2018, 2017 data were missing for most large ICT goods exporters and importers. Data are missing either as a time series, or for the period 2014-2016 for 12 least developed countries, as well as for a number of island states and other countries and territories. The ICT goods classification adopted by the Partnership on Measuring ICT for Development was developed by the OECD through its Working Party on Indicators for the Information Society (WPIIS). When the definition was first released in 2003 it was based on a list of 6-digit items according to the HS classification, the HS 1996 and HS 2002 editions. Since then the definition of ICT goods has been revised in 2008 and the transition from HS 2002 to HS 2007 resulted in a break in time series[3]. UNCTAD prepared a technical note on the analytical implications of applying the new definition of ICT goods[4]. And subsequently a second technical note on the transition from HS 2007 to HS 2012[5] and a third technical note on the transition from HS2 2012 to HS 2017[6].

3.36 Telecommunications, computer, and information services as a percentage of services trade

International trade in telecommunications, computer and information services covers the sale and purchase from abroad of services that are the main product of the ICT sector. Many other services not included here can be provided remotely on top of the underlying ICT infrastructure services which are in focus here. These other services are separately covered under ICT-enabled services.

The share of telecommunications, computer and information services as a proportion of services exports increased in most G20 countries, except for France, Canada, Indonesia, Mexico, Saudi Arabia, and Turkey where it declined in 2016 as compared to 2006. With 33.5% India had the highest value, followed remotely by China, the European Union and Argentina, with values between 12% and 13%. In Turkey and Mexico such services represented less than 1%. The biggest drop in the sector to services exports was recorded in Indonesia, by more than 6%, and the biggest increase was in China, by almost 9%.

[3] *Measuring trends in ICT trade: From HS2002 to HS2007 / ICT product definition, OECD 2011, available online at:* http://unstats.un.org/unsd/class/intercop/expertgroup/2011/AC234-23.PDF.

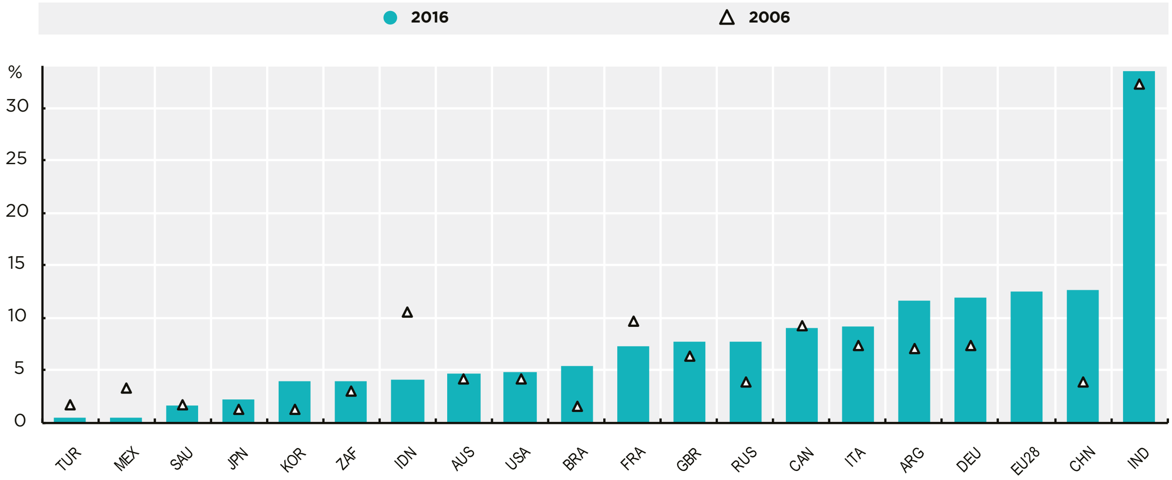
[4] *Implications of applying the new definition of "ICT goods", UNCTAD 2012, available at:* https://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d01_en.pdf

[5] *Updating the Partnership Definition of ICT Goods from HS 2007 to HS 2012, UNCTAD 2014, available at:* http://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d02_en.pdf

[6] *Updating the Partnership Definition of ICT Goods from HS 2012 to HS 2017, UNCTAD 2018, available at:* http://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d10_en.pdf

Telecommunications, computer and information services as a percentage of services trade

Exports, G20 countries, 2006-16



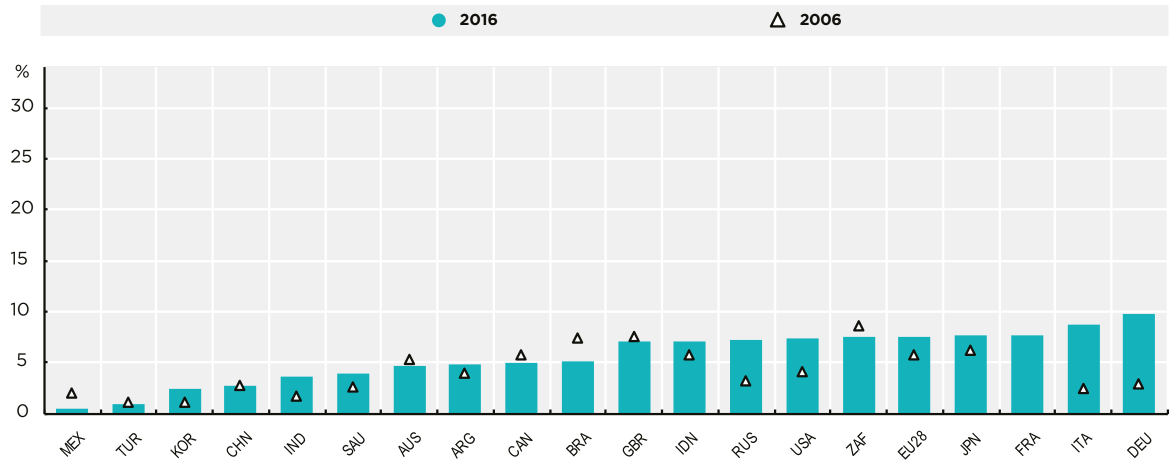
Source: Data are UNCTAD, WTO and ITC secretariats' calculations, based on: IMF, Balance of Payments Statistics, European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), online database, OECD, OECD.Stat, UN DESA Statistics Division, UN Service Trade Statistical Database, Other international and national sources, UNCTAD-WTO estimates, May 2018.

Notes: For the Unites States film and television tape distribution are recorded under Charges for the use of intellectual property n.i.e. (rather than under Audiovisual and related services). For India figures for "telecommunications, computer and information services" are estimated by UNCTAD-WTO, based on data reported on computer services by the Reserve Bank of India. "Telecommunications, computer and information services" exclude estimates for Information Technology Enabled Services (ITES) and Business Process Outsourcing Services (BPO), (source: RBI, Survey on Computer Software & Information Technology Services Exports, various issues), which are then covered under "other business services". For the EU28 eventual discrepancies between the European Union (28) aggregated data and the figures for its members can be attributed to European Union Institutions' (EUI) transactions. For France and Italy data for 2006 are estimated.

In comparison, on the import side, the values are more homogeneous as in most G20 countries telecommunications, computer and information services represent between 5% and 10% of services imports. A high proportion of the ICT goods used throughout their economies. European countries show the highest values, followed by Japan. On the other hand, imports of such services remained low, at less than 3%, in Mexico, Turkey, the Republic of Korea and China. In 2016 as compared to 2006, such imports increased slightly in most G20 countries, with the exception of Argentina, Brazil, France, Mexico and Turkey.

Telecommunications, computer and information services as a percentage of services trade

Imports, G20 countries, 2006-16



Source: Data are UNCTAD, WTO and ITC secretariats' calculations, based on: IMF, Balance of Payments Statistics, European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), online database, OECD, OECD.Stat, UN DESA Statistics Division, UN Service Trade Statistical Database, Other international and national sources, UNCTAD-WTO estimates, May 2018.

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Measurability

All G20 countries compile and report trade in services statistics, although not all of them provide details at a higher level of disaggregation of EBOPS 2010. UNCTAD (2015)[7] showed that the OECD ICT services sector definition transcoded to trade in services statistics would need to build on data at the two-digit level of disaggregation of EBOPS 2010 and include telecommunications services, computer services and licenses to reproduce and/or distribute computer software. With currently available information it was not possible to retrieve trade in services data for telecommunications services for China, India, Saudi Arabia and South Africa; for computer services for China, Saudi Arabia, South Africa and Turkey; for information services for China, Indonesia, Mexico, Saudi Arabia and South Africa. UNCTAD (2015) recommends that countries report trade in services data at a more disaggregated level, also by partner country, in order to be able to distinguish ICT services from other services that are provided over ICT networks, such as information services, for example. Beyond the G20, data availability for trade in services statistics is generally very good. Several developing countries report data only in accordance with the BPM5 standard and have not yet started reporting in accordance with BPM6. Since telecommunications, computer and information services is a main component only under the BPM6 standard, this means that data on this sector is not available from the countries reporting in accordance with BPM5.

[7] *International Trade in ICT Services and ICT-enabled Services: Proposed Indicators from the Partnership on Measuring ICT for Development (TN/UNCTAD/ICT4D/03), UNCTAD, October 2015, available at: http://unctad.org/en/Pages/DTL/STI_and_ICTs/ICT4D-Technical-Notes.aspx*

4 Initiatives and Case Studies

Argentina

Argentina has several ongoing initiatives to measure the Digital Economy. The National Institute of Statistics and Censuses includes specific modules in household surveys. The Ministry of Science, Technology and Productive Innovation carries out business surveys to measure the extent of resource allocation to R&D activities and technology adoption. Moreover, the National Communications Authority conducts various initiatives to measure digital infrastructure.

Household survey

The Module of Access and Use to Information and Communication Technologies (MAUTIC in Spanish) is a national survey carried out by the National Institute of Statistics and Census (INDEC) to provide a measure of the computer and internet availability in Argentine households and of computer, internet and mobile phones use by people 4 years and older. These indicators are released with other socio-demographic and labor characteristics, such as gender, highest educational level attained (ISCED 0 to 6), labor force status, and occupation (ISCO-88).

Business surveys

The Business Research and Development Survey, conducted by the Ministry of Science, Technology and Productive Innovation, follows the OECD Frascati Manual to measure indicators such as the fraction of investment and number of employees specifically allocated to R&D activities among local businesses operating in the Information and Communications Technology (ICTs) sector. The survey is conducted on an annual basis on a panel of 2 000 firms representative of business sizes, locations and main economic activities (agriculture, manufacturing industry and services).

The National Survey of Employment and Innovation Dynamics, carried out jointly by the Ministry of Science, Technology and Productive Innovation and the Ministry of Production and Labor, surveys a sample of manufacturing firms with 10 or more registered employees on their innovation and technology adoption activities. The sample is selected based on social security administrative registries. Indicators are representative at the national level and can be broken-down into business size and economic activity at the ISIC 4-digit level. The methodology follows the recommendations of the OECD's Oslo Manual of Guidelines for Collecting and Interpreting Innovation Data and RICYT's Bogota Manual of Normalization of Technological Innovation Indicators for Latin America and the Caribbean. The survey was first carried out in 2013 for the 2010-2012 period, and the second wave is currently under development. Anonymized microdata is available for research purposes upon request by filing a research proposal.

Digital infrastructure: regional Connectivity Index

Apart from collecting standard indicators about Internet subscriptions, speed, and connectivity, the National Communications Authority estimates a Connectivity Index. The index gathers measures of Internet penetration, quality, speed, mobile penetration, and technology types at the district level. It takes values between 0 and 1 to reflect how well connected each district is. The indicator is estimated following two steps. First, the fixed and mobile networks are assigned a score according to their performance in terms of household coverage, access technology and speed. Second, a weighted average is calculated and normalized to obtain a final value where 1 represents the best possible connectivity relative to a point of reference.

Resources

More information on the products mentioned above can be found in the following links:

- Business Research and Development Survey: http://indicadorescti.mincyt.gob.ar/r_encuesta_id_sector_privado_esid_2016.php.
- National Survey of Employment and Innovation Dynamics: http://www.mincyt.gob.ar/estudios/encuesta-nacional-de-dinamica-de-empleo-e-innovacion-resultados-globales-2010-2012-11493.
- Connectivity Map: https://indicadores.enacom.gob.ar/MapasConectividad.aspx
- Other science and technology indicators produced by the Ministry of Science, Technology and Productive Innovation: http://indicadorescti.mincyt.gob.ar/indicadores.php.
- Internet access indicators at the National Communications Authority: http://datosabiertos.enacom.gob.ar/dashboards/20000/acceso-a-internet

Australia

Understanding Digital Transformation

Australia's national statistical agency, the Australian Bureau of Statistics (ABS), produces a range of economic, social and population statistics that are key to informing the government, business and Australian community. The ABS publishes a range of statistics that help users to understand the penetration of the digital economy to businesses and the Australian community.

Business use of information technology

The extent to which business uses selected technology is captured in the Business Use of Information Technology Survey (ABS cat. no. 8129.0). Some of the indicators of digital economy utilization by business it collects are: the extent of internet access, the use of broadband, web presence, social media presence, and internet commerce (i.e. the placing and receiving of orders via the internet). This information is available by industry facilitating development of industry specific ICT strategies.

Measuring innovation

The ABS measures the level of innovating businesses in Australia via the Business Characteristics Survey (ABS cat. no. 8167.0). In 2014-15, 45% of businesses were innovation-active, and 38% of businesses introduced innovation.

Expenditure on research and development

ABS statistics cover expenditure on research and experimental development (ABS cat. no. 8104.0), and investment in the development of digital technologies. This includes expenditure by businesses, higher-education institutions, and government. In 2015-16, expenditure on R&D in the field of Information and Computing Sciences accounted for 40% of total business expenditure on R&D, up $561 million (9%) from 2013-14. R&D is also captured in Australia's measure of Gross Domestic Product (GDP) as gross fixed capital formation, as outlined in the SNA08.

Integrated Datasets

The Australian Government is investing in data integration to maximize the value of the Governments data assets through the Data Integration Partnership for Australia (DIPA) initiative. Through data integration and analysis, the DIPA creates new insights into important and complex policy questions. Two data integration projects of relevance to the measurement and analysis of the digital economy are the Business Longitudinal Analysis Data Environment (BLADE) and the

Multi-Agency Data Integration Project (MADIP). The BLADE links administrative and survey data over the period 2001-02 to 2013-14 for all active businesses in Australia. This integrated data environment enables analysis of industries over time and includes numerous microeconomic variables.

Development of a Satellite Account

The ABS is undertaking research to measure the impact of the digital transformation on the economy. Given the various perspectives and approaches adopted in the research and statistical communities, the ABS is considering a satellite account approach as the first step to understand the economic measurement challenges raised by the digital economy. The creation of a satellite account will require defining what the digital economy is to determine where the boundary exists. In order to identify the goods and services to be included within the supply-use framework, the Bureau of Economic Analysis (BEA) includes the following in its definition of the digital economy **i)** the digital-enabling infrastructure needed for a computer network to exist and operate; **ii)** the digital transactions that take place using that system ("e-commerce"); and **iii)** the content that digital economy users create and access ("digital media").

Implementation challenges

There are challenges in measuring some transactions of the digital economy and the price and volume of transactions, with more guidance on the measurement of these activities needed. The activities of the digital economy are included in the Australian System of National Accounts (ASNA) framework. If the enterprise operating in the digital economy is engaged in the Australian tax system, then the activity is captured in Australia's National Accounts. Other, less regular sources of data (such as the Household Expenditure Survey) will capture expenditure and production relating to the digital economy (albeit with a lag).

Brazil

ICT Enterprise Survey

The primary objective of the ICT Enterprises Survey project is to measure the access to and use of information and communication technologies (ICT) in Brazilian enterprises with 10 or more employed persons. The project focuses on measuring enterprises' presence and activities on the web and social media, e-commerce and e-government activities as well as digital capabilities and skills. The results of the ICT Enterprises Survey are a key source of data for evidence-based policymaking.

The Survey is conducted since 2005 by the Brazilian Internet Steering Committee (CGI.br), through the Regional Centre for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Centre (NIC.br). The survey comprises a set of 56 indicators divided in the following modules: Module A: General information on ICT systems; Module B: Internet use; Module C: Electronic government; Module E: Electronic commerce; Module F: ICT skills; Module G: Software.

The survey's results highlight the progress and, especially, describe the main challenges that arise in the competitive realm as a result of digital transformation, focusing on the digital environment of organizations and reveal the extent to which Brazilian enterprises are tapping into the potential unleashed by ICT.

Through the data it is possible to conduct an in-depth analysis of the current situation of enterprises within the context of the digital economy, including i) ICT access and use by small, medium and large enterprises and the availability of ICT infrastructure (broadband speed, type of broadband connections, networking facilities, usage of software and applications, etc); ii) Online presence and their digital environment (websites and social networking websites, engagement in e-commerce and e-government activities); and iii) Digital capabilities and skills, exploring the capabilities of enterprises to adopt software, cloud computing and other ICT-based applications in their processes.

Policymakers are facing the challenge of having access to timely, reliable and national representative data and statistics on broadband connectivity, ICT infrastructure, e-commerce, e-government, etc.

In recent years, the Regional Centre for Studies on the Development of the Information Society (Cetic.br) has been an important voice in international debates on the standardization of indicators and methodological definitions for the production of ICT statistics. Cetic.br has been an active participant in forums sponsored by the International Telecommunications Union (ITU), the Economic Commission for Latin America and the Caribbean (UN ECLAC), the Organisation for Economic Co-operation and Development (OECD), and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Its several ICT standalone surveys have become essential for disseminating data and bringing ICT statistics producers and policymakers closer together.

Methodology

The ICT Enterprises survey was developed to maintain international comparability. It uses the methodological standards proposed in the Manual for the Production of Statistics on the Information Economy (UNCTAD, 2009), prepared in partnership with the Organisation for Economic Co-operation and Development (OECD), the Statistical Office of the European Communities (Eurostat, European Commission), and the Partnership on Measuring ICT for Development. This coalition, formed by various international organizations, seeks to harmonize key indicators in ICT surveys.

Resources

- Publication:
  http://www.cetic.br/media/docs/publicacoes/2/TIC_Empresas_2017_livro_eletronico.pdf
- Table of results:
  http://www.cetic.br/pesquisa/empresas/indicadores
- Data visualization portal:
  http://data.cetic.br/cetic/explore?idPesquisa=TIC_EMP

Implementation challenges

The main challenges related to the implementation of a regular survey to measure the digital economy through the level of online activities (being e-commerce a proxy variable) by the business sector are related to the required budget to carry out data collection and data processing, as well as to have the proper instruments to face the highly dynamic business and technological environments. This leads to the challenge of constantly revising and creating indicators without losing sight of its historical series and comparability with studies conducted by national and international institutions.

Canada

Canadian Digital Service Unit (CDS)

The Canadian Digital Service is a digital government unit housed within the Treasury Board Secretariat of Canada as part of a plan to modernize the way government designs and delivers digital services. The three pillars of CDS' operations are: delivering solutions, building capacity, and providing advice. The group works with federal organizations to design, prototype, and build better digital services.

Statistics Canada Digital Economy Survey (DES)

Statistics Canada will collect information from households on individuals' purchases of digital products (e.g. music and video streaming, online gaming, mobile apps etc.) as well as methods of earning money online. The DES is in collection July 2018 and the results will be released in September 2018.

The Canadian Internet Use Survey (CIUS)

Statistics Canada will measure the impact of digital technology in Canada and, specifically, internet use by individuals, with data released in early fall 2019.

Survey of Digital Technology and Internet Use (SDTIU)

Statistics Canada will collect information on the impact of digital technology in Canada and, specifically, Internet use by businesses. The data will be released by September 2020.

Digital Skills and E-Skills/ Economic Strategy Tables

Canada's Economic Strategy Tables will set ambitious growth targets, identify challenges, and lay out an actionable roadmap. The Digital Industries Economic Strategy Table has identified industry leadership and public-private collaboration as the foundation for impact in the following priority themes:

1. Increasing domestic uptake of digital innovation
2. Leveraging the value of data and Artificial Intelligence
3. Fostering the growth of homegrown digital companies
4. Growing the digital talent base

A final report, outlining recommendations for policies and actions, is expected in the fall of 2018.

Develop a framework to measure the size of the Digital Economy (jointly with OECD)

The OECD (partly funded by the Government of Canada) will develop a framework to measure the size of the digital economy. Given the current lack of digital economy metrics, this project will help to inform government's priorities regarding the digital economy. The work will be central in the OECD Going Digital project on digitalization analysis to support the policy implications of the digital transformation. The final report will be produced by March 2019 (with workshop to help inform the project in September 2018).

Methodology

The OECD will build on past work to develop a framework to estimate the size of the digital economy, on the basis of the Systems of National Accounts approach across OECD countries, based on Gross Domestic Product (GDP) and other international standards as applicable. This will lead to the development of common and internationally comparable OECD indicators in this domain

Resources

- Canadian Digital Service Unit (CDS): https://digital.canada.ca/
- Statistics Canada Digital Economy Survey (DES): https://www.statcan.gc.ca/eng/about/smr09/smr09_090
- The Canadian Internet Use Survey (CIUS): https://www.statcan.gc.ca/eng/survey/household/4432
- Survey of Digital Technology and Internet Use (SDTIU): https://www.statcan.gc.ca/eng/survey/business/4225
- Digital Skills and E-Skills/ Economic Strategy Tables: https://www.ic.gc.ca/eic/site/098.nsf/eng/home
- Develop a framework to measure the size of the Digital Economy (jointly with OECD): http://www.oecd.org/going-digital/

China

The Scale of Digital Economy

The methodology to measure the digital economy was developed by the China Academy of Information and Communications Technology (CAICT) of the Ministry of Industry and Information Technology, with joint efforts of other research institutions. The metrics are consistent with existing macroeconomic frameworks and can be used for comparisons with GDP and related measures.

Methodology

The digital economy is composed of the digital industry (also referred to as digital industrialization) and the digitalization of industries (also referred to as industrial digitalization). The digital industry mainly includes the telecommunication and internet industry, the software and information technology industry and the electronic information manufacturing industry. The digitalization of industries considers the output and efficiency improvement brought by other existing industries using information and telecommunication technology (ICT), as well as the emergence of new industries. The scale of the digital economy is the contribution of these components to the Gross Domestic Production (GDP).

The method to calculate the index of digital industry is to sum up the added value of the industries, which is obtained my multiplying the industry income times the value added of every industry. The industry income data is obtained from official statistics and the value-added rate is calculated based on the statistical data provided by the National Bureau of Statistics.

The index of digitization of industries could be evaluated with econometric methods. The basic principle is that the economic output (which can be roughly understood as GDP) could be treated as the result of the input of economic factors, -capital, labor, intermediate product and natural resources-. The capital input is divided into ICT capital input and non-ICT capital investment, and each input contributes to the output to a certain degree. For example, for a certain industry, following the premise that other inputs remain unchanged, each addition of information products input will increase the output by a corresponding share. The sum of the marginal contribution of all ICT inputs across all industries result in the index of digitization of industries.

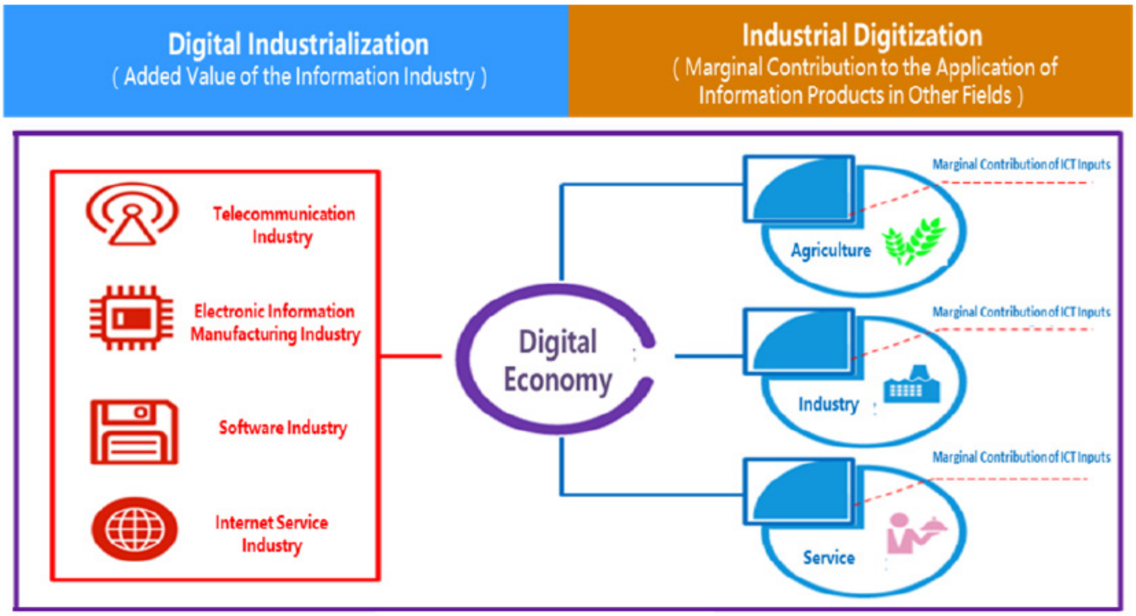
Resources

- White Paper on Development of China's Digital Economy 2017, by CAICT: *http://www.caict.ac.cn/kxyj/qwfb/bps/201804/P020170713408029202449.pdf*

Implementation challenges

The statistical data, especially the input-output table employed by this methodology, may not be the same in other countries, which leads to low possibilities of cross-country comparability.

Figure 1: Components of Digital Economy



European Union

Digital Economy and Society Index (DESI)

The Digital Economy and Society Index (DESI) is a composite index that summarizes relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness. The DESI has been the EU's key analytical tool since 2014, measuring progress of EU countries towards a digital economy and society.

The EU has also developed a methodology to compare Europe with the rest of the world. The International DESI (I-DESI) evaluates the performance of both the individual EU countries and the EU as a whole in comparison to Australia, Brazil, Canada, Chile, China, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Russia, Serbia, Switzerland, Turkey and the United States. This is the second time the Commission compares the DESI with international data. Indicators of the International DESI are built on a similar but not identical set of indicators as the DESI due to the fact that some DESI indicators are not available in non-EU countries. The 24 indicators of the I-DESI have been collected and analyzed for 45 countries (3/4 of G20 covered). The availability, quality and statistical coherence have also been assessed for them.

Methodology

The DESI is composed of five principal policy areas, which regroup overall 34 indicators:

1. Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and broadband prices
2. Human capital	Basic skills and internet use, advanced skills and development
3. Use of internet Service	Citizens' use of content, communication and online transactions
4. Integration of digital technology	Business digitisation and e-commerce
5. Digital public services	eGovernment and eHealth

Resources

- DESI webpage:
  https://ec.europa.eu/digital-single-market/en/desi
- DESI data:
  https://digital-agenda-data.eu/datasets/desi/visualizations
- DESI methodology:
  http://ec.europa.eu/information_society/newsroom/image/document/2018-20/desi-2018-methodology_E886EDCA-B32A-AEFB-07F5911DE975477B_52297.pdf

DESI and iDESI results

In 2017, all Member States improved in the DESI results. Denmark, Sweden, Finland, and the Netherlands have the most advanced digital economies, followed by Luxembourg, Ireland, the UK, Belgium and Estonia. Ireland, Cyprus and Spain progressed the most (by more than 15 points) over the last four years, while the lowest increase in digital performance was recorded in Greece (below 10 points).

The results of I-DESI show that the top four EU countries (Denmark, Finland, Sweden and the Netherlands) are among the global leaders. They are just behind Korea and have higher scores than the United States and Japan. At the same time, however, the comparison shows that the EU's average in digital performance is significantly lower.

France

The Digital market barometer and the Digital Observatory

The "Baromètre du Numérique" (Digital market barometer) is an annual survey on the adoption and use of digital tools in France. This survey is published by Arcep (French national telecoms regulator) and the General Economic Council (CGE) since 2003, and France's Digital Agency joined the collaboration in 2016. Conducted by the Research Centre for the Study and Observation of Living Conditions in France (CREDOC), this survey consists of face-to-face interviews with a representative sample of more than 2 000 people, ages 12 and up. They have to answer questions about the nature of their terminals (smartphone, computer, and others) and their use (social networks, e-commerce and e-administration, among others). This survey provides a measure of the adoption of digital equipment and data to analyzes the digital practices; reveals inequalities in access and digital skills; enables to anticipate the major trends and to implement policies for better access and adoption of the digital technology by the whole population.

The "Observatoire du numérique" (Digital Observatory) was created in November 2011 and is managed by the Directorate-General for Enterprise (Ministry of Economy and Finances). This initiative collects and interprets data and reports in order to measure and analyze the impact of digital technology on the economy and to compare France to other State members of the European Union. The "Observatoire du numérique" includes a macroeconomic vision to define the digital economy and measure the weight of ICT in European countries' main economies, and sectorial indicators about R&D, e-commerce and infrastructures. It also provides measures of the use of digital technology by households, businesses and administration.

Methodology

For the last edition of the Digital market barometer, results were coming from a study conducted in June 2017 by the Research Centre for the Study and Observation of Living Conditions in France (CREDOC). It consists of face-to-face interviews with a representative sample of 2 209 people (2 004 adults and 205 young people), ages 12 and up, selected according to the quota method. Two types of questionnaire were used for the survey: one for people aged 18 and older and the second for the young people between the ages of 12 and 17.

The Digital Observatory project aims at measuring the different aspects of ICT and presents four different sections: i) "Publications", where recent data is added, as well as studies and reports on the topic, in order to provide the reader with an insight of the current state of research on the topic; ii) "Macroeconomics", which presents the weight of ICT sector in the GDP of European economies; iii) "Digital economy", which explains the different ways the digital economy can be measured and provides structural indicators (R&D, infrastructures, e-commerce) on the topic; and iv) "Use of digital technology", which measures the use by households, businesses and administrations of relevant digital technology, in France and other European countries.

Resources

- The 2017 Digital market barometer report: *https://www.economie.gouv.fr/files/files/directions_services/cge/Actualites/barometre-numerique-edition-2017.pdf*
- The data of all the Digital market barometer annual reports are available online in open data format: *https://www.data.gouv.fr/fr/datasets/barometre-du-numerique/*
- The "Obervatoire du numérique" is published on the website of the Directorate-General for Enterprise (Ministry of Economy and Finances): *https://www.entreprises.gouv.fr/observatoire-du-numerique*

Implementation challenges

The data of the Digital Observatory project comes mainly from Eurostat and French administrations. While this allows us to provide reliable comparison of economies on our website, it may be hard to extend it to other countries that do not collect such data, especially on the "use of digital technologies" section.

Germany

Monitoring Report "Wirtschaft DIGITAL" (DIGITAL Economy)

The monitoring report "Wirtschaft DIGITAL" measures the progress made in the digital transformation of the German economy. It consists of two components:

- The "DIGITAL Economic Index" measures the current and future degree of digitization of the German industrial economy, the manufacturing sector and the service sector in a differentiated way according to eleven core industries and different company sizes. Besides the measurement of the level of digitalisation it also identifies the advantages of and obstacles to digitalisation.

- The "DIGITAL location index" rates the performance and competitiveness of the German digital economy (ICT sector and internet economy) in an international comparison of ten countries.

Based on these data, the report identifies policy demands for Germany. In 2017 the promotion of the expansion of broadband, the creation of a pro-digital legal environment and access to publicly available knowledge as basis for innovation ranked highest in the list of demands.

Methodology

The first part of this annual report, the DIGITAL economic index, is based on quantitative, computer-based and standardized telephone interviews of German digital companies on the current status and future prospects of digitalisation in Germany.

The second part, the DIGITAL location index, is an international secondary analysis in Germany and nine other countries, based on data from the Federal Statistical Office of Germany as well as from EITO, WEF, ITU, World Bank Group, European Patent Office, European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), OECD and others.

Resources

- Recent reports; in German only: https://www.bmwi.de/Redaktion/DE/Artikel/Digitale-Welt/monitoring-wirtschaft-digital.html

- Archived reports in German and management summaries in English: https://www.tns-infratest.com/wissensforum/studien/mrwd-berichte.asp

Implementation challenges

The monitoring report is prepared on behalf of the Federal Ministry of Economics and Energy by Kantar TNS and the Center for European Economic Research (ZEW) Mannheim. The survey-based part of the report is based on personal views of the interviewed company representatives. It therefore reflects a sentiment of the German digital economy, whereas a fact-based analysis of the situation of the German digital economy (if available) might produce different results. For international comparison, the lack of comparability of data is the biggest challenge.

Japan

IoT International Competitiveness Index

The Ministry of Internal Affairs and Communications of Japan compiled and released an IoT International Competitiveness Index as a reference for the reinforcement of the international competitiveness of the ICT industry. This index analyzes the ICT industry by dividing it into two markets; the "IoT Market" which consists of components relevant to sub-markets such as "Smart City" and "Connected Car", and the "Conventional ICT Market"; which consists of components relevant to sub-markets such as "Cloud" and "Fixed network equipment" (see "Figure 2" below).

Methodology

The calculation is based on 16 items of value-based service/product shares and potential competitiveness which includes the R&D and M&A situations of each company. The scores and rankings per country and region have been calculated by targeting 1 500 companies in ten major countries and regions.

Resources

- http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Releases/Telecommunications/2018_01_05.html

Figure 1: Rankings and Scores of Enterprises per Region in Ten Major Countries and Regions

(Reference) Rankings and scores based on the shares in 2015.

	All markets		IoT market		Conventional ICT market	
	Ranking	**Score**	Ranking	Score	Ranking	Score
U.S.A.	**1st**	**65.5**	1st	64.6	1st	66.3
Japan	**2nd**	**57.6**	2nd	60.8	2nd	54.5
China	**3rd**	**54.8**	3rd	56.7	3rd	52.9
Germany	**4th**	**48.8**	5th	48.7	5th	48.9
South Korea	**5th**	**48.4**	6th	47.1	4th	49.7
Netherland	**6th**	**47.0**	4th	49.3	10th	44.7
Finland	**7th**	**45.6**	10th	43.1	6th	48.2
Sweden	**8th**	**44.7**	9th	43.3	7th	46.2
France	**9th**	**44.6**	8th	44.0	9th	45.2
Taiwan	**10th**	**44.6**	7th	43.7	8th	45.4

Rankings and scores based on the shares in 2016.

	All markets		IoT market		Conventional ICT market	
	Ranking	**Score**	Ranking	Score	Ranking	Score
U.S.A.	**1st**	**67.7**	1st	66.6	1st	68.7
Japan	**2nd**	**57.1**	2nd	60.9	3rd	53.3
China	**3rd**	**55.8**	3rd	55.8	2nd	55.8
South Korea	**4th**	**47.7**	6th	46.4	4th	49.1
Germany	**5th**	**47.0**	4th	47.9	6th	46.0
Netherland	**6th**	**46.3**	5th	47.6	9th	44.9
Taiwan	**7th**	**45.1**	7th	44.2	8th	45.9
Finland	**8th**	**44.8**	9th	43.5	7th	46.0
Sweden	**9th**	**44.6**	10th	43.0	5th	46.2
France	**10th**	**44.0**	8th	43.9	10th	44.0

Figure 2: IoT International Competitiveness Index-Survey Items

Major classification	Middle classification	Small classification
A. Clouds (Broad)	A. Cloud (Broad)	IaaS, SaaS, PaaS, CaaS
B. Networks	B1. Fixed network equipment	Routers, switches, network backbone equipment, FTTH equipment, Broadband CPEs, servers
	B2. Mobile network equipment	Mobile phone base stations, Small mobile phone base stations, Wi-Fi access points
C. Key devices	C. Conductor	MEMS sensors, image sensors, MCUs, discrete semiconductors, and high-frequency semiconductors
D. Terminals	D1. Information terminal	PCs, smartphones, tablets
	D2. Home appliances /OA equipment	TVs, DVDsBD recorders,copiers, printers, digital cameras, portable game consoles, game consoles
	D3. Smart city	Wearable (information and video), Digital signage, Surveillance cameras
	D4. Healthcare	Wearable (sport/fitness), Consumer healthcare equipment, X-rays, Ultrasonic waves
	D5. Smart factory	Industrial robots, Machine visions, Programmable logic Controllers
	D6. Connected car	Cellular modules for automobiles
	D7. Smart energy	Smart meter, Smart lighting equipment
E. R&D	E1. ICT market R&D	Number of major R&D sites and R&D expenses in the ICT market
	E2. R&D in IoT market	Number of major R&D sites in the IoT market
F. Finance	F1. M&A in ICT market	M&A amount in ICT market
	F2. M&A in IoT market	Amount in M&A in IoT market
G. Standardization	G. IoT-related standardization	Number of companies participating in IoT-related standardization groups and number of chair and secretary companies

Data source: IHS Global.

Note: Survey items in bold frames refer to the IoT market.

Republic of Korea

Plan for GDP statistics reflecting digital economy

As the institution in charge of managing GDP statistics in Korea, the Bank of Korea (BoK), established a plan to continuously improve and complement GDP statistics by reviewing measurement status, increasing basic statistics and developing estimation methods in preparation for a growing digital/sharing economy. First, the BoK reviewed domestic GDP and its reflection of the digital economy. To ensure that the statistics reflected economic activity related with digital commerce and sharing economy, the BoK installed a National Account Research Team in the Economic Statistics Department in July 2016 and conducted a preliminary survey in May 2017. The BoK inspected the measurement status of the digital/sharing economy, which includes sharing economy enabled by digital technology (home sharing, car sharing, P2P loan service) and the conventional digital economy (digital commerce, free digital service). In consideration of the survey results, digital/sharing economy will be included in GDP statistics as from March 2019, when the revision of benchmark year will be executed. The BoK plans to continue to improve and complement GDP statistics, by increasing basic statistics, developing estimation methods in preparation for a growing digital economy.

Methodology

The Korean System of National Accounts (2008 SNA) includes all market transactions, meaning that, in principle, market transactions related with the digital/sharing economy must be captured in GDP statistics. GDP statistics currently capture general transactions in the digital economy, such as e-commerce and digital content transactions, but due to inadequacy of basic statistics, it does not capture transactions related to the sharing economy enabled by digital technologies, in particular unregistered home sharing and P2P carpool services.

The non-captured data is insignificant in size, as production activity in these sectors remain low in Korea. However, given the growth potential held by the digital/sharing economy, it is important to continuously monitor the market situation (e.g. online intermediary service trends) and expand basic statistics to fully capture all sectors of the digital/sharing economy.

Therefore, the following measures will be carried out to prepare for the growing digital/sharing economy: i) Survey Korea's digital/sharing economy business model; ii) Expand basic data related to digital/sharing economy and develop estimation methods; iii) Price new goods and services; and iv) Conduct research on measuring consumer utility related to the digital/sharing economy.

Resources

- http://www.bok.or.kr/portal/bbs/P0000559/view.do?nttId=228576&menuNo=200690

Implementation challenges

The Korean SNA does not measure subjective consumer utility of free digital services or various online intermediary services, and with the absence of relevant international standards, it is difficult to reflect the data.

GDP Statistics Reflecting Digital Economy in Korea

Category	Sector	Assessment
Sharing Economy Enabled by Digital Technologies	Home sharing	Parts not captured by GDP statistics take up less than 0.005% of nominal GD
	Ride sharing	• B2C taxi services (e.g. Uber Black) are fully reflected in GDP statistics • Household income created by carpool, etc. are omitted, but insignificant in size
	Car sharing	• All B2C services are captured • P2P services are not included in GDP statistics, given that they are illegal and have no established market
	P2P loan services	Captured through measurement of financial insurance services
Conventional Digital Economy	Digital commerce	Captured through Internet, mobile transactions
	Free digital	Captured if there is source of economic revenue (e.g. ad revenue)
	Services	Excluded from GDP statistics if there is no source of revenue

Source: Bank of Korea.

Mexico

ENDUTIH - National Survey on availability and use of Information technology in households

Considering that it is essential to have accurate and timely statistics with the greatest possible geographical disaggregation of emerging technologies, since 2001 the National Institute of Statistics and Geography (INEGI) began to develop a module on the availability and use of ICT in homes, MODUTIH. Except in 2003, this project was lifted annually, until 2014.

As of 2015, INEGI began the development and implementation of a special survey on digital technologies in the social sector: The National Survey on Availability and Use of Information Technologies in Households (ENDUTIH), which allows a continuous integration of basic indicators, and at the same time facilitates the incorporation of new contents and the scope of a greater precision derived from a specific conceptual and statistical design.

In this regard, ENDUTIH, is the main source of related statistics in Mexico and it aims to obtain information on the availability and use of information and communication technologies in households to generate statistical information on the subject and support decision making in public policy matters; also, it offers elements of analysis to national and international studies and general public interested in the subject.

INEGI in collaboration with the Ministry of Communications and Transportation (SCT) and the Federal Institute of Telecommunications (IFT), gives continuity to the exclusive survey that begun in 2015.

During the second quarter of 2017, the National Institute of Statistics and Geography (INEGI) conducted the ENDUTIH survey 2017.

Methodology

This exercise is done through interviews with members of randomly chosen households, from whom it gathers their experience on the use of information and communication technologies (ICT). The information generated by the ENDUTIH is comparable with the data collected in 2015 and 2016.

ENDUTIH 2017 includes a sample that allows to characterize the phenomenon of the availability and use of ICT for the 32 states and in 49 selected cities. In this regard and for the first time, ENDUTIH collects and provides information of the urban and rural scope for each entity of the country.

With this effort, INEGI and institutions that support the conduct of this survey (the Ministry of Communications and Transportation (SCT) and the Federal Institute of Telecommunications (IFT)), endorse their commitment to generate more and better statistics in order to make them available to users.

The generation of results at the national level together with the design of the sample, the operational field and the other phases of the survey process are responsibility and exclusive attribution of INEGI; also, as in the previous year, the support and collaboration of the Ministry of Communications and Transportation and the Federal Institute of Telecommunications, allowed to generate the results at regional level that were mentioned before.

Resources

- *http://www.beta.inegi.org.mx/proyectos/enchogares/regulares/dutih/2017*

Implementation challenges

Derived from the methodological change that was implemented from the National Survey on Availability and Use of Information Technologies in Households (ENDUTIH) 2015, the results of the statistical series of the Module on Availability and Use of Information Technologies in Households (MODUTIH) 2001-2014 is not presented in a continuous fashion with the new series of the ENDUTIH 2015-2017, since the information is not comparable because, as of 2015, the informant was instructed to give an account of the use and availability of ICT's from their own experience and not from the perspective of all household members as it used to be captured until 2014.

The Russian Federation

The Public Services Quality Monitoring System «Your Control»

This is a Project launched by the Federal Government of the Russian Federation in 2011 to ensure the unbiased feedback from people regarding the quality of public services they have been provided. The System allows to evaluate the quality of public services through a number of diverse channels: one can leave the grade and comments on the web-site, respond with the grade by SMS or leave the grade at a special terminal at public services office, where the service was provided, also people can evaluate the quality of E-services in Public Services Portal. The scope of the Project is constantly growing. By now more than 50 public services of the 9 Government bodies are being mandatorily evaluated and amount to more than 200 public services. The scope of the Project is expected to keep growing. This is a democratic tool aimed at promoting close cooperation between the Government and the citizens towards a trustworthy, efficient, transparent, and non-discriminatory environment at the public administration. The constant growth of the audience of the System and the people's willingness to participate in the monitoring are the best proof of the high demand for such feedback mechanism and its relevance.

Methodology

The feedback from people is being collected through multiple channels aimed at different groups of people with different level of access to the ICT infrastructure. Those who have access to computer can leave an assessment and an extended comment on the web-site. Those who have a phone can respond with a grade to an SMS without charge (there is a single toll-free number being used throughout the whole country). Others can leave an assessment at a special terminal placed at a public service office, where they can also be assisted by specialists. A scale from 1 to 5 is being used, where 1 means completely dissatisfied and 5, totally satisfied. There are a number of criteria being used to assess the services, such as: i) The total time spent in the public services office; ii) The waiting time in the line to receive the public service; iii). The level of competence and courtesy of the public servant who provided the services; iv). The level of comfort at the premises where the services is being provided; and iv) The access to the tracking information about the public services provision.

SME Business Navigator

For many years G20 countries have been concerned with the improving of the idea of the SME's digital development. In 2015, under the Turkish G20 Presidency, issues of digitalization of SME's were included in the G20 agenda for the first time. Chinese G20 Presidency continued the work on «digital SME», broadened its scope and brought out the issues of the support measures for all types of SME's for discussion. It was agreed that SME's and entrepreneurs are vital sources of productivity growth, innovation and, therefore, economic growth and job creation across G20 countries.

In September 2016 the Russian Federal Corporation for Developing Small and Medium Business (SME Corporation) launched the SME Business Navigator - a free web tool for Russian small and medium entrepreneurs, who are willing to open or to expand their businesses within the formal economy requirements. Entrepreneurs using the SME Business Navigator (more than 665 thousand organizations) can use web-based instruments to: i) Choose what kind of business to open by analyzing case studies and looking for market niches; ii) Create a preliminary business plan based on model or tailored plans using the data and statistics on potential customers and competitors; iii) Find where to get a loan and apply for a guarantee; iv) Learn about support policies available for SMEs; v) Find available properties for rent from the database of state and private property available; vi) Be aware of biggest buyers' procurement plans based on the information from the state procurement system (including https://zakupki.gov.ru portal and procurement by the SOEs).

Methodology

The main principle of SME Business Navigator is its orientation to the demands of entrepreneurs. From the beginning of its creation project working group included representatives of public business associations of entrepreneurs (OPORA Russia, Business Russia, Chamber of Trade and Industry of Russia, Russian Union of Industrialists and Entrepreneurs), Agency for Strategic Initiatives, Associations of banks. At all stages of system creation, the SME Corporation received feedback from entrepreneurs during design thinking sessions. Services of SME Business Navigator operate on the basis of official statistical data including data on average salary, taxes, and other obligatory charges. Parameters and types of most popular business types which are included in the SME Business Navigator are selected together with business associations of entrepreneurs. Types of support measures are elaborated together with banks, organizations of business support infrastructure, state bodies and local authorities. The basic principle of starting own business with the help of Business Navigator is to find and to fill vacant market niche in the field of chosen business.

Resources

- https://smbn.ru/msp_en/help/bn.htm

Kingdom of Saudi Arabia

Measurement of e-Government Transformation

In reference to e-Gov Application Regulations issued pursuant to the Cabinet's resolution number 40 dated 28/03/2006 and number 252 dated 28/06/2010 regarding supporting and reinforcing the process of transformation into e-Gov, in addition to the general provisions of such regulations included in the clause number 22, which states that each Government entity (GE) must implement a biannual Score-Measurement of how much it has achieved in the e-Gov Transformation. Such Measurement should be implemented in accordance with certain indicators and criteria defined by Yesser Program and to be included within the annual report of each GE, and a copy of such a report is to be sent to the Royal Highness illustrating what is achieved by the GEs.

Accordingly, the Measurement first initiative was launched to evaluate the factual status of e-Gov Transformation. This includes evaluation of the GEs internal e-Transactions and all initiatives and programs relevantly executed to support this mission. It also included evaluating distinctive projects adopted to help develop Government performance and ensure effectiveness and efficiency of those services. Yesser has been in charge of periodically following up on this Measurement in accordance with a specified methodology and a set of indicators. It has also been responsible for preparing regular reports to be sent to GEs plus a general report to be sent to the Royal Majesty pursuant to relevant regulations.

With a comprehensive methodology based upon international best practices, basic guidelines were formulated to design a comprehensive framework for measuring the development of general work of the Program, taking into consideration the objectives behind this Measurement as follows:

- Providing decision-makers with expressly clear and direct evaluations, enabling them to follow up development of work at relevant GEs within the National Strategy and other related plans.
- Supporting the Program's motivating message towards e-Gov Transformation and contribution toward Digital Economy as required.
- Availability of comparison using measurable KPIs related to objectives of Saudi Digital initiatives.
- Covering all instructions included within regulations of e-Gov application.

Methodology

Hypotheses were put in accordance with various studies executed by Yesser after evaluating the status of GEs through continuous communications to know their preparedness for e-Gov Transformation, yet keeping in mind the following principles:

- e-Gov Transformation does not mean merely an absolute technological transformation in itself, while technology here is a substantially included part. The most important principle of the total process is the acceptance of such a transformation that is more to Ideology than to Technology.
- Specific characteristics of KSA were taken into consideration.
- GEs have reached different stages of e-Gov Transformation; however, a unified methodology should be formulated for all such entities deciding the point of launch.
- A Supportive methodology should necessarily be formulated for the application of the Program's executive plan and the National Plan for Communications and Information Technology.
- The Methodology should focus on a solid and reinforced base ensuring acceleration of the Transformation process and its execution for the welfare of citizen and community.
- The final objective of the Methodology should be focused on providing and developing integral and effective e-services for different types of stakeholders.

Resources

- https://www.yesser.gov.sa/EN/transformation_indicators/transformation_measurement_mechanism/pages/about_measurement.aspx

Implementation challenges

Previous measurement experiences have shown many learnt lessons and ideas to develop the management and implementation of the measurement process according to the feedback from the GEs, work mechanism findings and measurement results. The need to improve the measurement process has emerged. The following are the most prominent improvement recommendations for the 6th Measurement that are continued in the 7th Measurement (on the go):

- Prepare GEs for the next phase.
- Responses validation mechanism and physical visits to each agency.
- Provide an e-mechanism that enables GEs measure their transition on continuous basis during the year.

Singapore

Digital Economy Framework for Action

Driving digital transformation is a Whole-of-Government (WoG) effort. At the broadest level, the economy is the biggest domain driving Singapore's growth and competitiveness. This is supported by the Government which is leading key programs and initiatives to catalyze growth and innovation across all domains, including the public sector, so as to harness digital technologies and benefit from them. Singapore's plans to drive digitalisation across the economy is detailed in the Digital Economy Framework for Action.

Launched on 21 May 2018, the Digital Economy Framework for Action outlined three strategic priorities to sharpen Singapore's competitive edge to be a leading digital economy through i) accelerating the digitalisation of traditional industries, and support businesses and workers in digital adoption; ii) building competitive edge by reaping digital value from new and emerging ecosystems; and iii) creating, in partnership with the Infocomm Media (ICM) industry, the next-generation digital industry that would serve as an engine of growth for the future and vibrant economy. More importantly, this framework also serves as a guiding basis for Singapore's concerted effort to monitor digitalisation - to identify data needs and develop indicators to help chart progression and map development milestones. These indicators will inform the impact of programs and initiatives that the government has set out to achieve.

Singapore is developing a superset of digital metrics that are relevant to monitor progress and identify areas for action in each corresponding pillar and enablers of the Digital Economy Framework for Action. First, a set of metrics to benchmark Singapore's digital economy internationally in areas of competitiveness, future readiness and digital trust. Second, a systematic view and "pulse-check" metrics to track digital progression across sectors and businesses. This includes diagnostic tools for specific sector of interests to flag laggards and identify pain points that require intervention and policy action. Firms and enterprises could also tap on these tools to benchmark development and assess areas for improvement. Third, metrics that track growth of the four critical enablers (i.e. talent development; research and innovation; governance, policy and regulations, and standards; and physical and digital infrastructure) that form the foundation of a healthy and vibrant digital economy. Singapore's end-goal is a measurement framework comprising relevant metrics and tools that would allow us to track whether our digital economy is competitive, trusted and future-ready.

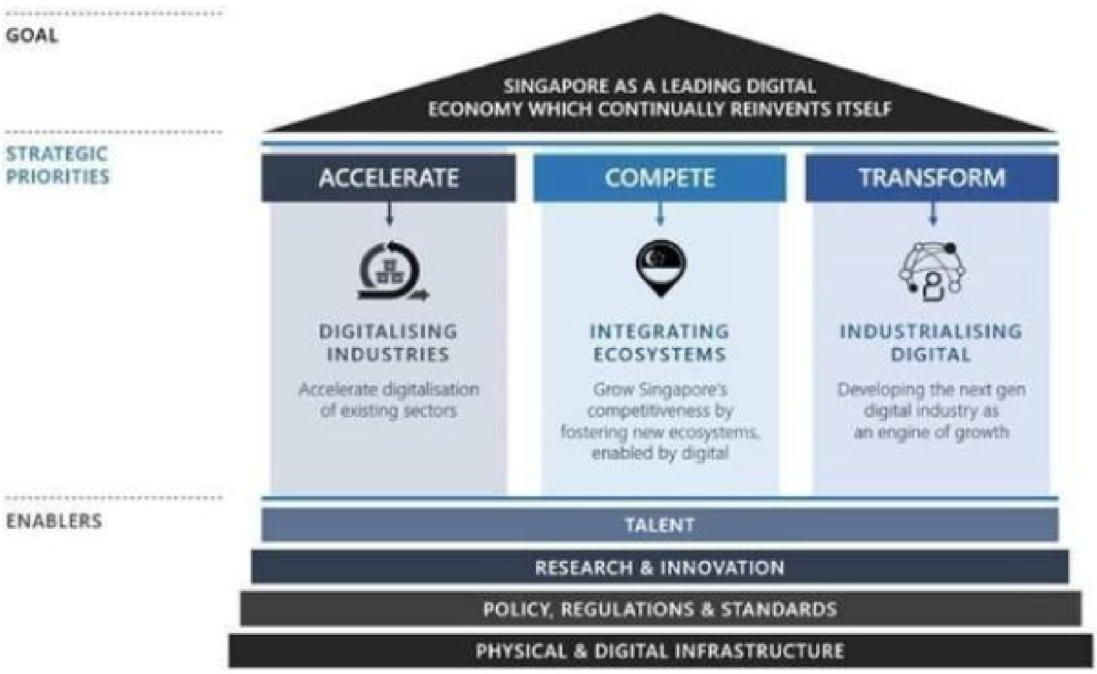
Methodology

Singapore's measurement framework is a work-in-progress and it involves ongoing consultation across multiple agencies to help in designing a set of current and relevant indicators to address the gaps in how we measure and track developments of the digital economy. Infocomm Media Development Authority (IMDA), Singapore's key agency in leading this WoG digital economy measurement effort, also recognizes the body of work done by various countries and international organizations and conducts research into existing models and international measurement frameworks, such as World Economic Forum (WEF)'s Global Information Technology Report (GITR) Index, Organisation for Economic Co-operation Development (OECD)'s work on digital trust, International Institute for Management Development (IMD)'s Digital Competitiveness Index, European Commission's Digital Economy and Society Index (DESI) to further develop work in this area. These international models are particularly pertinent to Singapore's effort in coming up with metrics that would identify areas at a broad national level that require progress to improve international competitiveness.

Resources

- Digital Framework for Action: https://imda/gov.sg/sgdigital/digital-economy-framework-for-action

Singapore's Digital Economy Framework



Turkey

Information Society Strategy and Action Plan (2015-2018)

The 2015-2018 Information Society Strategy and Action Plan was prepared with a focus on growth and employment under eight main pillars. Five factors played critical role in determining the focus and the context of the Strategy. These factors are Turkey's progress and ongoing needs in transforming into an information society; Turkey's fundamental problems and immediate opportunities; national, thematic and regional policy documents, in particular The Tenth Development Plan; and international policy trends, particularly the Digital Agenda for Europe initiative.

In that framework, the eight pillars of Information Society Strategy and Action Plan are:

1. Information Technologies Sector
2. Broadband Infrastructure and Competition
3. Qualified Human Resources and Employment
4. Diffusion of ICT into the Society
5. Information Security and User Trust
6. ICT-Supported Innovative Solutions
7. Internet Entrepreneurship and e-Commerce
8. User-Centric and Effective Public Services

Strategy and Action Plan consists of seven main chapters. In the Introduction, milestones of information society transformation in Turkey, relevant previous studies and outcomes, and also the preparation period of the new Strategy are outlined. The second chapter discusses how the new Strategy connects and serves to Turkey's goals on growth and employment. Current global state and trends in information society transformation are presented in the third chapter. The fourth chapter analyses current state in Turkey and discusses promising opportunities. The fifth chapter covers Turkey's policies, strategies and goals towards 2018; and necessary actions to achieve these goals are explained in detail in the sixth chapter. Finally, the seventh chapter presents the monitoring and coordination approach for implementation of the Strategy.

Methodology

Developments were illustrated both qualitatively and quantitatively in accordance with the methodology developed by Ministry of Development.

Resources

- *http://www.bilgitoplumu.gov.tr/en/wp-content/uploads/2016/03/Information_Society_Strategy_and_Action_Plan_2015-2018.pdf*

United Kingdom

Department for Digital, Culture, Media and Sports (DCMS)

Digital Sector Economic Estimates

Statistics are produced on the contribution of the Digital Sector to the UK economy, measured by gross value added (GVA), employment, imports and exports of services and goods and the number of businesses. These statistics are updated annually and the primary use of them is to monitor the performance of the industries in the digital sector, helping to understand how current and future policy interventions can be most effective.

Methodology

The digital sector is defined by the 4 digital Standard Industrial Classifications (SIC07) codes, which allows for international comparability. These codes can be found on page 9 of the methodology document "DCMS Sectors Economic Estimates: Methodology" (see link below).

GVA estimates are obtained from the Office for National Statistics (ONS) Input-output supply and use tables and the Annual Business Survey (ABS), a survey of businesses listed on the Inter-departmental Business Register (IDBR). Regional GVA data are obtained from the ONS balanced regional GVA series and the ABS.

Jobs/employment data are obtained from the Annual Population Survey (APS), which is itself a derivative of the Labour Force Survey (LFS).

Imports and Exports of services statistics are derived from the International Trade in Services (ITIS) survey, a survey of businesses looking at their overseas trade. Imports and Exports of goods statistics are based on data from the EU-wide Intrastat survey and from Customs import and export entries, collected by HMRC.

Data on number of businesses is from the Annual Business Survey (ABS).

Resources

- Economic estimates methodology document: https://www.gov.uk/government/publications/dcms-sectors-economic-estimates-methodology
- Economic estimates statistical document: https://www.gov.uk/government/collections/dcms-sectors-economic-estimates
- ONS LFS Document: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/july2018#quality-and-methodology

Implementation challenges

The ability to produce consistent figures each year also allows trends over time to be measured. However, as a result there are substantial limitations to the underlying classifications. The SIC codes used to develop the series were developed in 2007 and have not been revised since. Emerging sectors are therefore hard-to-capture and may be excluded in our estimates.

United States

Defining and Measuring the Digital Economy

This paper, made possible by support from the Commerce Department's National Telecommunications and Information Administration (NTIA), describes the work of the Bureau of Economic Analysis (BEA) to develop estimates towards the construction of a new digital economy satellite account. These estimates are the first step to a comprehensive measure of the contribution of the digital economy to gross domestic product (GDP).

Methodology

BEA prepared these statistics within the supply-use framework, following methodology used in the production of other BEA satellite accounts, including those on travel and tourism, arts and cultural production, and outdoor recreation. The estimation process includes three main steps: i) develop a conceptual definition of the digital economy; ii) identify goods and services within the supply-use framework relevant for measuring the digital economy defined in the first step; and iii) use the supply-use framework to identify the industries responsible for producing these goods and services, and estimate the output, value added, employment, compensation and other variables associated with this activity.

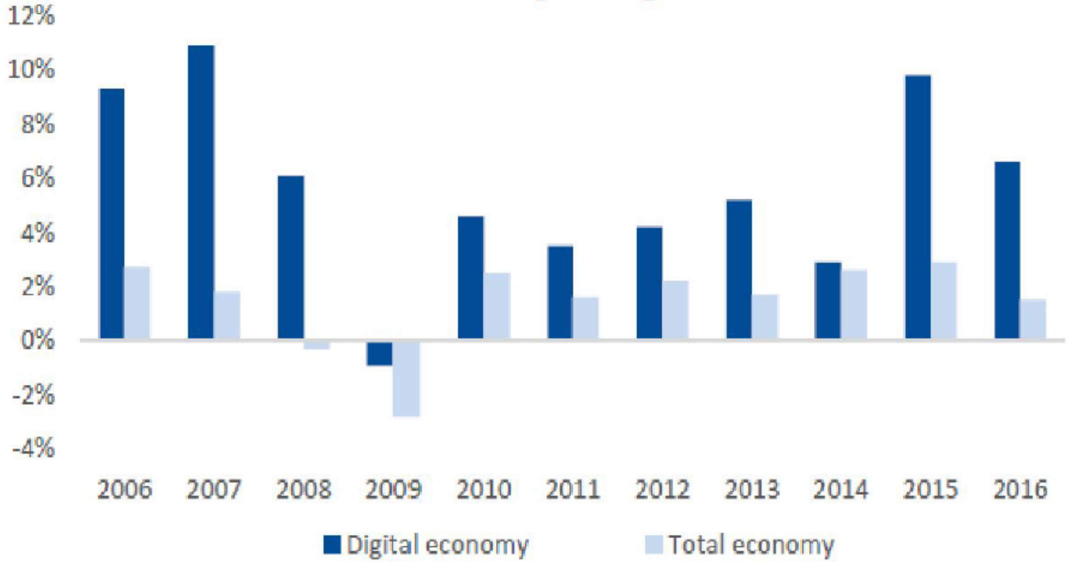
Resources

- See Bureau of Economic Analysis: *https://www.bea.gov/research/papers/2018/defining-and-measuring-digital-economy*
- See the National Telecommunications and Information Administration's Digital National Data Explorer at *https://www.ntia.doc.gov/data/digital-nation-data-explorer*
- See U.S. Department of Commerce. "First Report of the Digital Economy Board of Advisors." (2016) Available at *https://www.ntia.doc.gov/files/ntia/publications/deba_first_year_report_dec_2016.pdf*

Implementation challenges

This report presents BEA's initial work to lay the foundation for a digital economy satellite account. Conceptually, a digital economy satellite account should include all goods and services related to the digital economy. However, the preliminary estimates presented here are based on goods and services that are primarily digital. There are numerous challenges to estimating the economic contribution of "partially-digital" goods and services which are laid out in this report. These challenges are opportunities for future research to expand these early estimates into a complete digital economy satellite account.

Chart 3. Digital Economy Real Value Added and Total Economy Real Gross Domestic Product: Percentage Change from Previous Year



U.S. Bureau of Economic Analysis

Organisation for Economic Cooperation and Development (OECD)

Measuring the Digital Transformation

The OECD has worked on measurement of the digital economy since the late 1990s. This involves methodological and measurement work, but also includes experimentation with new metrics and seeking to identify data and measurement gaps that can be explored in the future. Data are used extensively in OECD policy reports and specialised measurement publications.

Methodologies

Between 1998 and 2003 the OECD developed guidelines on the measurement of the information society: definitions of ICT and content sectors, products and technologies, as well as survey frameworks for ICT use in business and in households/by individuals. These guidelines are periodically reviewed and revised and have been adopted by the European Union and the UN Statistical Commission. In 2014 the OECD produced Measuring the Digital Economy: A New Perspective where countries were benchmarked along many relevant dimensions, gaps were identified and a measurement agenda was developed. Today, the OECD is working on measurement in a number of areas, including Artificial Intelligence, the Internet of Things, broadband metrics, digital security and privacy, consumers' trust in online environments, skills in the digital era, government digital services, digital transformation of government operations and their use of data, digitalisation of science, "digital" trade, barriers to trade in digital services, digital economy in GDP and digitalisation and the future of work. Much of this measurement work occurs in close consultation with OECD policy committees to ensure policy relevance and responsiveness to key priorities.

In January 2017, the OECD launched an organisation-wide project - Going Digital: Making the Transformation Work for Growth and Well-being. The project is developing an integrated policy framework to help policy makers better understand the transformation that is taking place and implement policies that foster a positive and inclusive digital economy and society. Each of the main policy dimensions of the Going Digital integrated policy framework – access, use, innovation, jobs, society, trust, and market openness – is mapped to key benchmark indicators and relevant policy levers. At the same time, existing metrics are being reviewed and measurement gaps identified. This work will lay the foundation for future measurement initiatives in developing a medium to long-term Measurement Roadmap for the digital transformation.

Implementation challenges

Not all OECD countries implement the existing OECD methodological guidance on the digital economy in full, reflecting differences in national priorities and measurement tools. Moreover, resources can be a key constraint e.g. in implementing specialised surveys of household or business ICT use, or in improving the measurement of price indices of ICT goods and services, or being able to experiment with new measurement tools in hard to measure areas. New sources and methodological approaches, often building on digital tools, may facilitate implementation or open new ways of measuring, e.g. by drawing directly on data from the Internet.

Resources

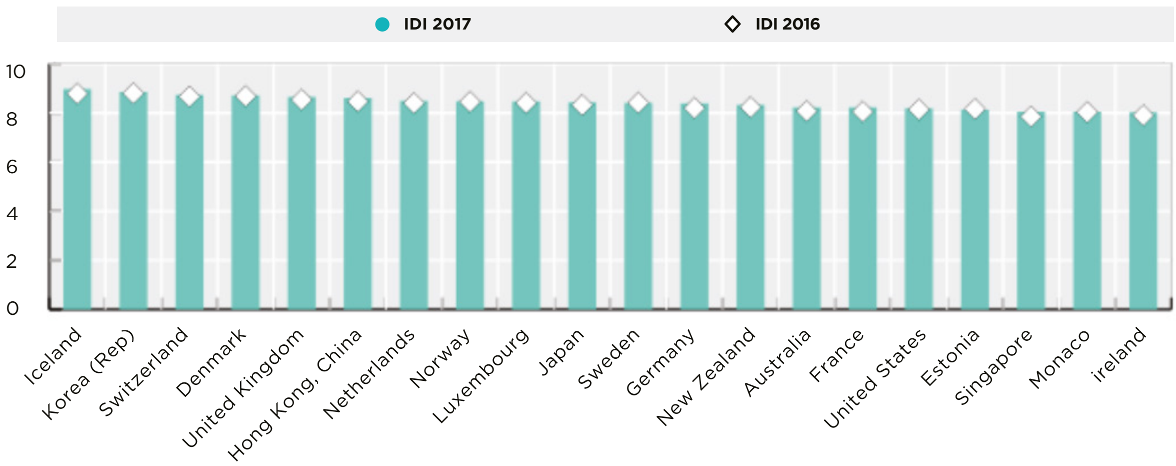
OECD methodological work and data on the digital economy is disseminated via reports and online resources, including:

- OECD Guide to Measuring the Information Society (2011): http://www.oecd.org/sti/ieconomy/oecdguidetomeasuringtheinformationsociety2011.htm
- OECD Model Survey on ICT Access and Usage by Households and Individuals (2014): http://www.oecd.org/sti/ieconomy/ICT-Model-Survey-Access-Usage-Households-Individuals.pdf
- OECD Model Survey on ICT Usage by Businesses (2014); http://www.oecd.org/sti/ieconomy/ICT-Model-Survey-Usage-Businesses.pdf
- OECD Broadband Portal: http://www.oecd.org/sti/broadband/broadband-statistics/
- OECD ICT statistics Database: http://oe.cd/hhind (households/individuals); http://oe.cd/bus (businesses)
- Measuring the Digital Economy – A New Perspective (2014): http://www.oecd.org/sti/measuring-the-digital-economy-9789264221796-en.htm
- Science, Technology and Industry Scoreboard 2017 – The Digital Transformation: http://www.oecd.org/sti/scoreboard.htm
- "Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth?", Statistics Working Papers, https://doi.org/10.1787/a8e751b7-en
- Digitalisation and the Future of Work: http://www.oecd.org/employment/future-of-work/
- OECD Going Digital Project: http://www.oecd.org/going-digital/

International Telecommunication Union (ITU)

ICT Development Index

The ICT Development Index (IDI) is a composite index that combines 14 indicators[8] into one benchmark measure that can be used to monitor and compare developments in ICTs between countries and over time. The main objectives of the IDI are to measure the level and evolution over time of ICT developments within countries and of their experience relative to other countries; progress in ICT development in both developed and developing countries; the digital divide, i.e. differences between countries in terms of their levels of ICT development; and the development potential of ICTs and the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills. The graph below shows the top 20 ranked countries in the IDI 2017.



[8] *To ensure that the IDI stays relevant and captures the many changes that take place in a rapid changing environ ment, the IDI is periodically reviewed and revised, with the most recent revision concluded in 2017. As a result, 14 indicators will be included in the 2018 IDI, compared with 11 indicators in previous editions of the IDI.*

Methodology

The ICT development process, and a country's transformation to becoming an information society, depends on a combination of three factors: the availability of ICT infrastructure and access, a high level of ICT usage, and the capability to use ICTs effectively, derived from relevant skills. These three dimensions therefore form the framework for the IDI. Based on this conceptual framework, the IDI is divided into three sub-indices, the access sub-index, the use sub-index and the skills sub-index.

Conceptual framework of the ICT Development Index

The indicators used to calculate the IDI are selected on three criteria. First of all, the indicator needs to be relevant in contributing to the main objectives and conceptual framework of the IDI. Secondly, data need to be available for a large number of countries, as the IDI is a global index. And finally, principal components analysis is used to examine the underlying nature of the data and explore whether their different dimensions are statistically well-balanced.

Resources

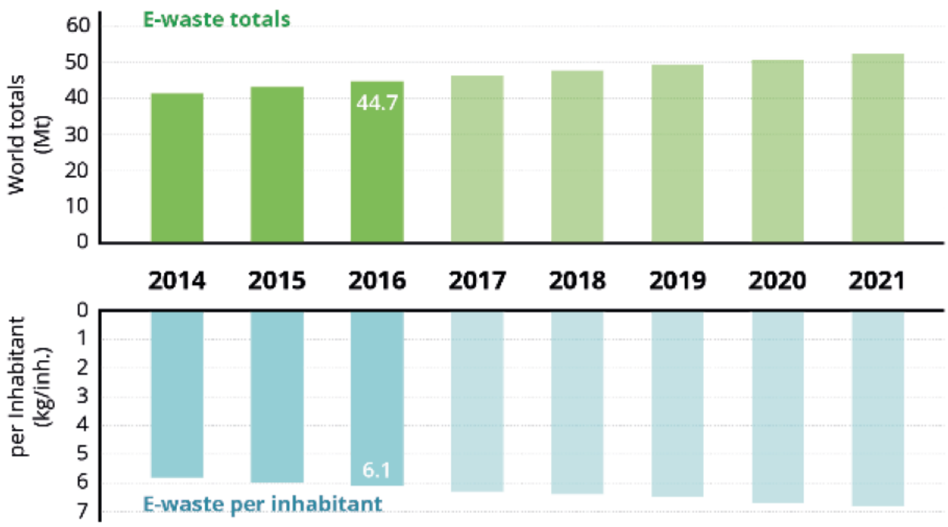
- The IDI was developed by ITU in 2008 in response to ITU Member States' request to establish an overall ICT index, was first presented in Measuring the Information Society Report 2009 (ITU, 2009), and has been published annually since then, see *https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx.*
- IDI data visualization 2017: *https://www.itu.int/net4/ITU-D/idi/2017*/.
- IDI methodology: *https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx*.

Implementation challenges

The inclusion of five new indicators in the IDI necessitates additional efforts by countries to collect the data for the indicators to be included in the revised IDI. It is especially important to improve data availability for the two indicators on Internet traffic and the indicators on mobile phone ownership and ICT skills, for which data currently only exist for about one-third of countries.

Global e-waste Statistics Partnership

Graph 1: Global e-waste generated



Note: 2017-2021 are estimates

The Global e-waste Statistics Partnership, which includes ITU, UNU and ISWA[10], is addressing the growing global electronic waste (e-waste) challenge by producing worldwide e-waste statistics, by raising visibility on the importance of tracking e-waste, and by delivering capacity building workshops to countries. End 2017, the Partnership published the Global E-waste Monitor, which includes data on the following indicators: a) the amount of e-waste generated (Graph 1) b) the amount of e-waste properly documented and recycled (Graph 2), and c) number of countries with e-waste legislation (Graph 3).

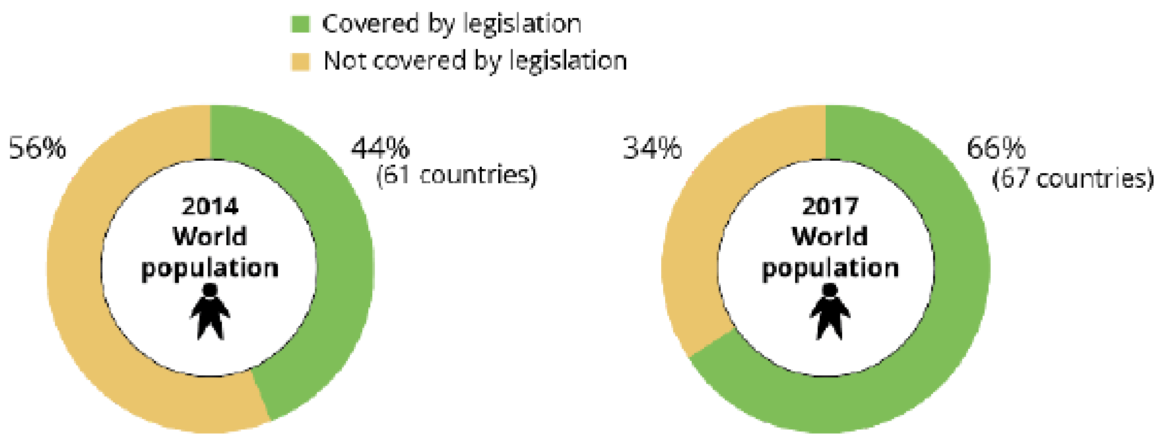
Increasing levels of e-waste are the result of several trends, including a growing digital society, characterized by technological progress, innovation and social and economic development. But, growing levels of e-waste, and its improper and unsafe treatment and disposal through open burning or in dumpsites, pose significant risks to the environment and human health. Measuring e-waste is an important step towards addressing the e-waste challenge. Statistics help to evaluate developments over time, set and assess targets, and identify best practices of policies. Better e-waste data will help to minimize its generation, prevent illegal dumping, promote recycling, and create jobs in the reuse, refurbishment and recycling sectors. It will contribute to the achievement of the Sustainable Development Goals, in particular SDG12, to 'ensure sustainable consumption and production patterns'.

[10] *The Global E-waste Statistics Partnership are: The International Telecommunication Union (ITU), the United Nations University (UNU) acting through its Vice Rectorate in Europe hosted Sustainable Cycles (SCYCLE) Programme and the Solid Waste Association (ISWA).*

Methodology

The Global E-waste Statistics Partnership collects data on e-waste based on a harmonized measurement framework and set of indicators, which were developed by the Partnership on Measuring ICT for Development, published in the recently as "E-waste Statistics: Guidelines for Classification, Reporting and Indicators". The calculation of e-waste generated is based on empirical data from the apparent consumption methods, a sales-lifespan model. For the EU, data on the collected and recycled e-waste is available from Eurostat and for 77 other countries in the world, data was collected from a pilot questionnaire that UNU conducted with UNECE, OECD, and UNSD.

Graph 2: World population (& number of countries) covered by e-waste legislation in 2014 and 2017



Source of above graphs: Global E-waste Monitor 2017.

Resources

- The latest available global data are published in the Global E-waste Monitor 2017, in particular in Annex 2 and 3.

Implementation challenges

Only 41 countries, mainly within Europe, currently collect official e-waste data but pilot questionnaires have been sent by UNECE, OECD and UNSD. These results were used to compile the global totals on e-waste collection and recycling rates. Most countries do not have official e-waste data and many do not have the capacity to collect these data. To this end, the Global E-waste Statistics Partnership carries out regional capacity building workshops. Major challenges remain the lack of awareness about the importance of e-waste data and the lack of national coordination between different stakeholders involved in e-waste data production.

Partnership on Measuring ICT for Development

The Partnership on Measuring ICT for Development is an international, multi-stakeholder initiative that was launched in 2004 to improve the availability and quality of ICT data and indicators, particularly in developing countries. The Partnership has guided policy makers in producing ICT statistics that are crucial to informed decision-making, including through the identification of a core list of ICT indicators and methodologies to collect these indicators. The Partnership helps developing countries collect ICT statistics, particularly through capacity-building and hands-on training for national statistical offices, and collects and disseminates information society statistics. Its membership has grown from originally 11, to today 14 regional and international organizations[9]. The Partnership work is coordinated by a Steering Committee, which is elected every three years. The current Steering Committee is made up of ITU, UNCTAD, and UIS.

Members of the Partnership on Measuring ICT for Development

Source: Partnership

[9] International Telecommunication Union (ITU), Organization for Economic Co-Operation and Development (OECD), United Nations Conference on Trade and Development (UNCTAD), United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (UIS), United Nations Department of Economic and Social Affairs (UNDESA), the World Bank, United Nations University Institute for the Advanced Study of Sustainability, UN Economic Commission for Africa (ECA), UN Economic and Social Commission for Asia and the Pacific (ESCAP), UN Economic and Social Commission for Western Asia (ESCWA), UN Economic Commission for Latin America and the Caribbean (ECLAC), European Commission (Eurostat, Digital Economy and Society Index -DESI- and International DESI), UNEP Secretariat of the Basel Convention (SBC), and the International Labour Organization (ILO).

Methodology

One of the key achievements of the Partnership on Measuring ICT for Development has been the identification of a core list of indicators. This list of over 50 indicators, which was agreed upon through a consultation process involving governments and international organizations, covers the following areas: ICT infrastructure and access; access and use of ICT by households and individuals; use of ICT by businesses; the ICT sector; trade in ICT goods; ICT in education; and e-government. The list was identified to help guide countries in measuring the information society.

The core list of ICT indicators is composed of over 50 indicators in the following areas:

- ICT infrastructure and access (10 indicators);
- ICT access and use by households and individuals (19 indicators);
- ICT access and use by enterprises (12 indicators);
- ICT sector and trade in ICT goods (4 indicators);
- ICT in education (9 indicators);
- ICT in government (7 indicators).

The Partnership recommends the core list as a basis for ICT data collection in countries. The indicators included in the core list are clearly defined and associated with statistical standards, which allows comparability across countries. An increasing number of countries are integrating the core list of ICT indicators into their existing household and business surveys. The members of the Partnership are providing assistance in this process.

The core list of ICT indicators was the outcome of an intensive consultation process by the Partnership on Measuring ICT for Development, which involved NSOs worldwide. The indicators are based on internationally agreed standards (especially those developed by ITU, OECD and European Commission).

Through a Task Group on ICT for the SDGs, the Partnership is currently working on a proposal for a thematic list of ICT indicators that could be used to measure ICT availability and use in sectors relevant to the SDGs that are not covered in the global SDG indicators framework. The Task Group further aims at improving availability of disaggregated data, for the indicators that will be defined in the thematic list, in addition to the ICT indicators included in the SDG measurement framework.

Resources

- Partnership home page: https://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/partnership/default.aspx.
- Partnership core list of ICT indicators: https://www.itu.int/en/ITU-D/Statistics/Documents/coreindicators/Core-List-of-Indicators_March2016.pdf

UNCTAD

Measuring Exports of ICT-enabled/digitally-delivered Services

Services that are delivered remotely over ICT networks are of growing interest for both developing and developed countries, as they represent a strategic component of the digital economy value chain. Currently these "ICT-enabled" services are not well captured by official statistics. The lack of statistical data constitutes a significant gap in the tool-kit policy makers need to design and implement ICT policies for development.

UNCTAD is working to improve the measurement of exports of ICT-enabled services. A new methodology has been developed in collaboration with other members of the Partnership on Measuring ICT for Development[11], and in collaboration with Inter-Agency Task Force on Statistics of International Trade[12]. ICT-enabled services are defined as those services that are delivered remotely over ICT networks, similar to services supplied via WTO GATS mode 1. A model enterprise survey questionnaire has been developed, as well as training material, following closely the recommendations of the Manual on Statistics of International Trade in Services (2010) and the IMF Balance of Payments Manual 6th edition.

Methodological details are available in the UNCTAD Technical Note 3 *International Trade in ICT Services and ICT-enabled Services: Proposed Indicators from the Partnership on Measuring ICT for Development*[13] and were presented and approved at the 47th Session of the United Nations Statistical Commission[14].

[11] *For more information on the Partnership please see http://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/partnership/pub.aspx*

[12] *For more information on TFITS please see http://unstats.un.org/unsd/trade/taskforce*

[13] *Available online at http://unctad.org/en/Pages/DTL/STI_and_ICTs/ICT4D-Technical-Notes.aspx*

[14] *See (E/CN.3/2016/13), http://unstats.un.org/unsd/statcom/47th-session/documents/2016-13-Partnership-on-measuring-ICT-for-development-E.pdf and (E/CN.3/2016/24), http://unstats.un.org/unsd/statcom/47th-session/documents/2016-24-Interagency-TF-on-international-trade-statistics-E.pdf*

Pilot tests

UNCTAD is seeking to enhance the statistical capacity of developing countries to measure and report internationally comparable data on the share of trade in services that +is digitally-delivered, by major partner country, and by sector. During 2017, UNCTAD piloted the new model survey questionnaire in three countries: Costa Rica, India and Thailand[15]. A session at the UNCTAD E-commerce Week 2018 also discussed results, lessons learned and recommendations for other countries interested in implementing the survey.

The implementation of the survey in Costa Rica showed that ICT-enabled services represented 38% of total services exports in Costa Rica in 2016[16]. Some 97% of the exports of services identified as potentially ICT-enabled were actually delivered over ICT networks. These services were mainly exported by large foreign-owned enterprises and involved management, administration and back-office services. In India the survey showed that 65% of the Indian commercial services exports were ICT-enabled in 2016[17]. Some 81% of the potential ICT-enabled services exports were digitally delivered, i.e. considerably lower than in Costa Rica. Computer services, the biggest contributor, accounted for 63% of the ICT-enabled services. For exporting SMEs, remote delivery over ICT networks constituted the predominant mode of supply (more than 99%), while for larger enterprises, this mode accounted for some 80% of their total exports. In the United States, another study concluded that potential ICT-enabled services represented just over 50% of total services trade in 2016[18].

Next Steps

There is now a need to secure additional funding to implement the project in more developing countries. For this purpose, UNCTAD is exploring possibilities for teaming with up financing and implementing partners to roll it out. The G20 may wish to endorse this work.

[15] *For more information please see: http://unctad.org/en/pages/MeetingDetails.aspx?meetingid=1412.*

[16] *See http://unctad.org/meetings/en/Presentation/dtl_eWeek2018p03_RigobertoTorresMora_en.pdf.*

[17] *See http://unctad.org/meetings/en/Presentation/dtl_eWeek2018p04_AmitavaSaha_en.pdf.*

[18] *See http://unctad.org/meetings/en/Presentation/dtl_eWeek2018p05_JessicaNicholson_en.pdf*

International Labour Organization

Discussion on statistics on work relationships at the 20th ICLS

The International Labour Organization (ILO) will convene the 20th International Conference of Labour Statisticians (ICLS) at its headquarters in Geneva, Switzerland during 10-19 October 2018. Among other things, the Conference will review and discuss for possible adoption a draft suite of international standards for statistics on work relationships. If adopted at the 20th ICLS, the new statistical standards will replace the International Classification of Status in Employment (ICSE-93), adopted in 1993 as a resolution of the 15th ICLS. A central element of the proposals is a revised International Classification of Status in Employment (ICSE-18). It includes 10 categories to allow better identification of workers with non-standard employment arrangements including those with fixed-term and with casual and short-term contracts of employment, to address concerns about both the blurring of the boundary between paid employment and self-employment and to measure the growth of dependent self-employment. It will also propose a new International Classification of Status at Work (ICSaW) aiming to extend ICSE-18 to cover all forms of work. The proposals are integrated by a conceptual framework for statistics on work relationships which defines the key concepts, variables and classification schemes included in the new standards. The need for better statistics on various dimensions of non-standard employment is provided through a series of cross-cutting variables and categories, which provide more detailed measures of the degree of stability and permanence of the work, and allow the identification of specific groups of social concern. They cover topics such as duration of work contract, multi-party employment arrangements, domestic work and job-dependent social protection.

Discussion on International Standard Classification of Occupations at the 20th ICLS

The ICLS will also discuss whether or not to update the existing version of the International Standard Classification of Occupations, 2008 (ISCO-08). The main purposes of ISCO-08 are to provide: (a) a basis for the international reporting, comparison and exchange of statistical and administrative information about occupations; (b) a model for the development of national and regional classifications of occupations; (c) a system that can be used directly in countries that have not developed their own national classifications. These occupations also include the ones related to the digital economy. The ILO is preparing a report, to be presented as a room document at the 20th ICLS that will provide comprehensive information on: (a) occupations that are not included or not appropriately classified in ISCO-08; (b) various approaches to the definition and application of skill level and skill specialization/type for the arrangement of occupational groups in classification systems.

An updated and expanded set of categories was provided in ISCO-08 for occupations involved in the provision of goods and services in information and communications technology (ICT). These categories reflected the rapidly evolving occupational structures that emerged during the revolution in ICT that occurred during twenty years following the development of ISCO-88. There is concern, however, that the boundaries between some of the categories are blurred and that jobs may frequently be classifiable to several different groups, in a sector whose occupational structures and skill requirements remain fluid. There may, for example, be a need to determine whether an increasing number of jobs in ICT referred to as "architects" (enterprise architect, solutions architect, software architect, network architect, systems architect ...) are adequately covered by the existing unit groups or reflect new or emerging occupations. The treatment of occupations such as data miner also requires further investigation. There may be a need to determine whether new social media occupations are emerging at the boundary between ICT and the world of marketing and advertising (Search engine optimization (SEO) specialist, SEO strategist, On-line community manager, On-line content moderator) or whether these are specializations of existing occupations. Internet enabled commerce and increased levels of international trading is having a significant impact on the skill content of existing occupations in commerce and may be giving rise to the emergence of new occupations and job titles such as International Trade Technician, E- merchandiser, E-commerce shop assistant, Technical Specialist in e-commerce, E-commerce operator, and Expert in digital relationship management. There is a need to evaluate the extent to which these developments may require the creation of one or more unit groups or revision of the scope and definitions of existing groups.

Resources

- **Document for discussion are available on the ICLS website:**
  https://www.ilo.org/20thicls

- **Resolution concerning statistics of work, employment and labour underutilization:**
  https://www.ilo.org/global/statistics-and-databases/standards-and-guidelines/resolutions-adopted-by-international-conferences-of-labour-statisticians/WCMS_230304/lang--en/index.htm

- **Document from Meeting of the Expert Group on International Statistical Classifications, New York, 6-8 September 2017: Options and Possibilities for the Future Revision of the International Standard Classification of Occupations, 2008 (ISCO-08):**
  https://unstats.un.org/unsd/classifications/expertgroup/egm2017/ac340-P34.PDF

World Bank Group

Digital Economy Country Assessment (DECA)

Digital transformation today affects all levels of life - an individual, an organization or an entire country. To assess the readiness and maturity level of digital transformation, comprehensive tools are needed that characterize the digital development process and the factors affecting it.

In 2017 the World Bank, in collaboration with the Institute of the Information Society, developed a Digital Economy Country Assessment (DECA) methodology to help countries and regions assess their readiness for digital adoption.

Methodology

The DECA methodology is focused on diagnostics of the current situation to provide the basic assessment of the current maturity level of the digital economy; to identify key gaps, challenges and opportunities in digital economy development; and to identify areas that require more careful analysis before policy actions or investments. The digital economy – the economy based on the development and use of digital technologies – is built on foundations that enable transformation across all aspects of the economy and society.

The DECA framework is designed as a common set of indicators that can be applied for the whole country, for its regions (in case of a federated state), and for certain sectors of the economy or subject areas (like education or healthcare). The DECA methodology is still evolving and is being refined based on operational feedback gained from its rollout across an initial set of countries. It was first applied and further improved by the World Bank and Russian partners during the development of the Digital Economy Program, endorsed by the Government of the Russian Federation in 2017. See Figure 1 for an example chart.

Figure 1: Example Chart of DECA Assessment for the Russian Federation (2017)

Resources

- http://www.worldbank.org/en/programs/digital-development-partnership

Implementation challenges

With DECA methodology being very broad, the team has been facing a trade-off and balancing act between promptly addressing the urgent needs of the client countries in a rapid, streamlined manner and conducting a comprehensive assessment using the current methodology. Therefore, the team has been looking for a right balance between monitoring the country's digital economy status quo and analyzing the country-specific strengths, weaknesses, opportunities and challenges to develop practical recommendations and prioritize interventions within a strategy and roadmap or a World Bank financed project. A streamlined, simplified version of DECA is being developed at the moment, named "Digital Economy eXpress Assessment" (DEXA) to better address this subtle balancing act.

IMF

Measuring the Digital Economy in Macroeconomic and Financial Statistics

The IMF Statistics Department has written a Policy Paper on Measuring the Digital Economy to examine the measurement challenges and data gaps for macroeconomic and financial statistics raised by the emergence of the digital economy. There has been much discussion of whether existing methods for measuring GDP capture the growth of the digital economy, and the paper assesses the GDP measurement controversy. The paper also considers the measurement challenges for other areas of statistics (including price indexes, balance of payments, and financial and monetary statistics) and the new data needs created by the digital economy, including granular information on the digital sector and digital transactions.

While the over-arching conceptual framework of GDP remains sound, the paper recommends a new treatment of data as asset, development of complementary welfare indicators. It also distinguishes a digital sector, and recommends updating classification systems to cover online platforms and platform-enabled activities and supplementary measures of digital transactions. The paper identifies many practical steps to compile more accurate or complete measures of prices, growth, productivity, balance of payments, and financial statistics.

Resources

- Measuring the Digital Economy Policy Paper:

https://www.imf.org/en/Publications/Policy-Papers/Issues/2018/04/03/022818-measuring-the-digital-economy.

Inter-American Development Bank (IADB)

Broadband Development Index (IDBA) in Latin America and the Caribbean

The main goal of the IDBA is to size the digital progress in Latin America and the Caribbean (LAC) by measuring the state of broadband development in the 26 Bank-member countries, as well as in additional reference countries (64 nations in total). The IDBA is a powerful tool to identify the magnitude of the gap in two different geographic approached, first when we compare the state of the art of one country versus the cluster region the country belongs to, and second, when we compare the country with respect to the OECD.

The following table shows a comparison of the average IDBA 2016 and IDBA 2017 for LAC and OECD clusters:

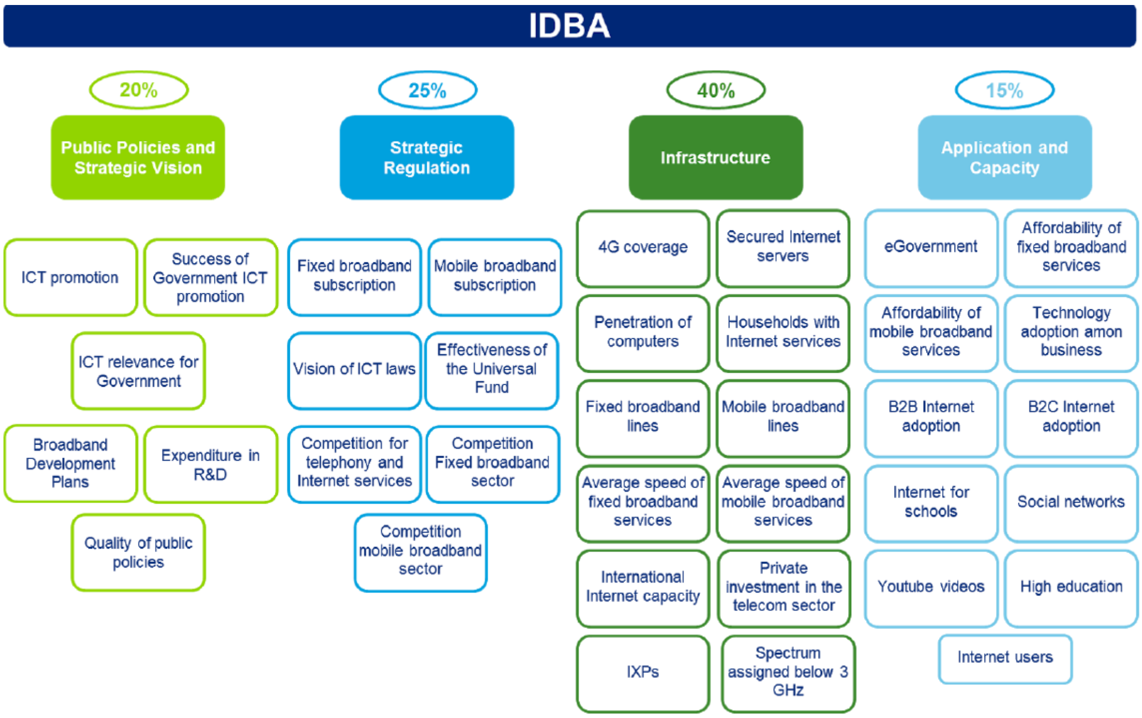
IDBA 2016 vs IDBA 2017						
	LAC		OECD		GAP	
	2016	2017	2016	2017	2016	2017
IDBA	4,28	4,51	6,12	6,20	1,84	1,69
Public Policies and Strategic Vision	3,89	3,90	5,77	5,76	1,88	1,86
Strategic Regulation	5,25	5,55	6,72	6,70	1,47	1,15
Infrastructure	3,87	4,20	5,78	6,02	1,91	1,82
Application and Capacity	4,18	4,30	6,31	6,30	2,13	2

Methodology

The IDBA consists of four pillars and 36 variables. Each of the pillars ranges from 1 to 8, as is the case for the index and the variables. Also, each of the pillars has a specific weight that reflects its importance within the ecosystem, and each of the variables is evenly weighted within the same pillar.

The following figure shows the structure of the index:

Structure of the IDBA



The variables are inputs from international databases. Due to their heterogeneity, are normalized (lineal, direct, inverse or logarithmic).

Resources

- The Broadband Development Index (IDBA) in Latin America and the Caribbean is available at: https://descubre.iadb.org/es/digilac/pages/indice-de-desarrollo-de-banda-ancha
- The Annual Broadband Development Index in Latin America and the Caribbean IDBA 2016, including a detailed description of its methodology, is available (in Spanish) at https://publications.iadb.org/handle/11319/8193.

References

- Ahmad, N. and P. Schreyer (2016), "Measuring GDP in a Digitalised Economy", OECD Statistics Working Papers, 2016/07, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jlwqd81d09r-en
- Brezzi, M., L. Dijkstra and V. Ruiz (2011), "OECD extended regional typology: The economic performance of remote rural regions", OECD Regional Development Working Papers, 2011/06, OECD Publishing, http://dx.doi.org/10.1787/5kg6z83tw7f4-en.
- European Commission (2014), "E-Skills for jobs in Europe: Measuring progress and moving ahead", European Commission, www.researchgate.net/publication/265972686_e-Skills_for_Jobs_in_Europe_Measuring_Progress_and_Moving_Ahead (accessed 29 August 2017).
- Inaba, T. and M. Squicciarini (2017), "ICT: A new taxonomy based on the international patent classification", OECD Science, Technology and Industry Working Papers, No. 2017/01, OECD Publishing, Paris, http://dx.doi.org/10.1787/ab16c396-en.
- OECD (2004), "ICT skills and employment", in Information Technology Outlook 2004, OECD Publishing, Paris, http://dx.doi.org/10.1787/it_outlook-2004-8-en
- OECD (2011), OECD Guide to Measuring the Information Society 2011, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264113541-en.
- OECD (2014b), "Forecasting future needs for advanced ICT competence in Norway", DSTI/ICCP/IIS(2014)5, OECD, Paris.
- OECD (2015a). Proposal for a EUROSTAT-OECD Definition of ICT Specialists. Published as OECD OLIS document DSTI/ICCP/IIS(2015)7/REV1. Download: http://ec.europa.eu/eurostat/cache/metadata/Annexes/isoc_skslf_esms_an1.pdf
- OECD (2015b), The OECD Model Survey on ICT Access and Usage by Households and Individuals, 2nd Revision, Working Party on Measurement and Analysis of the Digital Economy, OECD, Paris, https://www.oecd.org/sti/ieconomy/ICT-Model-Survey-Access-Usage-Households-Individuals.pdf
- OECD (2017a), OECD Science, Technology and Industry Scoreboard 2017: The digital transformation, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264268821-en
- OECD (2017b), OECD Compendium of Productivity Indicators 2017, OECD Publishing, Paris, http://dx.doi.org/10.1787/pdtvy-2017-en

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