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Trends in regulating the global digital economy

Ewan Sutherland

LINK Centre, University of the Witwatersrand[‡]

Abstract

Digital technologies are being adopted at a faster pace than previous waves of innovation, and their use is re-shaping administration and business, consumer behaviour and social interactions. They are subject to widely varying regimes, from lightly regulated but heavily standardised global equipment markets, heavily regulated markets for wireless services, to barely regulated over the top (OTT) services. The regulation of aggregators and platforms is achieving greater attention. Leading governments encourage the creation of new technologies and the adoption of existing and emerging technologies, in pursuit of economic growth and improved productivity. They fund research and development (R&D), expansion of university courses, the creation and growth of technology hubs, the deployment of new networks (e.g., FTTH and 5G) and the extension of established networks in areas considered not commercially viable. Considerable attention has been given to the Internet of Things (IoT) and the Industrial Internet of Things (IIoT), frameworks for connecting billions of objects, enabling smart buildings, homes, factories and cities. To secure economic and social gains, governments are updating cybersecurity strategies, to counter threats from criminals, hostile states and terrorists. The European Union (EU) has elevated data protection to be a right, alongside privacy, and enacted the General Data Protection Regulation (GDPR), supported by a network of national supervisory authorities. Skills shortages are long-standing, despite some international movement of individuals, with growing demand in cybersecurity, and with growing demand for the skills required to work with artificial intelligence and robotics. There remain difficulties in measuring the digital economy and society.

Keywords: Competition, Economy, Globalisation, Governance, Privacy, Regulation.

Introduction

Since the early 1960s, there have been discussions and speculations about an information or knowledge age, economy and society (Machlup, 1962; Drucker, 1969; Bell, 1973; Porat, 1977; Masuda, 1981). Today, in Europe and East Asia the preferred terms include digital economy, government and society. The view from the United States of America (USA) is somewhat different, if only because it eschewed an explicit industrial policy until the Trump Administration, with companies taking the lead on digitalization and lobbying against

[‡] http://twitter.com/#!/sutherla http://ssrn.com/author=927092 http://orcid.org/0000-0001-5220-9605

regulation.[1] The underlying drivers are established firms trying to develop new technologies and to find applications to sustain and improve their market positions, while being challenged by any number of new entrants and start-ups that seek to disrupt the market and destroy established revenue flows. In OECD (2018) countries about one-quarter of total business expenditure on research and development (BERD) is by information and communication technology (ICT) and related content industries. Given the shortage of domestic skills, US-based firms have successfully relocated much of their research to other countries (e.g., China and India), allowing them to remain leaders in the application of ICTs (Branstetter, Glennon, & Jensen, 2018). The results include a continuing flow of digital technologies, such as 3D-printing, artificial intelligence (AI), the Internet of Things (IoT), next generation networks, robotics, and social networks, that are being applied to transform business operations by easing tasks such as collaboration, connectivity, and the use of information and knowledge. Underlying and enabling this is a set of telecommunications networks, both fixed and mobile, of ever increasing capacity, supported by physical distribution systems that collect and deliver packages of all sizes to many though by no means all locations.[2] The benefits of digitalization have fallen firstly to firms and governments with the highest levels of human and organizational capital, those making intensive use of knowledge, while the effects on income and jobs depend on those benefits are distributed. This paper sets out and analyses some of the major global trends in the regulation of technologies and its markets.

The scope of digitalization demands considerable attention from government, with the outcomes being tied to the quality of the governance in a particular state, to the capacity of its judges, ministers and officials, the availability of data, and the openness and transparency of is operations. A variety of regulatory state models are used for issues (e.g., competition and data protection) and sectors (e.g., energy and telecommunications), involving complex legislation, policies, and regulatory agencies. Digitalisation is required of governments, parliaments and judiciaries, to improve accountability, efficiency, and transparency, but also to meet the expectations of citizens, who now receive direct and nearly instantaneous engagement in commercial interactions. For example, this presents significant challenges for the police in addressing digital crime and in collecting and processing digital evidence (HMIC, 2015; Mason & Seng, 2017). Technology enables vast improvements in making data available to citizens, seen, for example, in the work of the Open Government Partnership (2018).

The European Union has engaged with technology as part of its economic policy for decades, partly in response to the industrial challenges posed by the USA, Japan, Asian 'tiger' economies, and, most recently, China (Bangemann, 1994; Monti, 2010). Its aspiration is to complete its digital single market (DSM), spanning its 27 member states,[3] the four countries in the European Economic Area (EEA) and the accession countries in the Western Balkans (EC, 2015) (see Table 1). Bringing down barriers to digital trade is expected to contribute an additional €415 billion to its annual gross domestic product (GDP), while the value of its data economy could reach €700 billion by 2020, or 4 per cent of GDP. The DSM is supported by a common legal framework, developed by the European Commission (EC), through public consultations and European regulatory networks (ERNs) (EC, 2018b) and scrutinised by the European Parliament and Council of Ministers. It is bolstered by analytical reports and detailed statistics, such as the Digital Economy and Society Index (DESI), to monitor the comparative performance of member states and competitor nations (see Figure 1). For example, the EC has identified gaps and mismatches in skills, with around 40 per cent of the EU workforce needing to improve their digital skills, and 70

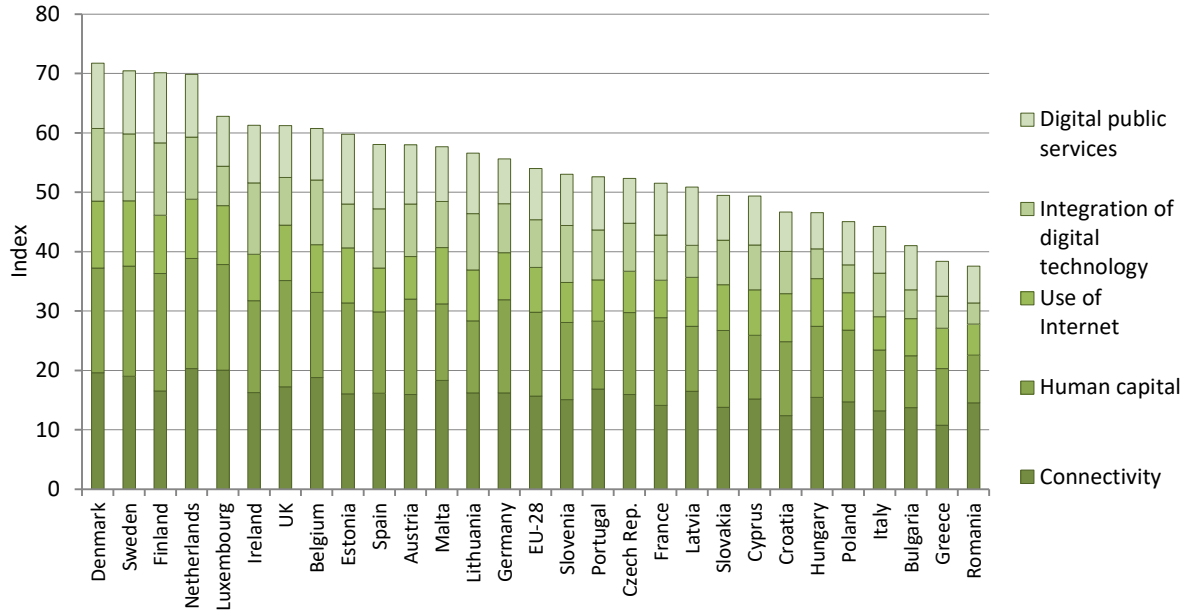
[1] The obvious exception is the poisonous debate on net neutrality, which the FCC regulated, then de-regulated (FCC, 2018), reversal of the latter decision was considered by the US Congress.
[2] Increasing efforts are being made to use drones to make local delivery more efficient.
[3] The United Kingdom leaves the EU at the end of March 2019.

million citizens lacking basic literacy and numeracy. Since citizens need to trust businesses and governments before they adopt and use digital services, there have been actions on cybersecurity and the General Data Protection Regulation (GDPR) (see below).[4]

Table 1 **Recent European Commission communications on the Digital Single Market**

Title	*Reference*
A Digital Single Market Strategy for Europe	COM(2015) 192
Standard essential patents providing a clearer framework to incentivize the development of key technologies	COM(2017) 712
Towards a common European data space	COM(2018) 232
Tackling online disinformation: a European approach	COM(2018) 236
Completing a trusted Digital Single Market for all	COM(2018) 320

Figure 1 **EU member states Digital Economy and Society Index scores (EC, 2018c)**



The OECD (2016) also identified the central challenge of skills, finding an insufficiency of supply and calling for the retraining of individuals whose present skills were no longer needed. It identified subsidies to help individuals acquire technology skills as a powerful tool to stimulate growth in total factor productivity (TFP) (Stokey, 2018).

There is are risks of widening the digital divides between developed and emerging economies, and within emerging economies between cities and rural areas, and between the well and the poorly educated (Dahlman, Mealy, & Wermelinger, 2016). In Africa, where labour is plentiful and often unemployed or underemployed, ICT and managerial skills are in very short supply, because of systemic failings in national education systems. These skills shortages make the attraction of foreign direct investment (FDI) more difficult and constrain governments seeking to improve cybersecurity, data protection and digital government. Even in South Africa, with its sophisticated economy and universities, there has been long-standing recognition of an ICT skills shortage that has yet to be reduced (Schofield, 2016; 2017).

[4] Directive (EU) 2016/1148 concerning measures for a common high level of security of network and information systems across the Union.

The offshoring of activities, such as manufacturing and call centres, was driven by cost reductions, enabled and supported by innovations in logistics and ICTs. Reshoring, bringing these activities back home, has invariably changed or transformed the processes, products and services, rather than merely requiring yet more cost savings. This is the result of balancing strategy, operations, and markets, with trends in outsourcing, offshoring, and reshoring illustrating fashions and fluctuations in corporate strategy, as executives respond to competition as well as to advice from consultants, plus the temptation to emulate competitors (Vanchan, Mulhall, & Bryson, 2018). The adoption of 3D-printing, artificial intelligence (AI), big data and robotics is enabling reshoring, using automation to contain higher labour costs, but also permitting reinvention of goods and the manufacture of new kinds of, often customised, goods (Vecchi, 2017). These changes in the value chain emphasise the move away from assembly and production, to design, development and after-sales services, with significant consequences for the number and type of jobs and skills. This means that the competitiveness of industry depends directly on ICTs and related skills, with those countries seeking to develop through industrialisation and offshoring potentially too late, with work being automated or transformed to move it closer to the end customers.

Automation is forecast to accelerate the changes in workforce skill requirements seen over the past 15 years (Bughin, et al., 2018):

- Strongest demand will be for technological skills, both basic and advanced, with a decline in demand for physical and manual skills, including general equipment operation, though still likely to be the largest category of workforce skills in 2030 in many countries;
- Companies need continuous learning for workers and to shift to greater used of cross-functional and team-based work, while changing tasks require jobs to be redefined. Executive teams will need to boost their knowledge if they are to succeed with automation and artificial intelligence;
- Competition for highly skilled workers will increase, while job displacement will be concentrated mainly on lower skilled workers, potentially increasing income inequality and reducing middle-range wage jobs, requiring combined efforts to manage extensive retraining and other transitions; and
- Governments will need to strengthen safeguards for workers in transition and encourage mobility.

Taxation has become an important issue, because of the growth of cross-border e-commerce, with concern that firms such as Alphabet and Amazon accrue their profits in ways that avoid paying tax in many countries and greatly reduce the total tax they pay (EC, 2018a). The US Supreme Court recently overturned a previous decision blocking the requirement for out-of-state retailers, including e-commerce suppliers, to pay local taxes, the effects include raising tax revenues for states and increasing the complexities for larger on-line retailers (Fiegerman & DePillis, 2018; South Dakota v. Wayfair, Inc., 2018). Australia has removed the exemption for foreign e-commerce on paying its 10 per cent General Sales Tax (GST) for purchases under AUD 1,000 (Frank J. , 2018), with a further AUD 7 per parcel levy being considered for screening (Horn, 2018).

The economic and social advances made using digital technologies are threatened by poor cybersecurity, with systems increasingly vulnerable to attacks from hackers, foreign powers and terrorists. Countries have very different levels of preparedness for such attacks and, even as the threats increase in sophistication and volume, few have the capacity to resist (ASPI, 2017). The adoption of cybersecurity strategies requires a whole-of-government approach, encompassing all levels and work outsourced to private firms, plus outreach to citizens, firms and voluntary organisations (Sutherland, 2018). Development and implementation of these strategies requires greatly increased supplies of skills, which depend on boosting education in science, technology, engineering and mathematics (STEM),

to feed into specialist courses in colleges and universities. It also requires an expanded supply of continuing professional development (CPD) courses for managers and board directors, plus civil servants, ministers, judges, prosecutors, and police officers.

Countries in Africa suffer both a significant digital divide compared to OECD countries and because of the markedly lower levels of digitalisation obtain fewer benefits. Manufacturing is generally a low proportion of GDP, with firms enduring and having to overcome poor infrastructure, including unreliable power supplies, railways, roads and telecommunications, all of which are in need of considerable investment. Digitalisation in manufacturing requires an enabling environment for skills, encouragement of innovation and the adoption of ICTs, digital accelerators and technology hubs, plus substantial funding (Banga & te Velde, 2017). A digital economy requires ICT infrastructure that many African countries still lack, and which are 'takers' of developments in policy, regulation, standards and technology, primarily originating in the most advanced economies.

The next section examines issues of economic growth, innovation and productivity. This is followed by an analysis of data protection agencies, laws and rights. The next section considers the approaches taken to the promotion of access to information and communication technologies. This is followed by an examination of competition and consolidation in the sector. Industrial automation and industrial revolution are then analysed. Finally, conclusions are drawn and issues identified for further research.

Economic growth, innovation and productivity

The 2008 global financial crisis caused a significant and sustained drop in national economies (Milesi-Ferretti & Tille, 2011; van Lelyveld & de Haas, 2014). However, ICTs outperformed other sectors in terms of net business population growth between 2009 and 2012 that involved relatively high shares of medium and high-growth firms.

The OECD (2014) has recognised the challenges in measuring the digital economy. For example, there was a very rapid rise of use of the Internet, especially amongst younger citizens, but with differences by age, gender and geography, creating a set of digital divides that have not been easily measured. It is made more complex by the pace of change in uses of the Internet that are difficult to track and to compare. A particular problem is to understand the reasons for those who prefer not to use new technologies, beyond those of limited income or lack of access to networks. These may require policy and regulatory interventions that are not amongst the traditional techno-economic responses of sector regulators.

There have long been analyses concerning the economic effects of the adoption of ICTs, sometimes struggling to find effects or to explains delays (Cardona, Kretschmer, & Strobel, 2013; Marsh, Rincon-Aznar, Vecchi, & Venturini, 2017; Niebel, 2018). The connection between mobile phones and economic growth has long been argued by the operators and their trade body, the GSM Association (Deloitte, 2012). They have lobbied governments for the assignment of more spectrum, and the reduction of licence and spectrum fees, based on claims it would boost economic growth by allowing the operators to expand more cheaply. However, their willingness to pass on any costs savings from these measures depends on competition, severely constrained by oligopolistic spectrum assignments and network effects, emphasised by the recent pattern of consolidation.

Economic transactions are increasingly dependent on computers, not least those involving mobile phones, enabling their transformation through new business models and new means of value creation (see Table 2) (Phelps, 2018). Firms with high levels of organizational capital (e.g., decision-making processes and management of people) and human capital (i.e., skilled labour) are likely to see the largest productivity benefits from investments in digital technologies (Bouwman, Nikou, Molina-Castillo, & de Reuver, 2018). One major change in

Africa, using the only widely available infrastructure, mobile phone networks, has been the introduction of banking and financial transactions, starting in Somali and diffusing outwards, being taken up by both banks and mobile operators.

Table 2 Digital transformation of economic activities (Varian, 2016)

Data collection and analysis	Firms can collect large quantities of information about personal preferences that can be used to predict customer behaviours and improve service delivery.
Personalization and customization	Firms are able to customise products and services. Customers demand streamlined experiences and expect merchants to possess information about their purchase history, billing preferences, shipping addresses and the like.
Experimentation and continuous development	Firms can exploit large data sets and powerful prediction algorithms to automate systems and inform decisions on production and resource allocation.
Innovations in contracting	Firms and consumers can monitor and verify the performance of others with whom they are conducting transactions, facilitating new types of economic transactions (e.g., ridesharing, e-money, distributed ledgers).
Coordination and communication	Communication tools (e.g., document-sharing software, video conferencing, wireless devices) allow people and 'things' to interact with increased flexibility, regardless of location. Firms can more easily serve a global market.

France has a long tradition of state-ownership and direction of its economy, with *étatisme* applied to ICTs or *informatique*, through state-owned enterprises (SOEs) such as Groupe Bull and Alcatel, and the identification of *technopoles* as centres for the growth of specific technologies (Minard, 2014; Cacaly, Le Coadic, & Cacaly, 2007).[5] Analyses of the likely economic and societal effects of ICTs and necessary actions by government were identified by Nora and Minc (1978). Today, President Macron, a former digital minister, has emphasised innovation and start-ups (Tiersky, 2018), in contradistinction to historic policies that favoured large enterprises, encouraging domestic and African start-ups in France (Adegoke, 2018).[6] He has set out to replace complacency with ambition, to reclaim economic dynamism and national purpose. For example, Macron commissioned a report on artificial intelligence (Villani, et al., 2018), and has undertaken to spend €1.5 billion (ZAR 24 billion) over five years, identifying possible disruptive advances in business and the need to consider the ethics of its use (Wired, 2018). Macron has also sought to ensure that all citizens are engaged with the Internet and through *Action publique 2022* to create a government for a digital age (COEPIA, 2018). This requires overcoming structural obstacles for some 20 per cent of the population, some 10 million people, with *l'illectronisme*.[7]

Economic history describes three industrial revolutions since the eighteenth century (see Table 3), though these are contentious, in particular with disputes over the significance in the second revolution of electricity and Fordism. Partly to drive economic change, but also as a way of trying to understand it, there has been discussion of a fourth industrial revolution (4IR), based on digitalization (Schwab, 2017). It is much too early to judge whether it is truly a revolution, not least given the difficulties in assessing its effects on long-run economic growth and productivity (D'Souza & Williams, 2017). An alternative characterisation is as a second machine age, in which cognitive and knowledge-based tasks are being automated and cheaply produced at great scale (Brynjolfsson & McAfee, 2014). Past experience suggests that efficiency gains from general purpose technologies (GPTs) (e.g., steam engine and electricity) are not immediate (Bresnahan & Trajtenberg, 1995; Helpman & Trajtenberg, 1996; Rousseau, 2010). There must be a deployment phase, after which the technologies are widely used and become fully enmeshed within firms and in their relationships with customers and suppliers. Schumpeter (1947) described the process of

[5] The policy was first adopted in the 17th century by Jean-Baptiste Colbert.
[6] Il devient en 2014 ministre de l'Économie, de l'Industrie et du Numérique.
[7] This roughly translates as lacking digital literacy.

'creative destruction', with initially slow economic growth, in part because of its structural displacement of labour.

Table 3 Industrial revolutions

	Period	*Major features*
First industrial revolution	1760 to 1850	Originating in the United Kingdom, shifting from rural-agrarian to urban-mechanized systems of production. Key technological advances arose from the application of steam power, including cotton spinning, steamships, and railways, and the transition from wood to metal for construction.
Second industrial revolution	1870 to 1970	Led by the United States, shifting to mass production, distribution and communication. Key advances arose from the application of electricity for motors, lighting and communications, urban water and sewage systems, the internal combustion engine for ground and air transport, highways, plastics, air conditioning, high-rise buildings (n.b. lifts), antibiotics and reduction of infant mortality.
Third industrial revolution	began in 1960s	Centred on ICTs and led by the United States. Significant advances in computing and networks, accompanied by steep price declines and rapid quality improvements in hardware and software. Key innovations have been in semiconductors, personalisation of computers, email, faxes, photocopying, electronic documents, the Internet, e-commerce, bar-code scanning, automatic teller machines (ATMs), automatic credit scoring and mobile telecommunications

Growth in labour productivity, or GDP per unit of hours worked, is defined as the weighted sum of:

(i) Capital deepening: growth in capital input per hour;
(ii) Labour quality improvements: increases in the productivity of each unit of labour, a function of the age and skill levels of the workforce; and
(iii) Multi-factor productivity (MFP) growth: output growth that is unexplained by (i) and (ii).

Firms investing in digital technologies can expect higher productivity, because they are providing tools to enable more efficient work, making the production process more capital intensive. The continuing fall of prices for digital technologies encourages firms to modernize their equipment, so that they can achieve cost efficiencies and enhanced capabilities.

Developed economies are presently seeing a systematic decline in shopping in physical stores, with a rapid, if uneven, shift to online shopping aided by delivery services, with the loss of jobs and closure of stores in high streets and malls. The remaining stores are being automated, reducing staff levels, with initial efforts at the elimination of check-out workers (Dastin & Nellis, 2018). Retailing is increasingly dominated by apps and social media on mobile devices and 'influencers', plus the use of voice assistants, with expectation of the deployment of augmented reality (AR). For example, this is ending traditional annual fashion cycles, through very rapid development and distribution of designs (Bladow, 2018).[8] To support online retailing, and completion of the EU single market, the EC proposed significant reforms to enable cross-border purchases using e-commerce and to ensure the possibility of delivery of goods (EPRS, 2018).

The application of technologies in cities is attracting very large sums of investment (see Table 4).

[8] For example, the day after the marriage of the Duke and Duchess of Sussex, copies of the dress worn by the Duchess were available for purchase on the Internet.

Table 4 Leading urban technology sectors 2016-2018

Sector	*VC investment (USD billions)*	*Share of investment*	*Number of start-ups*	*Share of start-ups*
Mobility/ride-hailing	46.8	61.0%	258	19.2%
Food delivery	14.6	19.0%	410	30.6%
Co-living & co-working	6.4	8.3%	109	8.1%
Bikes and scooters	6.4	8.3%	102	7.6%
Smart cities	5.6	7.3%	154	11.5%
Real estate tech	3.2	4.2%	117	8.7%
Construction technology	2.5	3.2%	192	14.3%
Total	76.8	-	1342	-

Over several decades corporation have developed sophisticated global production networks (GPNs) or global value chains (GVCs), with raw materials being converted to finished goods after passing across several international borders. The recent policy changes by Donald Trump have challenged these arrangements, as he insists that manufacturing be located in the United States, even when US-based corporations have preferred to assemble and manufacture elsewhere. His transactional approach to international trade threatens the future of multilateral institutions and treaties, notably North American Free Trade Association (NAFTA) and the World Trade Organisation (WTO), the consequences of which are very difficult to predict. In the first instance, his trade war appears to be directed at steel, aluminium and automobiles, but his actions against Broadcom, China Mobile, Huawei, and ZTE, show how disruptive he can be in the telecommunications market.

The rapid pace of technological change means that economic analyses are necessarily running to catch up, often using longitudinal data for technologies that are or have been superseded. Some of the changes come from disruptive players engaged in regulatory arbitrage or regulatory evasion, which makes the collection of data more difficult. Bundles of technologies are sometimes presented as panaceas or game-changers, often based on remarkably little evidence. Nonetheless, governments, MNCs and venture capitalists continue to apply large sums of capital to hasten the advance of technology in the expectation of economic growth and financial returns.

Data protection

One of the most prominent global legal changes of 2018 has been implementation of the General Data Protection Regulation (EU) 2016/679, which together with Article 8 of the EU Charter of Fundamental Rights, gave EU citizens greater control over the data collected about them. The GDPR was built on the Data Protection Directive 95/46/EC and the work of the national data protection authorities individually and collectively, through the Article 29 Working Party (now the European Data Protection Board (EDPB)), together with the jurisprudence of the Court of Justice of the European Union (CJEU). The GDPR is both a political and a technocratic measure, reflecting the desire to ensure greater control for citizens over their privacy, built on decades of practical experience of regulating the use and misuse of data.

Data protection comes from a tradition of EU efforts to balance and constrain the adverse effects of technological changes being introduced to boost economic growth and productivity. It stands in stark contrast to the United States of America, which continues to rely on relatively old legislation and where the Federal Trade Commission (FTC) has only some responsibility as a data protection authority. Inevitably, the USA also relies on the courts, with civil litigation and class actions against firms abusing and misusing data they collected or permitted to be published or stolen. The US Congress has been lobbied heavily and politicians have received campaign contributions from firms engaged in systematic data collection and its sale, seeking to block further legislation. Firms have also lobbied the

United States Trade Representative (USTR) to have him press foreign governments not to restrict international data transfers, as this would interfere with their collection and sale of personal data. Data held on non-citizens is given little, if any, protection in the USA. The result has been that platform operators systematically hoover up all the data they can and sell it on for as much money as they can.

An additional 'right' emerged from a Spanish case brought before the CJEU. The Court found that the processing of data by search engines fell under the Data Protection Directive 95/46/EC, that the operator of the search engine was a data controller, and that the data were covered by the Charter of Fundamental Rights, both Article 7 on privacy and Article 8 on data protection. While the data found by searching the Internet might have been lawfully published, it might no longer be necessary in the light of the purposes for which they were collected or processed by the search engine:[9]

> As the data subject may, in the light of his fundamental rights under Articles 7 and 8 of the Charter, request that the information in question no longer be made available to the general public on account of its inclusion in such a list of results, those rights override, as a rule, not only the economic interest of the operator of the search engine but also the interest of the general public in having access to that information upon a search relating to the data subject's name. However, that would not be the case if it appeared, for particular reasons, such as the role played by the data subject in public life, that the interference with his fundamental rights is justified by the preponderant interest of the general public in having, on account of its inclusion in the list of results, access to the information in question. (Google Spain & Google Inc v AEPD & Costeja González, 2014)

Google created a mechanism for individuals to apply for the removal of data based on these principles, with the option for citizens of appealing to the national data protection authorities of the countries in which they are individual is resident. It became known as the right to be forgotten (RTBF). The idea that truthful information might no longer be relevant had been recognised in the concept of 'spent' criminal convictions. The GDPR strengthens the right to be forgotten through requiring the data controller to inform the controllers processing such personal data to erase any links to, or copies of those personal data. The right was included in the GDPR:

> Article 17 Right to erasure ('right to be forgotten')
>
> 1. The data subject shall have the right to obtain from the controller the erasure of personal data concerning him or her without undue delay and the controller shall have the obligation to erase personal data without undue delay where one of the following grounds applies:
>
> a) the personal data are no longer necessary in relation to the purposes for which they were collected or otherwise processed;
>
> b) the data subject withdraws consent on which the processing is based according to point (a) of Article 6(1), or point (a) of Article 9(2), and where there is no other legal ground for the processing;
>
> c) the data subject objects to the processing pursuant to Article 21(1) and there are no overriding legitimate grounds for the processing, or the data subject objects to the processing pursuant to Article 21(2);
>
> d) the personal data have been unlawfully processed;
>
> e) the personal data have to be erased for compliance with a legal obligation in Union or Member State law to which the controller is subject;

[9] He has requested the removal of a link to an article in *La Vanguardia* newspaper concerning his home on which had been foreclosed resulting in an auction, though he had subsequently paid off the debt.

f) the personal data have been collected in relation to the offer of information society services referred to in Article 8(1).

2. Where the controller has made the personal data public and is obliged pursuant to paragraph 1 to erase the personal data, the controller, taking account of available technology and the cost of implementation, shall take reasonable steps, including technical measures, to inform controllers which are processing the personal data that the data subject has requested the erasure by such controllers of any links to, or copy or replication of, those personal data.

3. Paragraphs 1 and 2 shall not apply to the extent that processing is necessary:

a) for exercising the right of freedom of expression and information;

b) for compliance with a legal obligation which requires processing by Union or Member State law to which the controller is subject or for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller;

c) for reasons of public interest in the area of public health in accordance with points (h) and (i) of Article 9(2) as well as Article 9(3);

d) for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) in so far as the right referred to in paragraph 1 is likely to render impossible or seriously impair the achievement of the objectives of that processing; or

e) for the establishment, exercise or defence of legal claims.

Removal of data must be weighed against the public interest.

The decision by the United Kingdom to leave the EU has required complex legislation to transpose into British law a large part of the EU *acquis*, including the GDPR as the Data Protection Act 2018.[10] However, the EU Withdrawal Bill does not transpose the EU Charter of Fundamental Rights, thus removing from those within the jurisdiction of the United Kingdom the right to data protection, though a right to privacy remains in the European Convention on Human Rights, through the Human Rights Act 1998.[11] The effect of Brexit will be to remove the right to be forgotten and to undo the judgement of the Court of Appeal in Watson v. Home Secretary, which limited surveillance by GCHQ. It must also put in serious doubt the proposed EU-UK security treaty, since the transfer of any intelligence material or surveillance data from the EU-27 to the United Kingdom would strip it of the limitations imposed by the CEJU in the Watson case. A group of cases objecting to the United Kingdom laws and practice of interception and surveillance are awaiting judgement before the ECtHR.

One of the contentious issues has been the proposed revision of the ePrivacy Directive 2002/58/EC (EC, 2017).[12] The main aims are to:

- Enhance security and communications confidentiality;
- Define clearer rules on tracking technologies such as cookies; and
- Achieve greater harmonisation amongst the Member States.

The Corporate Europe Observatory has repeatedly reported the efforts of network operators to influence the legislation, presently being scrutinised by the Council and Parliament (CEO, 2017; CEO, 2018). As the bulk of the lobbying appears to address the Council it is not subject to EU rules, only national rules, making it relatively opaque. Network operators are very keen to limit the revisions to keep legislation in line with the GDPR.

[10] http://www.legislation.gov.uk/ukpga/2018/12/contents/enacted
[11] http://www.legislation.gov.uk/ukpga/1998/42/contents
[12] http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2017/0003(COD)&l=en

The African Charter on Human and People's Rights omits the right to privacy and is unenforceable in an international court (OAU, 1981). In contrast to Europe, Africa has a very small number of data protection authorities, with very limited powers and doubtful effectiveness. While the African Union adopted a Convention on Cyber Security and Personal Data Protection it remains almost entirely unratified (AU, 2014). Governments have been lobbied my ISPs and operators to rely on multistakeholderism and on corporate social responsibility (CSR), despite these having been shown to be grossly inadequate elsewhere.

One of the problems has been the abject failure to convey to engineers and entrepreneurs the principles of data protection, with the result that business models for social networks and devices, including many of the 'things' that comprise the Internet of Things (IoT), have been wrongly designed. The view has been that all conceivable data should be generated and collected, without regard to ethics or laws, in order to provide the greatest scope for monetization, something that occurs long after deployment and adoption. Now, a rearguard action is being fought to contain dominant digital platforms that have been built on generating insights into the behaviours and views of individuals that are sold for profit. The scale of this threat is illustrated by the targeting of political adverts to very small groups of individuals in ways that potentially undermine democracy (ICO, 2018).

The GDPR, the right to be forgotten and limitations on state surveillance are the gold standard for data protection and privacy. The data protection authorities are at least as important as the legal texts, providing a mechanism to learn from practical experiences, boosting confidence for consumers using e-commerce and citizens using digital government, while feeding into future legislative reviews. Outside Europe a right to data protection would be unlikely to be enforceable, given the very limited application of the rule of law, whereas a data protection authority would be able to encourage good practice and record data breaches.

Promoting access to ICTs

Global markets for network equipment and for consumer devices have been regulated only insofar as consolidation has required merger control (e.g., the acquisition of Siemens COM Group and Alcatel-Lucent by Nokia), though subject to strong standardisation and standard essential patents (SEPs). Whereas, there has been detailed regulation of networks based on the promotion of competition through market entry, supported by a range of pro-competitive measures. However, recent trends towards consolidation amongst operators have ended the reality or plausible threat of new entrants raising the level of conventional competition. Competition has come from over the top (OTT) players, 'stealing' established revenue flows by offering what appears to be free text messaging and voice telephony, together with paid subscriptions to movie databases (e.g., Netflix). The OTT players are engaged in regulatory arbitrage, working outside legal frameworks, and often based in foreign jurisdictions. The challenge to regulators is to determine whether it is in the public interest to regulate such services, in particular with a view to ensuring sufficient revenues flow to operators to build the infrastructure needed to access services.

Competition and innovation in the supply of equipment continues to reduce prices, but devices remain unaffordable for many. The smartphone market has only a small number of very large manufacturers, heavily dependent on a yet smaller number of suppliers of microprocessors. Nonetheless, the rise of the smartphone has been very rapid, compared to historical trends (see Figure 2 and Figure 3). While fierce competition and economies of scale resulted in significant firms exiting (e.g., Ericsson, Nokia, and Siemens), though the Apple iPhone seems immune to price competition, able to maintain a very high margin over the value of its components. The iPhone and its walled garden of services exemplify the global

production network (GPN), stretching from design, through assembly, physical and online stores, together with analysis of the big data sets generated by customers.

Figure 2 **Trends in ICT ownership in Japan (MIC, 2017)**

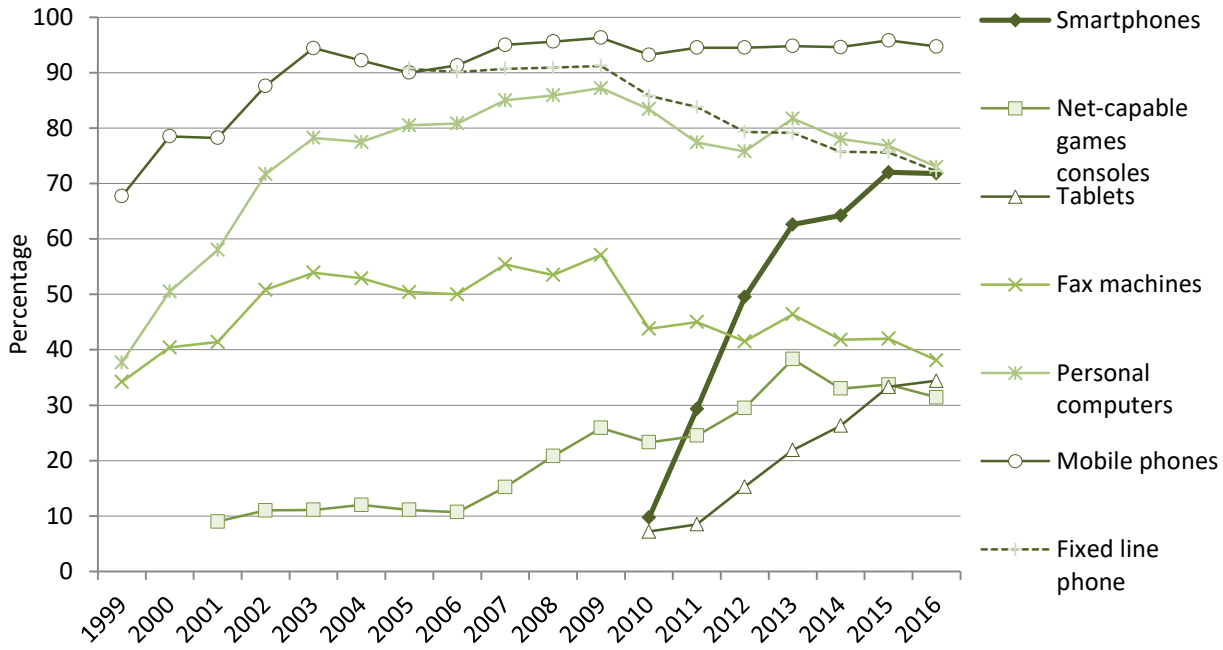
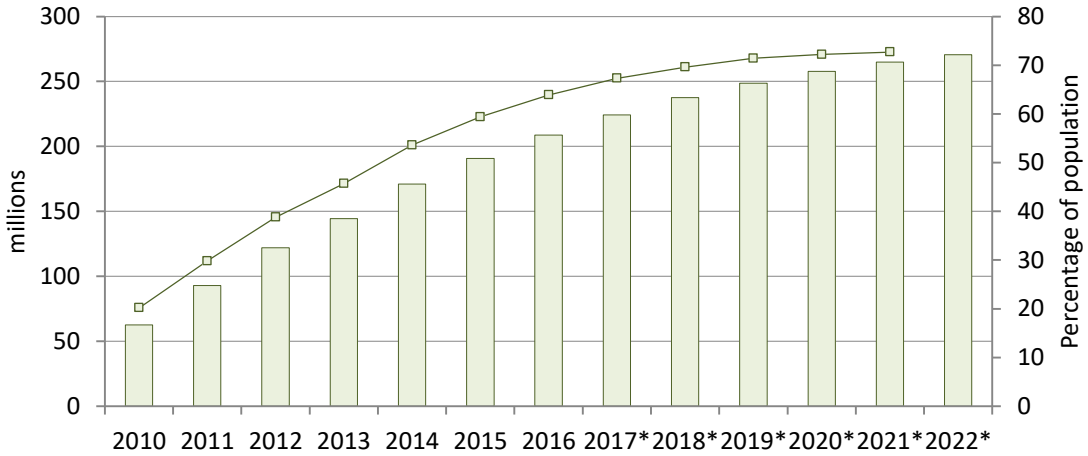
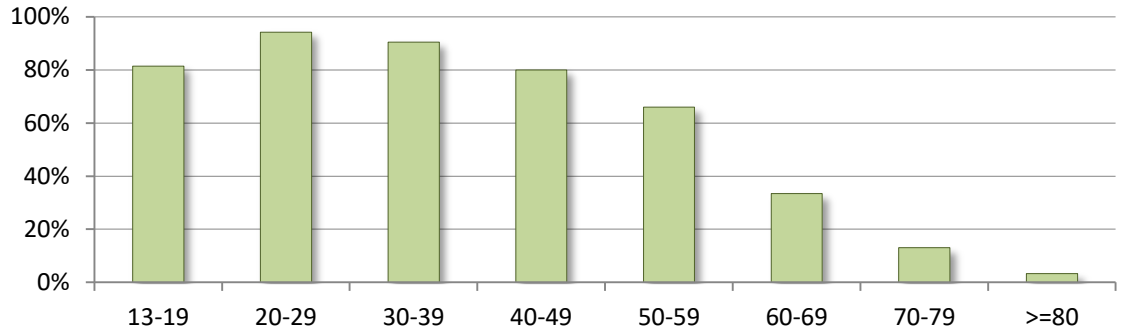


Figure 3 **Smartphone users in the United States of America (IIA, 2018)**



There are significant differences in the adoption and use of smartphones by gender, by socio-economic status, by disability and by age (see Figure 4). Each of these 'divides' can be addressed by public policy tools directed at operators, at retailers, and at specific groups of non-users. However, these require detailed analysis of the reasons for non-usage of the device or service and a cocktail of policy measures, often not in the area of conventional techno-economic measrures.

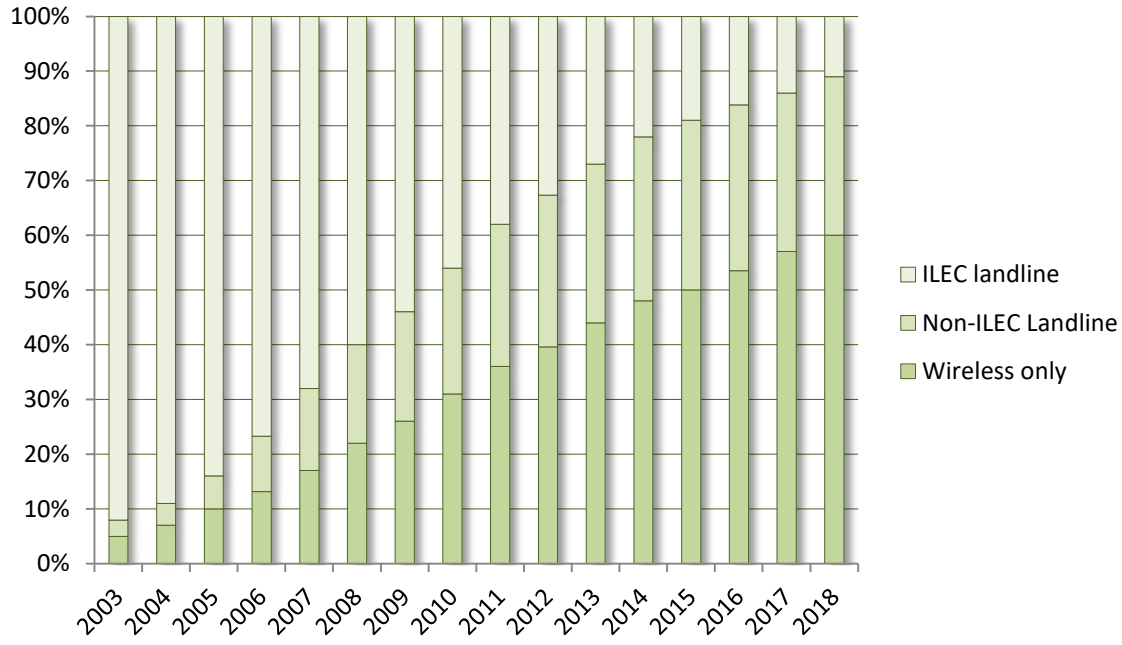
Figure 4 **Smartphone use by age range in Japan (MIC, 2017)**



With the adoption of smartphones reaching a plateau in leading countries, policymakers must address the need to intervene to reach those unable or unwilling to buy a smartphone and how they might do so. For example, they may want telehealth services for the elderly, a group that has been slow to adopt the smartphone, in part because of its novelty, but also because it is not easily used and may not be perceived to have relevant uses. There may be alternative ways to achieve policy goals.

Understanding use of mobile data services is difficult, given very diverse patterns of prices and use (tefficient, 2018). In the USA, CTIA (2018) reports mobile data traffic growth of forty times since 2010, with 273 million smartphones or 82% of the population,[13] though with variations by age and income. "One in five now rely only on their smartphone for home Internet access", having cut the cord (see Figure 5).

Figure 5 **Household voice penetration in the United States of America**



The push by manufacturers and operators for 5G mobile has resulted in lobbying of government and regulators to issue yet more spectrum in more bands. Given the absence of new entrants and a pattern of consolidation, it is very likely that the spectrum will be assigned to established operators and that they know this, greatly diminishing the value of auctions. Consequently, the emphasis by regulators has

[13] This assumes there are no customers with multiple subscriptions.

been on extracting commitments for improved coverage, rather than the large sums paid in previous auctions. The results are compromises, with entrenched operators being able to cut their costs through the use of additional spectrum from their existing masts and customers obtaining better coverage through the extension of networks in rural areas (see Table 5).

Table 5 Coverage commitments made in EU member states

Country	*Operators*	*Provision*
France	Bouygues, Orange, & SFR	Ubiquitous 4G access, better coverage of transportation routes, for every operator to cover 5,000 new locations (ARCEP, 2018)
Germany	Deutsche Telekom, Vodafone & Telefonica Deutschland	Raise coverage from 98 to 99% by 2020, upgrading 10,000 masts and building 1,000 more (Reuters, 2018)
United Kingdom	3, BT, O_2, & Vodafone	Proposing one coverage obligation of premises, of 60% of the 200,000 residential and business premises in rural areas not presently covered and two obligations to improve outdoor coverage requiring at least 92% of the total landmass (OFCOM, 2018).

In the European Union access to the Internet has been part of its universal service obligation, initially limited to dial-up (USO) (EC, 1997; 1998; 2002). A number of reviews excluded broadband, since the majority of consumers relied on dial-up (EC, 2006; 2008). Member states could require universal broadband, provided it was funded from general taxation, rather than having operators levy the money from customers, though even by 2011 only Finland, Malta and Spain had done so (EC, 2011). The legislative proposal, presently before the European Parliament and the EU Council,[14] adds broadband to the USO. A minimum speed is to be defined by a list of basic services that should be enabled, which will be amended to keep pace with developments, but presently includes banking, education and government (EC, 2016).[15] Whereas, expanding geographic coverage is expected to be addressed by means of coverage obligations in spectrum licences and public investment in conformity with state aid rules.[16] Additionally, there should be financial support from governments allowing operators to provide social tariffs for those with low incomes or special social needs (i.e., disabilities).

A decade or more ago, OECD countries adopted national strategies for broadband, encompassing many government departments and agencies. The aims were to accelerate deployment of fixed broadband, both wireline and wireless, in what were supposed to be boosts to national competitiveness, but through copying and emulation, ended in being strategic necessities. Nonetheless, they generally improved coordination between agencies, boost supply of broadband and increased demand, through a range of economic, social and technical measures, reaching far beyond the scope of the telecommunications regulator.

These were subsequently dwarfed by national cybersecurity strategies that required a whole-of-government approach, with the notable involvement of the intelligence services and the military. Such strategies are essential to secure the benefits being obtained from universal broadband and ICT access, since wider use of ICTs exposed citizens to significant threats of cybercrime and malware. Unless citizens are confident that the Internet is relatively safe they are unlikely to use digital government services or e-commerce.

Amongst the challenges for government has been the need to reformulate their policies and strategies to cope with technological and market changes, especially to improve the coordination between ministries and agencies, up to cybersecurity that requires everything

[14] http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2016/0288(COD)&l=en
[15] It will also remove the provision of legacy services: public payphones, comprehensive telephone directories and directory enquiry services.
[16] Subject to Article 117(1) TFEU.

to be coordinated. The historic approach of obtaining annual or quarterly data from operators has been superseded by the need for regular and specialised surveys to understand who has a technology and how they are using it, and why some people are not using it. The complexity and the pace of change require commensurate responses from ministries and agencies.

Consolidation has been a major issue, both within the telecommunications sector and efforts at 'convergence' with content providers, though the latter has seen several failures due to differences in business models and organisational cultures. The USA is, once again, seeing significant efforts at consolidation, with two notable cases being evaluated by merger control:

- AT&T and TimeWarner (US v. AT&T et al., 2018);[17] and
- Sprint and T-Mobile.

The USA has already seen substantial consolidation of operators, which had largely reversed the divestiture of AT&T, creating a small set of fixed and mobile operators (AT&T, Verizon), a couple of mobile-only operators (Sprint and T-Mobile), and one cable company (Comcast), plus a number of smaller competitors and rural operators.

In Africa, a number of operator groups have encountered difficulties. Etisalat overextended itself in Nigeria and withdrew, to be replaced by Dangote. Bharti withdrew from Kenya, selling to two local operators. The Lebanese firm Saudi Oger withdrew from South Africa, selling its controlling stake in Cell C to domestic interests. A pattern of increasing national control can be seen in many mobile phone markets, reflecting the need for operators to engage with politicians and regulators, skills that do not necessarily or easily transfer to other countries.

The most technically difficult issue concerns platform competition and the lack of contestability (McAfee & Brynjolfsson, 2017), since competition faces the large returns to scale and network externalities, potentially leading to natural monopolies where the winner-takes-all (Tirole, 2017). While monopolies are far from ideal, they deliver value to consumers as long as there is some prospect of competition, forcing them to innovate and even to drop their prices to maintain their large base of customers and to discourage rivals from trying to dislodge them. First, a rival must be able to enter the market and then to be able to well by creating value for consumers. Thus while Amazon was disruptive, because its Internet-based model delivered customer convenience, its sales in the USA are expected to be USD 258.22 billion this year, representing 49.1 per cent of all online retail spend and 5 per cent of all retail sales (Lunden, 2018). The *Bundesnetzagentur* wants to regulate the platforms as communications providers (CPI, 2018; Hardinghaus, Süss, & Fischl, 2018). However, Tirole argues against utility regulation of platforms, preferring "participative antitrust" in which corporations and other parties propose possible regulations and the competition authorities issue an opinion, creating some legal certainty, but without casting the rules in stone.

One exception is in undersea cables, which has historically been subject to periodic bouts of excessive exuberance by investors, when new cables were laid for which demand was uncertain or highly unlikely. Telegeography has reported that median monthly prices to lease capacity on critical routes declined by 26 per cent between 2016 and 2017, and by 30 per cent between 2014 to 2017 (Boudreau, 2018). These investments once excluded Africa, leading to an argument for regulatory interventions to provide open access. However, a surge in cable laying around Africa has removed that case (Song, 2017), leaving only the need to facilitate cable landing and interconnection, and to prepare for future bankruptcies.

The historic position of a ready supply of market entrants is long past, with consolidation the most common pattern, subject to the constraints of merger control. This limits the value

[17] The Department of Justice has lodged an appeal.

of pro-competitive market interventions and the sale of spectrum, given perfect knowledge of the buyers. At time same time highly technical challenges have arisen in the possible regulation of platforms that are highly popular, arguably economically beneficial, are dominant, but might well cease to be, as happened to IBM and Microsoft. The challenge is the extent to which we can believe that the platform behemoths might fall.

Industrial automation

The World Economic Forum (WEF) has trumpeted the Fourth Industrial Revolution (4IR) as the future (Schwab, 2017). Yet, this is not the result of careful historical analysis, rather it is a flag to rally those trying to create a particular future, hoping to drive economic disruption with a combination of technologies, driven by "extreme automation and extreme connectivity" (Baweja, Donovan, Haefele, Siddiqi, & Smiles, 2016), and some extreme lobbying by the manufacturers.

The European Commission has proposed strategies for advanced manufacturing with a view to increasing its contribution to GDP and employment in the EU, trying to recover some of the historic losses made to East Asia and the USA (EC, 2012; 2014). While 4IR, ICTs, and Industry 4.0 are potentially useful policy tools (see Table 6) to aid the competitiveness of industry, differential abilities to adopt them may increase the gap between the most successful companies and those less able to adapt, leading to an increase in territorial and social inequalities, requiring mitigation by the EU and its MSs (Veugelers, 2017).

Table 6 **National industrial automation strategies**[18]

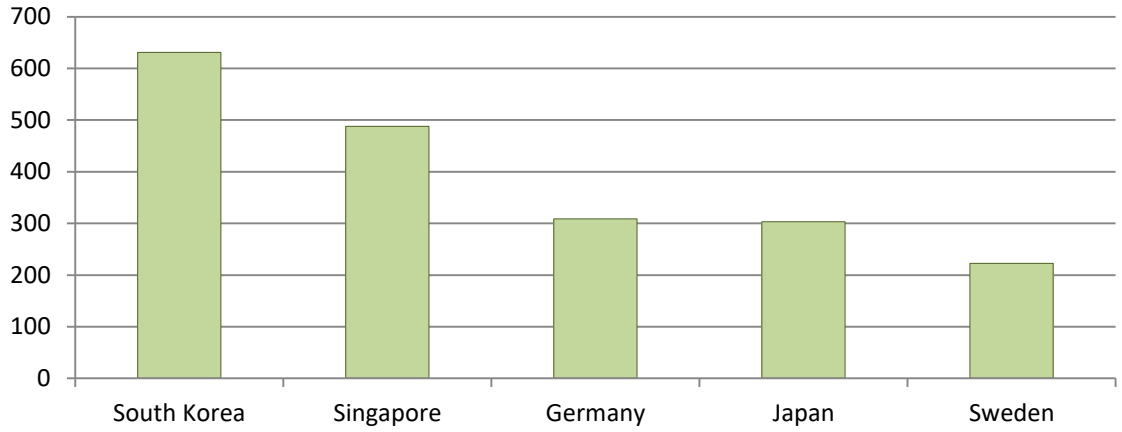
France	Industrie du futur[19]
Germany	Plattform Industrie 4.0[20]
Italy	Plano Industria 4.0[21]
Japan	Growth Strategy 2017[22] IoT Acceleration Consortium[23] General Framework for Secure IoT Systems[24]
United Kingdom	Digital Catapult[25] Industrial strategy[26]

Robots are central to automation, with their numbers growing at about 12 per cent per annum, though this is forecast to accelerate (see Figure 7). They are already used extensively in the automobile industry and are being introduced enthusiastically by the electronics industry. The leading nations are, in descending order:

1. China;
2. South Korea;
3. Japan;
4. United States; and
5. Germany.

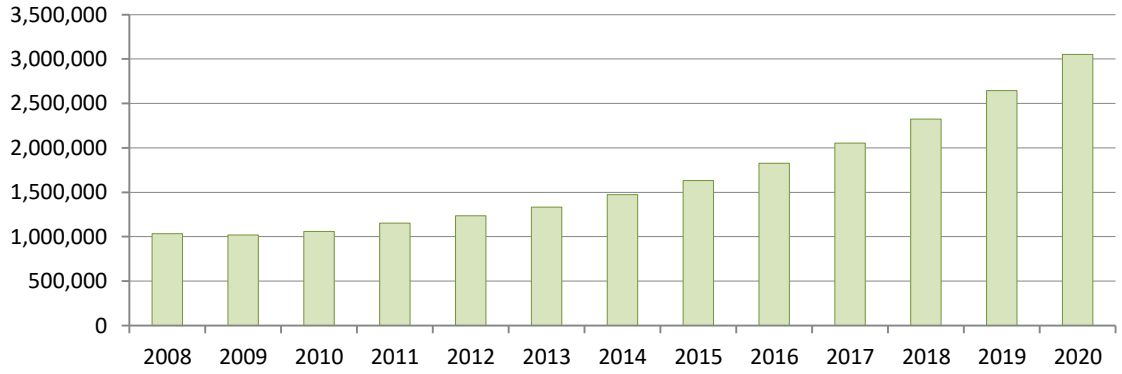
[18] https://ec.europa.eu/growth/tools-databases/dem/monitor/
[19] http://www.industrie-dufutur.org/
[20] https://www.plattform-i40.de/I40/Navigation/DE/Home/home.html
[21] https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Industria4.0_IT%20v2wm.pdf
[22] https://www.mofa.go.jp/files/000272312.pdf
[23] http://www.iotac.jp/en/
[24] http://www.nisc.go.jp/eng/pdf/iot_framework2016_eng.pdf
[25] https://www.digicatapult.org.uk/
[26] https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

Figure 6 **Robots per 10,000 workers in 2016 (Dalton, 2018)**



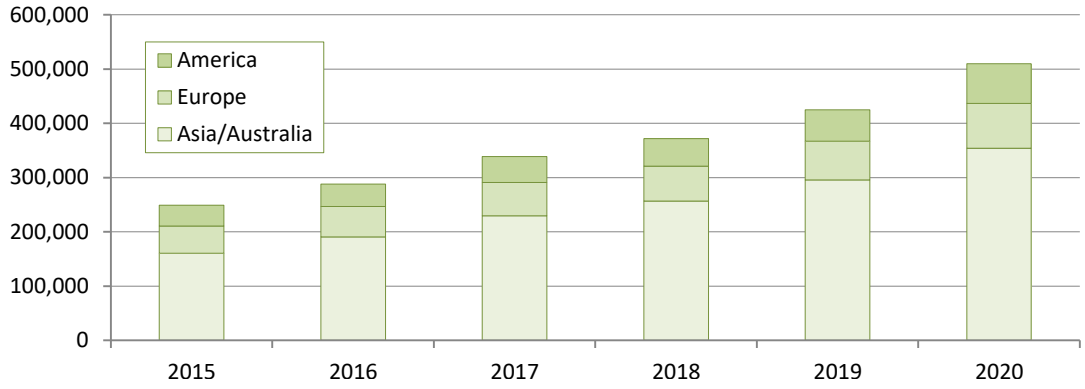
The supply of robots is increasing (see Figure 8). It is dominated by Asia, with China expected to supply 40 per cent of the global market by 2020, followed by South Korea and Japan.

Figure 7 **Estimated worldwide stock of robots (IFR, 2018)**



There are declining prices for components and improvements in vision, gripping and mobility of the robots. The addition of artificial intelligence is creating a market for collaborative robots, able to work alongside humans, rather than being caged in factories. Some workers are being given exoskeletons to improve their performance and to reduce the chances and costs of injuries (Dunietz, 2017; Borisoff, Khalili, Mortenson, & van der Loos, 2017; Zhang & Huang, 2018). Manufacturers also offer Robots as a Service (RaaS) and are using cloud robotics to improve their performance. Improvements are also being made to logistics, with the development of autonomous delivery robots (Scroxton, 2018; Olson, 2018) and drones or unmanned aerial vehicles (UAVs) (Marsh, 2015; McKinsey, 2017).

Figure 8 **Estimated and forecast worldwide supply of industrial robots (IFR, 2017)**



Robots are assigned some tasks formerly performed by workers, which in aggregate destroys jobs, though it creates jobs in robot-using firms through increased sales due to improved productivity and in upstream firms designing and constructing robots. The OECD suggests that automation is unlikely to destroy large numbers of jobs, finding only 9 per cent of jobs to be automatable, though ranging from 6 per cent in South Korea to 12 per cent in Austria, with less well qualified workers bearing the brunt of the losses (Arntz, Gregory, & Zierahn, 2016). In the USA, between 1990 and 2007 one additional industrial robot per thousand workers in a local area reduced the employment to population ratio by 0.18-0.34 percentage points and wages by 0.25-0.50 per cent (Acemoglu & Restrepo, 2017). A similar analysis for leading EU MSs found a smaller effect, probably due to the greater difficulty in dismissing workers and more active labour market policies, reducing the likelihood that those displaced would fall into long-term unemployment (Chicchio, Petropoulos, & Pichler, 2018). The adverse effects appear to have been greatest for the youngest cohort, with firms creating fewer vacancies while redeploying existing workers to different tasks, though with increased job losses amongst those without college or university education.

Workers in larger cities appear to have skills that better prepare them to work with automation, whereas smaller cities have relied on workers performing physical tasks, which are more susceptible to automation (Frank, Sun, Cebrian, Youn, & Rahwan, 2018). Thus smaller cities will need to invest in potentially expensive programmes to retrain workers, adapting and enhancing their existing skills to match the demands of firms deploying automation. Some cities may mitigate job losses by investing in and encouraging investment in new industries, though this requires expensive research and capital.

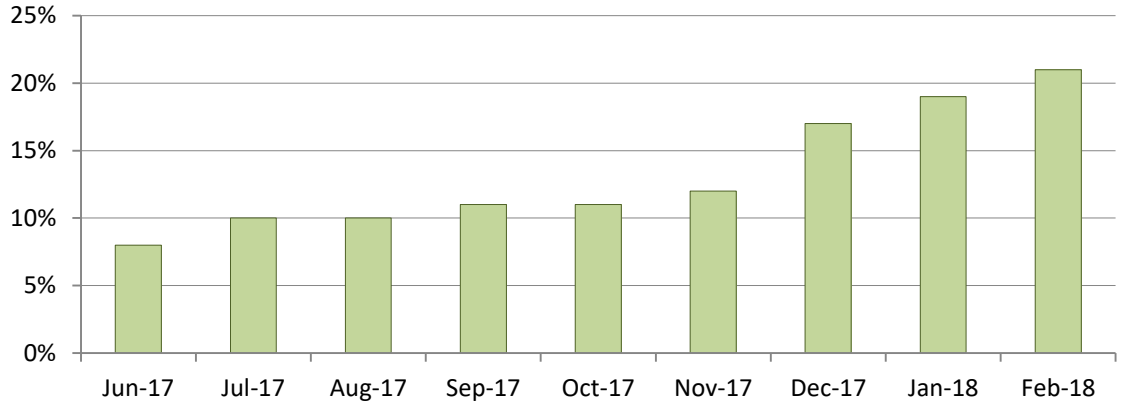
Domestic robots are emerging not in the humaniform of science fiction (Asimov, 1952), but as vacuum cleaners (e.g., iRobot Roomba and Samsung PowerBot), lawnmowers (e.g., Robomow RS635 and Honda Miimo),[27] and pets (e.g., the re-launched Sony Aibo).[28] In addition to their use in medical surgery, there are robot carers and exoskeletons for those requiring physical rehabilitation – all subject to the procedures for device approval (Ziefle & Valdez, 2017; Ackerman, 2018; Goher, Mansouri, & Fadlallah, 2017). There are also concierges or personal assistants, software that acts as an intelligent or voice-activated gateway to the Internet and online devices (see Table 7), with evidence of rapid adoption (see Figure 9). However, voice-activated systems have proved susceptible to attacks using inaudible commands and have been found to record conversations, with litigation underway to determine if data collected by a personal assistant can be produced as evidence in court (Moorthy & Vu, 2015). A highly controversial application lies in sexual robotics (Owsianik, 2017; Sharkey, van Wynsberghe, Robbins, & Hancock, 2017).

[27] There is an early stage robot for weeding gardens. https://www.kickstarter.com/projects/rorymackean/tertill-the-solar-powered-weeding-robot-for-home-g
[28] https://aibo.sony.jp/en/

Table 7 **Automated personal assistants and concierges**[29]

Vendor	*Brand*	*Functions*
Amazon	Alexa	
Apple	Siri	
Baidu	Duer	
Google	Assistant	
Microsoft	Cortana	
Samsung	Bixby & Viv	
Tencent	Xiaowei	
Tronton	Cluzee	

Figure 9 **Smart speaker penetration of Wi-Fi enabled homes in the USA (Engleson, 2018)**



Mining has always been a dangerous occupation, despite efforts to reduce the risks in more advanced economies. Automation is reducing the number of workers required in dangerous enviroments, while increasing efficiency and productivity (Simonite, 2016; Hermanus, 2017). Firms such as BHP Billiton and Rio Tinto are removing human operators from:

- Bulldozers;
- Diggers;
- Trains; and
- Trucks.

Robots allow firms to reduce their operating costs, increase their efficiency, and access ores in deeper rocks and on the seabed.[30] The effect is to reduce demand for unskilled labour and to increase demand for better educated workers (e.g., with advanced degrees). Countries that have relied on mining need comprehensive strategies that address the full value chain, from the supply of equipment through to finished products. In many African countries there is only artisanal and small scale mining (ASM), for which it is impossible to introduce advanced technologies, because of lack of capital and insecurity.

It has become more difficult for economies to sustain high levels of manufacturing output and employment, while simultaneously increasing wages and living standards. The internationalization of supply chains and increased competition have made the location of manufacturing more sensitive to wage levels. Technological changes have put downward pressure on demand for low-skilled workers. Consequently, it is unclear that the rapid manufacturing-driven growth experienced by Hong Kong, Singapore, South Korea, and Taiwan can be replicated today. Yet no country has yet reached middle- or high-income status by jumping directly to services, they have all first achieved substantial manufacturing employment. For developing countries manufacturing has been seen as a way to boost

[29] A more complete list is available at https://en.wikipedia.org/wiki/Virtual_assistant
[30] NASA (2018) sponsors an annual robotic mining competition to find technologies suitable for missions to Mars.

economic growth, to help the move towards middle-income and high-income status, but for individual citizens the primary interest has been the prospect of employment (Felipe, Mehta, & Rhee, 2014). Developing countries have traditionally seen their abundance of low-skilled labour as an advantage, but it could easily become a liability.

The fourth industrial revolution will not run to the plan set out by Schwab (2017), predictions of that sort never do, though it provides a 'straw man'. As MNCs adopt yet more advanced manufacturing technologies, governments need to address a range of policies to secure their positions, their national competitiveness and the contribution of manufacturing to their economies. They must ensure a sufficient supply of skills, through basic and higher education, and CPD, while retraining workers and managers displaced by automation, including support for relocation. Attracting FDI now requires a workforce with greater skills and flexibility, in addition to markets without barriers to trade. Among its effects, 4IR will further reduce the demand for low-skilled workers, while an increasing range of middle-skilled jobs are expected to be vulnerable to, at least, partial automation, with consequential risks of increasing income inequality. Managed poorly, automation could create a 'paradox of plenty', a richer society, but with heightened inequalities between individuals and communities. The 4IR proponents argue the gains are likely to be recirculated at the national level, with jobs reallocated rather than eliminated, with economic output increased, and the creation of new sources of wealth, but this requires considerable work by governments. At a lower level, regulating human-robot interactions requires considerable work, ensuring it is safe and secure.

Conclusions

Regulation of the economy comprises many distinct parts, including *ex post* competition policy and data protection, and *ex ante* sectoral models, each using some version of the regulatory state. These vary between countries and between sectors, reflecting historical developments, geographical diffusion, political objectives and views about the importance of consumer protection and economic growth. Leading countries engage in regular and sophisticated reviews of their various regulatory states, learning lessons about what has worked well and what can be improved, borrowing from other sectors and other countries. This is part of wider network governance in which they share experiences at ministerial and official levels through, for example, the OECD, G7, G20, APEC and EU.[31]

The importance of good governance is illustrated by the development of data protection in the EU, with its continuous examination of the issues and efforts to learn from the experiences of the national authorities, actively pursued by the European Commission and European Parliament, aided by European regulatory networks. The creation of the right to data protection and the 'right' to be forgotten, the revision of the legislative framework and the testing of the limits of state surveillance in the Court of Justice of the European Union show that progress has been made and that mechanisms exist to modify governance to face novel problems. The supervisory authorities serve vital roles in gathering data about data breaches and violations, and in providing analyses for governments and parliaments, aiding them in their drafting and scrutiny of draft laws and in post-legislative scrutiny. Similarly, in the telecommunications sector, national regulatory authorities have produced analyses of their markets, identifying developments, patterns and problems, while Eurostat and the OECD have provided comparable longitudinal data, increasingly using open formats. Open data on telecommunications in Africa remains limited (Song, 2017).

Parliaments need to work hard to ensure they are able to evaluate issues that involve complex economic, ethical and legal issues. They need high levels of skill in the analysis of

[31] See, for example, documents from the G7 ICT ministers meeting at http://www.soumu.go.jp/joho_kokusai/g7ict/english/index.html

policies, in drawing on the reports of the various agencies and the inputs from independent experts. They must also be able to scrutinise ministers and agencies in the work they perform, despite its complexities. Additionally, parliaments must make progress in the digitalisation of their own work, in being able to present themselves and their work to twentieth-first century electors using digital media and social networks. All of which must have robust cybersecurity.

In contrast to the *ex post* analyses of data misuses and markets, there are fears and hopes for new technologies, notably fourth industrial revolution (4IR), 5G, artificial intelligence (AI) and robotics, with speculation running far ahead of the limited data. The great wave of enthusiasm for 5G mobile may yet prove to be froth and hype, with the first talk of 6G. 4IR is similarly subject to overenthusiasm, but is neither standardised nor built into equipment that operators are obliged to deploy, being only a portmanteau for management and technological approaches to AI, automation, and big data that can be and will be combined in different ways as elements prove their usefulness or are superseded. Despite the absence of a business case 5G has been used by operators as a flag to lobby governments and regulators to release yet more spectrum. Yet the spectrum goes to a handful of operators whose behaviour is well-known, that are not especially competitive and pursuing consolidation, seeking to exclude alternative players. Policymakers have stepped back allowing spectrum to be used for any generation of mobile, while recognising the need to protect consumers in the shutdown of 'obsolete' generations (e.g., GSM). Deployment of 4IR requires little from government or regulatory authorities, but automation requires governments to boost training and retraining, to ensure a sufficiency of skills, as it must in cybersecurity.

The success of the European Union in establishing its leadership in data protection arises from complex governance processes that are not easily replicable elsewhere. Countries may wish to avoid the right to data protection in the belief that it hinders firms and thus economic growth. The right to protection from intrusions by the state is more fundamental, but one that is blocked or ignored by authoritarian regimes, of which there are an increasing number, the world having passed 'peak democracy'.

Further research is required to track the evolution of the technological portmanteaux of 4IR, AI and robotics, especially in identifying emerging policy and regulatory issues. The effects of the demand for skills and the effects on employment require further work. International and national network governance, the links between agencies and between governments require further analysis.

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