IPPR The Centre for Economic Justice

# CREATING A DIGITAL COMMONS

**James Meadway**

August 2020

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## ACKNOWLEDGEMENTS

The author would like to thank Peter Wells, Francesca Bria, Rowland Manthorpe and the staff at IPPR.

Funding for the this report was generously provided by Sir Trevor Chinn, Julian Richer and Martin Taylor.

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Meadway J (2020) *Creating a digital commons*, IPPR. http://www.ippr.org/research/publications/creating-a-digital-commons

# SUMMARY

We are in the early stages of the emergence of a new, digital economy, and the consequences of this are beginning to be felt across society. The collection, storage, analysis, and application of data will become the dominant feature of economic and social life within the next few years. This will include innovations like the growing capabilities of artificial intelligence (AI), based on data-intensive machine learning techniques, while the presence of 5G and the spread of cheap and ubiquitous sensors, potentially present in virtually any produced object, heralds a quantitative expansion in the sheer volume of digital information that can be processed, and a qualitative shift in how we live our lives as a result. Technologies from smart grids to autonomous vehicles become plausible realities in a world of ubiquitous data; but so, too, do the obvious possibilities of mass surveillance, the disappearance of meaningful privacy – and, from the point of view of building a just and democratic economy, the concentration of power and wealth in fewer and fewer hands. Already, we've seen a stark tendency towards the latter, with digital technologies reinforcing existing inequalities and disrupting economic structures – as indicated by the huge churn in the world's largest companies, from oil majors to data giants, in the decade since the crash.

The Covid-19 pandemic has accelerated these tendencies markedly. Cheap and simple methods to control infectious diseases, in the absence of a vaccine or a cure, have been known for centuries, but the appeal of data-based solutions to the problems of tracing and tracking contacts amongst those suspected of carrying the virus has been hard to resist for governments across the world. Contact-tracing apps have created new, and frequently more intrusive, techniques for mass surveillance and data-gathering, with mixed (at best) results.

The shift to homeworking, following the imposition of social distancing measures, has placed increased strains on existing infrastructure, and incentivised the development of new software for the monitoring of those working from home. Where a physical presence in the workplace is unavoidable, additional biological and health surveillance to check for the possible presence of Covid-19, and to enforce social distancing – as in the use, in Amazon warehouses, of infra-red tracking. Governments across the world have actively sought the assistance of data companies, from the tech giants to new AI start-ups, in the monitoring and processing of data – with the side-effect (intended or not) of reinforcing the tech giants' dominance. This expansion of the data economy and its greater presence in every part of our lives is likely to prove irreversible, whatever happens to the virus, a belief reflected in the soaring US stock market performance of Big Tech.

The underlying economics of data produce outcomes like these. Data, defined as information about the world that can be collected and analysed to extract meaning and generate value, has peculiar properties that make it quite distinct from the raw material (the 'new oil') it is sometimes described as. In the language of economics, it is 'non-rival' but also 'non-fungible'. Non-rival means that the same piece of data can be used over and over again, in multiple applications by multiple users, without damaging its fundamental value. The implication is that it can be repeatedly reproduced at minimum cost. But it is also non-fungible, in that any single piece of data cannot be replaced by another. One can of oil is much the same as another; but one data point about your weekly shopping is not the same as someone else's.

In combination, these two properties give rise to the distinctive economics of data: the value of any single data point can be minimal, but the fact that it is unique – and still contains meaning – means that in aggregate it can become immensely valuable. The underlying drive, then, is always to both aggregate as much data as can be found, so as to analyse and extract as much value as possible, while, in competitive conditions, also seeking to exclude others from accessing the same datasets. This sets the scene for the rise of Big Tech – post-industrial giants whose domination today owes much to their first-mover advantages in learning to accumulate and exploit as much data as they could faster than any rival. The attempts by all of them – assisted, increasingly, by states looking to gain strategic advantages – to move into the emerging field of machine learning is simply an extension of that existing dominance.

The need to regulate, manage, and perhaps control this emerging world has become a point of policy and political concern, as the possibilities – and the threats – become more apparent. There are three different approaches that public authorities might attempt to take to do this:

1. **competition as a manager**
2. **state imposition**
3. **creating a digital commons.**

The first is the familiar response from governments since the rise of the neoliberal paradigm for economic governance over the last four decades. It stresses the desirability of the market as a means to organise economic activity, and sees the role of government primarily as creating the best means for the market to operate. In the case of the data economy, it is an approach embodied in the UK government's *Unlocking Digital Competition* review, which laid out mechanisms by which a regulator could break open some of the monopolies (or near-monopolies) that had formed around data. Proposals by US senator Elizabeth Warren to break up Big Tech are of a similar – if more recognisably populist – kind.

These first two approaches have much to recommend them, operating, as they do, in the manner of the anti-trust legislation of an earlier period. Aside from the claimed economic advantages of imposing competition, there is the public policy issue; attempting to impose a form of market pluralism may well have beneficial wider consequences in reducing concentrations of power and easing the tendency towards a concentration of wealth. But the expectations it places on regulators acting genuinely in the public interest, while continually facing dynamic and very powerful market actors, are implausible. The risk of regulators becoming too close to those they are supposed to regulate, and responding to their demands first ('regulatory capture') is huge. Moreover, since the value of data is precisely in its aggregation, to reduce the extent to which aggregation can take place – as is implied in attempts to break up existing tech giants – genuinely creates risks for public value. And, to the extent that smaller, weaker tech companies are overwhelmed by larger competitors, it is not clear that simply breaking up existing tech in one part of the world doesn't clear the way for the emergence of a newer, faster, and more powerful alternative elsewhere. In a similar vein, proposals to radically 'privatise' data (insisting, for instance, that individuals receive payment for their data use) miss the fundamental point that, while personal data is immensely valuable for the individual, it is generally valueless for wider society until it is aggregated. Some collective solution is required.

Greater state control and direct intervention could achieve such collective solutions, but, again, these do not resolve the major difficulties. Both the French and UK governments have proposed unilateral 'digital services taxes'

(DSTs), which seek to claw back some of the value generated by the activities of Big Tech in their territories – the data giants being notoriously averse to paying taxes, and the existing tax system not being designed to cope with these new company structures. But this creates a different problem: while it may be desirable to tax these activities as a way to raise revenue, the activities themselves are potentially problematic. The structure of the data economy itself is at fault, not simply the fact that little of its activity is being taxed – and once governments have a source of revenue (assuming a DST ever takes shape), it has no incentive to lose it.

Some state control and management is clearly desirable; perhaps especially so in the case of the very large and potentially enormously valuable public databanks. For the UK, the ultimate prize for Big Tech is the NHS' data – perhaps the largest and longest-running set of longitudinal health data anywhere in the world. There are immense possibilities for using this data – to develop AI-assisted diagnostics, for example – but getting the balance right between allowing this use, and simply seeing the huge public value contained in these datasets exploited by Big Tech, is a concern for public intervention.

The final approach – creating a digital commons – is the one recommended here, and it is gaining increasing favour as the complexities of the data economy become more apparent. It requires a broader understanding of data as a public resource, but one of an exceptional kind: that there is space for market-based approaches, and for some direct state regulation, but that data will increasingly often require the creation of new forms of ownership and control, out of the hands of either market or state institutions. The recommendations we make are written with this in mind, and are focussed on how national government can play a stewardship role while allowing scope for democratic and innovative forms of ownership to function at a community, local, and regional level.

This report makes the following recommendations.

## FOR LOCAL GOVERNMENT

- **Local authorities, combined authorities and metro mayors should build consideration of the use of data for local public good into their procurement guidelines. Local licensing should include data use provisions as standard,** with cross-boundary working to achieve scale in negotiations as needed. Central government procurement guidance should include provisions for the local and public use of data in procurement contracts. Local development plans and local economic strategies should build in specific planning policies for the data economy, including requirements for developers to allow the public use of their data via planning obligations and section 106 agreements. Local authorities should look to include provisions for the fair access and use of data generated by licensees in the provisions of licences to operate.
- **Open data should be a standard at a local level.** Local governments should be seeking, where possible, to hold the data generated by their activities in an anonymised and open form as a matter of course. The new combined authorities, in particular, have the scale of operations needed to generate significant benefits for their constituents, as Transport for London has demonstrated.
- **Local authorities, either in partnership or individually, as well as combined authorities and metro mayors, should identify the key points for intervention in new digital infrastructure and, where appropriate, commit resources to ensuring infrastructure is under local and democratic control.** Where technologies like smart grids rely on the intensive generation and use

of data at a local level, the retention and effective management of new infrastructure will be essential for the public good.

### FOR THE UK GOVERNMENT

- **The creation of an Office of the Digital Commons.** This should include the functions of a conventional market regulator, including regulation the exiting provision of digital services through the platform utilities. But the office should also hold a broader remit to take a forward-looking approach to the future development of the digital commons. Any new regulator should be given a broad "stewardship" function over data and the data economy.
- **The government should move to establish a widely understood definition of a 'data trust', distinct from conventional trusts as defined under British law, and ensure that resources are made available to promote their creation and use.** This could be done under the aegis of the new Office for the Digital Commons, integrating data trust policy within its wider remit. **Future moves to extend the rights of citizens over their data should include the right to establish, with others, a data trust for the purposes of managing and regulating their data.**
- **The intellectual property regime around artificial intelligence research should be loosened** to remove barriers to intellectual progress and create a more public value-focussed approach to data-driven research. **Government should prioritise procurement from providers using open source, where this does not conflict with other objectives, and look to build open source principles into its own future data and software use.**
- **The government should commission a close study of open banking with a view to replicating its functioning in other data-intensive markets,** overseen by the new Office for the Digital Commons and building in specific provision for the creation of social value. The provisional lessons from open banking could potentially be usefully applied to other data-intensive parts of the economy where there is a need to break open potential monopolies on the use and exploitation of data.
- **Stewardship of the digital commons should extend to protection from unfair international exploitation.** 'Data sovereignty' is an emerging national issue. Where very large, very valuable datasets are created and held at the national level, there is a clear role for the state to play in protecting and conserving the value of them for the public good. This is a pressing issue for the UK as it leaves the EU and seeks to create new data transfer regulations as part of its negotiation of free trade agreements. It is vital that the public control and oversight of valuable UK-generated data is retained, and new restrictions on its cross-border transfer and use are needed.

As the world emerges from the first phase of the pandemic, the demands for a socially just and sustainable recovery have grown. The data economy can and should be an essential part of that reconstruction, from the efficient management of energy systems to providing greater flexibility in working time. However, without effective public policy, and democratic oversight and management, the danger is that the tendencies in the data economy that we have already seen towards monopoly and opacity – reinforced, so far, by the crisis – will continue to dominate. It is essential, then, that planning for a fairer, more sustainable economy in the future build in active public policy for data.

# INTRODUCTION

The salience of data as a political issue is rising rapidly, with the Cambridge Analytica scandal dragging some dubious practices into the public spotlight. But despite rising public concern over possible abuses, public attitudes have yet to settle on clear demands for policy, and policymakers themselves have tended to lag rather than lead industry developments. This paper builds on earlier work published to inform IPPR's Commission on Economic Justice in 2018, *The Digital Commonwealth: From private enclosure to public benefit*, which provided a starting point for consideration of the major issues presented by data and the digital economy, framed within the context of the commission's wider economic goals (Lawrence and Laybourn-Langton 2018). Given the pace of change in the digital economy, this paper seeks to both update our understanding and provide advanced warning of future developments, while setting out a plan for data and the digital economy that will secure prosperity and justice now and into the future.

There are, today, almost no parts of life that are untouched by the presence of data. Virtually every action we take produces some form of digital trail – our phones track our locations, our browsers track searches, our social network apps log our friends and family – even when we are only dimly aware of it. Transport for London maintain incredibly detailed information on the travelling patterns of Londoners, built up from 20 million daily 'taps' of an Oyster card or contactless payment (Weinstein 2016); retailers register our spending patterns via store cards. But it is the combination of this near-ubiquitous gathering of data with fast processing that has generated the economic and social transformation of the last few years – one that, if current developments in artificial intelligence (AI) continue, is only likely to accelerate. Combined with data-enabled technology, from the internet of things to 3D printing, we are potentially on the cusp of a radically different economy and society. This report focusses closely on data as the fundamental building block of the emerging economy, and argues that its use, management, ownership, and control as critical to shaping the future.

# 1.
# THE DATA ECONOMY TODAY

As defined in *The Digital Commonwealth*, data is: "information about the world that can be collected and analysed to extract meaning and generate value". What makes it unique in economic terms is something it shares with all knowledge: that, once generated, data is both *non-rival* but also *non-fungible* (Coyle 2019). Non-rival means that the same piece of data can be used multiple times, in multiple different applications, and the same data can be used simultaneously. Non-fungible means the inability for any one bit of data to be substituted for any other. Data can be copied easily, but it cannot be *substituted*: you can't swap a survey of the weights of apples for a survey of the weights of oranges. They are similar, but fundamentally different things. (Of course, you could combine the two in one big survey of the weights of fruit – but that would be an entirely new dataset.)

These two factors combine to make a unique economic prospect: that data can be simultaneously aggregated and replicated and applied many, many times over with no loss; but at the same time, insights gained from the data will be unique, and can only be found from applying analytics to specific data. Moreover, the more data is organised and compared with other datasets, the more value it can hold. Indeed, "individual data are of little or no value. Value emerges once data are compiled in large volumes and processed to provide insights and enable data-driven decisions" (UNCTAD 2019). The *economies of scale* in data are profound, and of a unique kind, relative to those in more conventional, material products. And as a peculiar detail, data is often hugely valuable to an individual user – as in a list of names and phone numbers of close friends – but close to valueless to society at large in isolation. It is only in the *aggregation* and then analysis of the data that society in general can claim any value. Because of this, proposals to pay individuals for their data (on the grounds that either they own it, or they 'work' to produce it) are wide of the mark, since the social value of any individual's data is essentially zero, or close to it; as a part of a dataset, a typical individual's personal data will be worth less than a penny (Steel 2013). Similarly, the use of metaphors referring to data as the 'new oil' or 'new water' or even 'new bacon' all fall short: the power and value of data lie in the possibility of its aggregation and combination, rather than being contained intrinsically.

> "In 2017, **90% of the world's data** had been created in the previous **two years**"

Once it became possible to collect and analyse data on a vast scale, the transformation of the economy was always going to be huge. The confluence of sensors and other means to input data becoming cheap and nearly ubiquitous, the price of connectivity and data storage dropping precipitously, and computers becoming fast enough to plausibly process massive datasets have delivered this. We have moved from a world of data scarcity to one of data abundance. Approximately 25 quintillion bytes of data are created every single day, and that volume is growing exponentially. To put that in perspective, the same IBM paper estimated, in 2017, that at least 90 per cent of the world's data had been created in the previous two years.[1] And, as we will see, this abundance is only likely to grow. Big Data is about to become much bigger.

But the peculiar economics of data have turned this abundance into a very distinctive economic outcome. The ability to claim property rights over data, and the ability of a legally-defined firm to do so, have led to the creation of vast, new types of enterprises commonly known as 'platforms' (Srnicek 2016). A platform is a business that acts as an intermediary between users, extracting value from their activities on the basis of the data generated. This value can monetised by various means: through selling advertising, targeted using data and analytics; through charging an access fee for a service; and, sometimes, through charging for exclusive use of hardware, as in the case of Apple. It is the capacity of digital platforms to aggregate, process, transmit, store, analyse, and make sense of data that allows them to generate value and act as the pillars of the digital economy.

The role of the major platforms today places them close to our more traditional conceptions of *infrastructure*: large socio-technical systems that provide a defined and essential public service. Google's search engine function, for example, is clearly very close to this ideal: were its search engine to fail, the economic costs would be hugely significant. Yet where once the provision of public infrastructure would be undertaken by public authorities – whether at local, regional or national level – the period since the 1970s has seen a global move towards a neoliberal model of governance in which essential infrastructure is provided through processes of (regulated) competition and, typically, private ownership. The platforms are far closer to this neoliberal ideal than traditional infrastructure, having grown and developed as private enterprises that then made themselves essential in one form or another. But, unlike more conventional private businesses, it is the qualities they share with infrastructure that create wider social and economic problems – and that have driven calls for similar regulation.

## BIG DATA AND THE PLATFORMS

As described in *The Digital Commonwealth*, the trends set in train by Big Data are presently working hard against the goal of a more socially just economy. The development of giant platform businesses over the last decade or so has been the decisive factor in the growth of a data economy more generally. Platform companies "take the form of 'multi-sided markets', where the platform functions as an intermediary between the provider of a service and its users", and presently some of the largest companies in the world, by market value, are of this form: Alphabet (Google's parent company), Facebook, Amazon, Apple, Microsoft and, outside US-centred internet, China's Alibaba and Tencent. Between them, these seven brands account for two-thirds of the value of the top 70 platforms (UNCTAD 2019). They now occupy the commanding heights not only of the digital realm, but also of the economy more generally. And, as data collection becomes ever more prevalent with databases and data analytics key to the platforms' success, that domination could easily be set to continue.

> **"Between them, just 7 brands account for two-thirds of the value of the top 70 platforms"**

The fundamental business model in each case is to act as an intermediary between different users: linking those selling books, for example, with those wishing to buy; or providing a search engine that will show preferred

1 Figure for 2017 cited in Royal Society (2017), p21.

advertisers' sites to those looking for specific items; or, in a variant on the theme, providing the hardware on which users can search for and download music; or matching those searching for taxi rides with available drivers. In each case, the platform is acting as the link between two different sets of end-users. Critical to the success of the platform business model is the speed and efficiency with which that matching can be performed, and it is this requirement that drives the platforms' hunger for data. With sufficiently large databases, fast computers, and increasingly sophisticated algorithms to process the data, the platforms can hope to steadily refine their offer to consumers. Doing so is immensely valuable: Alphabet generated $9 billion of profits in the first quarter of this year alone (Wong 2019). And the more data that is captured and analysed, the more potentially profitable a business can become, creating a massive incentive to grab as much data as possible.

But the economic impact of this business model is distinctive and poses a direct threat to any version of economic governance that stresses the primacy of price competition and market-induced efficiency. The justification for a laissez-faire approach to regulation and the belief in the efficiency of markets is well-known: in the absence of barriers to entry to a market, even the threat of additional competition from new entrants will be enough to enforce competitive discipline among firms already in the market. They will, as a result of this competition, be forced to cut costs for their output on existing product lines and innovate to create new products (or adapt old ones) that will allow them to capture new markets. In a completely ideal setting, excess profits for firms will be driven to zero and therefore 'consumer surplus' maximised simply through the automatic regulator of competition.

The decisive factor is the absence of barriers to entry (and, in principle, exit) for firms seeking to enter the market. But as soon as barriers exist, the discipline of competition will no longer strictly apply and the argument for self-regulation is undermined. With sufficiently high barriers, it evaporates entirely. Historically, barriers to entry have been linked to deliberate state or other coercive action. The state-backed monopoly rights the medieval guilds would claim over some forms of craft production enabled them to drive up payments to guild members. There are markets today where deliberate barriers to entry like defence production are maintained. But of more interest are the situations where barriers are created by the economics of the industry itself. Typically, these have appeared where the 'minimum efficient scale' required for production is larger than any single firm outside the market can usually obtain. In extreme cases, the minimum efficient scale could be so large as to produce a natural monopoly, in which only a single firm can realistically operate in the market.

For the digital economy, the specific form of these economies of scale typically emerges around the presence of 'network effects', or network externalities, in which the benefit to existing users of a network is increased for every new entrant to a network. The effect can be seen directly, as when Spotify offers more appropriate recommendations the more users it has, or indirectly, as when Google's map application Waze has a wider user database to build its optimal route suggestions from. These network effects create a very substantial barrier to entry for potential new firms relative to the incumbents; when a single network, like Facebook, has well over 2 billion users, the barriers to entry for competitors are clearly so large as to be insurmountable. This can be seen in the monopoly or near-monopoly market positions enjoyed by the platforms. Already, Facebook in the UK has 74 per cent of the social network market share, while Amazon accounts for 80 per cent of online book sales (BISC 2016). Google accounts for 88 per cent of the UK search engine market, far ahead of its nearest rival site (Statista 2019). Globally, Facebook and Google alone are set to earn $171.1 billion in advertising revenues in 2019, capturing 51 per cent of the total digital spend on advertising. In all these cases, the likelihood of competitive processes alone producing a significant rival is minimal. The digital economy has dramatic tendencies towards the creation of 'path dependency', in which whatever happens tomorrow in a market is critically dependent on whatever happens today – breaking the usual claim that markets allow for rapid shifts in economic outcomes.

Digital monopolies appear to be accelerating this rise in inequality by increasing economic rents (usually seen in the form of profits and returns on capital), and so contributing to a potentially declining share of national income being paid to labour in the form of wages and salaries. Research suggests that economic rents have increased as a share of national income over the last two decades, and that they are central to increasing inequality seen over the same period (Furman and Orszag 2015).

The result is an internet that, far from the initial optimism that the net would provide an open, innovative, and basically egalitarian new frontier for the economy and society, has increasingly come to not only reproduce the basic inequalities of our society, but to actively reinforce them (Zuboff 2019). Since the late 1970s, countries across the global North have seen sharp rises in inequalities of wealth and income. The causes of this have been variously attributed to technological change – including the 'hollowing out' of the labour market as technology destroys mid-level jobs, often in manufacturing – and to the emergence of a new form of governance, stressing loose, market-led regulation, private ownership, and, usually, minimal taxation on wealth.

Taken together, this style of governance is often known as 'neoliberalism'. The US and the UK are the two countries in the global North that embarked on it first and, arguably, have pursued it furthest. However, the rise in income and wealth inequality in the UK and the US has been significantly greater than that of other major developed countries like France or Japan (Frey and Osbourne 2015). So the presence of common technologies and globalisation alone are not enough to explain the increase: national policy makes a difference, too. Nor has the arrival of a platform-led digital economy significantly shifted this pattern. Indeed, there is a solid argument, given the economics of the data economy under the platforms, that they will be dramatically reinforcing existing inequalities.

## DYNAMICS OF PLATFORM MARKETS

But it is the *dynamic* impacts of these platform monopolies that should cause more concern. Driven by business models that intentionally seek to gather as much data as possible, platforms have a major incentive to leverage their existing market advantages into new markets. Data lends itself to this form of colonisation: the value of any data set increases markedly if it can be combined with any other, and the sheer scale of the platforms gives them the capacity to shift their business models elsewhere, either by organic growth, or through gobbling up smaller businesses. Alphabet "has acquired over 190 businesses and Facebook over 60 since their respective foundations" (Lawrence and Laybourn-Langton 2018).

These new markets can be far from the apparent original purposes of the platform. A dramatic recent example was the proposal by Facebook to launch Libra, a cryptocurrency based on the platform that is intended to reduce transactions costs for global payments (Statham et al 2020). Other platforms are making similar moves: Apple is extending Apple Pay into credit services, Amazon is offering loans, and so on. Google, a search engine, is researching self-driving cars. Amazon has expanded from selling books online into more general retail and cloud computing provision, to the point that the majority of its profits last year came from its cloud operations.[2] It is currently "on the brink of becoming one of America's largest defence contractors" thanks to a likely $10 billion Pentagon contract (Weinberger 2019). AI, and specifically the machine learning (ML) techniques based on big data analysis, are presently reinforcing these tendencies, as we cover shortly.

## THE PLATFORM LIFECYCLE

There are, however, some dynamics internal to the digital economy that potentially break path dependency and monopolisation. We are only a few years into the lifetime of the major platforms, and we have yet to see what a complete lifecycle for a platform company might look like. But there are signs that, where a company does not achieve the scale necessary to ward off competitor platforms, failure can be rapid. Given the anticipated expansion in scale of the data economy, as new technologies like 5G and the internet of things come into operation, the issue of achieving scale will remain pressing for all the existing platform companies.

MySpace is one possible future for the existing platforms. Launched in August 2003 as one of the first social network platforms, MySpace grew rapidly to become the most visited website in the world by June 2006. Its 100 millionth user was added shortly afterwards, and the entire company was purchased by News International for $580 million in July 2005, a record at the time. By late 2007, MySpace was valued at $12 billion.

However, less than a year later, Facebook overtook the site in terms of unique visitors, and MySpace suffered a rapid decline. User numbers fell precipitously, and the company began laying off staff, losing almost half of its payroll in early 2011 (Rao 2011). News International unceremoniously sold the site to an advertising company in June 2011 for just $35 million. Various reasons for the sudden shift in MySpace's fortunes have been offered, of varying degrees of persuasiveness: MySpace attempted to develop all of its functionality in-house, while Facebook allowed designers to build applications, widening its appeal; MySpace was slow to respond to the problems of spam, phishing, and inappropriate content that became to be seen as endemic to the site; and, perhaps most convincingly, MySpace's 'sandbox' approach to user page design – letting users go wild with text, graphics, and video content on their personal pages – offered fewer opportunities for advertisers to monetise their data compared to Facebook's rigid design specification. Because users had more freedom to do what they wanted with their pages, it was simply harder to reliably process their data (Gaehl 2012). Without sufficient advertising revenue, and with integration into Fox's other entertainment output proving elusive, the site was always going to lose out.

Whatever the specifics, however, a more general principle is likely to be illustrated here: that while platforms can go up like the proverbial rocket, they can fall to earth like a stick. The extraordinary dynamics of network externalities that drive the upsurge can fall away very rapidly, and due to remarkably little.[3]

Fear of this dynamic accounts in part for the extraordinary restlessness of the major tech companies. Each of the major platforms has spent the last half-decade or more continually expanding into fresh markets – or trying to – either via a process of internal growth or via fresh acquisitions. There are opportunities in doing so, in the form of potential new revenues to be secured from grabbing markets or offering new online products, but there also dangers in *not* doing so;

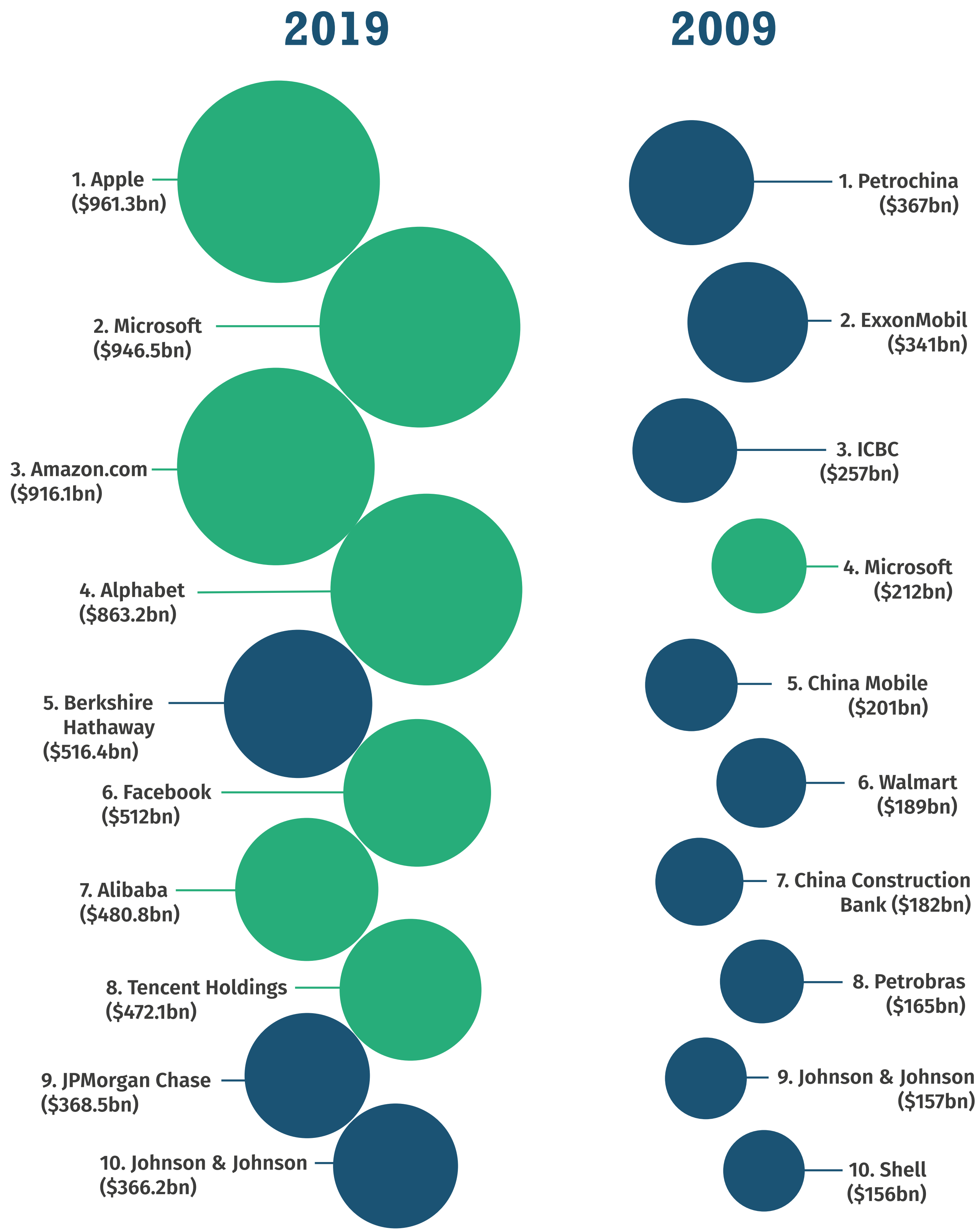
2 58 per cent of Amazon's 2018 operating income came from Amazon Web Services (AWS); see Condon 2019.
3 Interconnected networks are particularly prone to this effect. See Buldyrev et al 2010.

grim economics of scale could start to turn rapidly *against* the existing platforms. Already, there are signs of market saturation for some of them: Facebook is rapidly running out of additional eyeballs to plug into its social network, while younger users are abandoning the platform in droves. Of US citizens aged 13–17, 51 per cent say they use the platform – a huge figure, but down enormously from the 71 per cent that reported using it just a few years ago (Solon 2018). Fears for its core market drove Facebook's shares to the biggest one-day fall in US corporate history last year (Newton 2018). To secure its future, it, like the other platforms, must continually search out new products and markets.

This extraordinary dynamic – the pull of fresh revenues, and the push of market saturation – has helped drive the tech platforms into becoming some of the largest companies on the planet. A comparison, shown in figure 1.1, with the global giants of a decade ago, in the wake of the financial crisis, shows the dramatic change in the balance of power in the world economy. The oil majors are gone, replaced by mostly US platform giants.

Successful capitalism tends to be characterised by a balance between the *stability* of companies, allowing them time and space to grow and develop, and the *churn* of those companies, allowing the less successful to smoothly fail and be replaced by others. The appearance of the platform giants has changed the distribution of the world's largest companies in a comparatively short space of time. The degree of churn among larger firms in the global economy has remained fairly stable since the 1990s, but more recently the 'superstar effect' has become more pronounced, with a smaller fraction of firms at the top of the distribution capturing a greater share of value added (and, conversely, a larger share seeing losses) (Manyika et al 2018). It could be argued that platform companies present a pristine version of 'Schumpeterian' market dynamics: innovation allows them create temporary monopolies, and profits from these monopolies drive further innovation, securing the monopoly (Schumpeter 1942). The argument of this paper, however, is that the evidence points to a more insidious process, in which monopoly allows the capture of value generated elsewhere (including value generated through innovation), rather than innovation producing monopoly.

FIGURE 1.1: LARGEST COMPANIES WORLDWIDE, BY MARKET CAPITALISATION ($BN, NOMINAL)




Source: Statista (2020); Visual Capitalist (2020)
Note: Green circles = platform businesses

## BEYOND THE TECH PLATFORMS

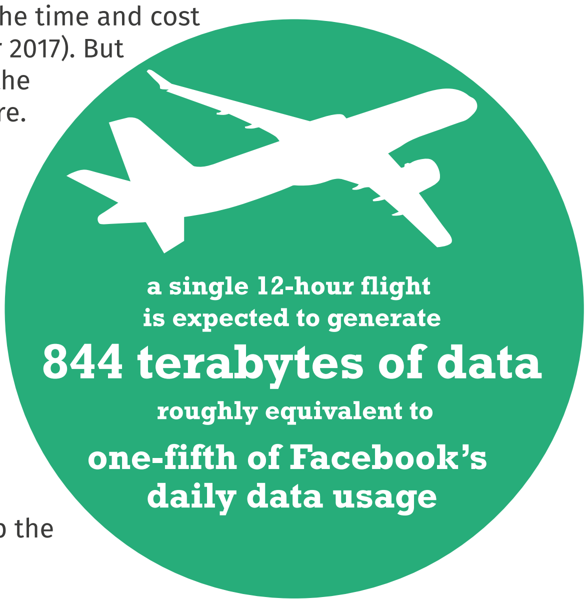
But alongside the dynamic driving the expansion of the tech platforms into fresh markets, more conventional corporates are making increasing use of Big Data. Some are even attempting to transform their entire business models into something similar to tech platforms.

Following Nick Srnicek's analysis (Srnicek 2018), we can broadly divide the wider platform economy into five areas:

- **advertising (eg Google, Facebook):** extract data from the users of the platform, analyse it for behavioural insight and sell those insights for profit, primarily to advertisers
- **cloud providers (eg Amazon Web Services, Salesforce):** own the hardware and software that provides the backbone of a cloud-based digital infrastructure, generating revenue by renting it out
- **product (eg Rolls-Royce, Spotify):** generate revenue from transforming traditional goods into services, collecting rents and/or subscription fees
- **lean (eg Uber, Airbnb):** intermediate between the owner of an asset or provider of a service and the user of that asset or service; these platforms charge rents in the process and have minimal asset ownership
- **industrial (eg General Electric, Siemens):** provide the hardware and software that enable the large-scale capture and analysis of data from manufacturing processes to improve those processes.[4]

As data becomes ubiquitous, we can expect platform and platform-type models to become more prevalent, at least for those parts of the economy where scale still matters. The pharmaceutical industry, beset for years by the declining productivity of the traditional 'pipeline' model for drug discovery,[5] has been turning to data intensive methods.

GlaxoSmithKline signed a $43 million deal with Exscientia for a licence to use their AI drug discovery system which, it is claimed, will cut the time and cost taken to bring a drug to market by three-quarters (Hirschler 2017). But perhaps more threatening to the existing pharma giants is the move by platform companies into the provision of healthcare. Chinese platform Tencent is "aggressively" expanding into drug discovery, signing two major deals for data-driven pharmaceutical AI last year with US companies Atomwise and XTalPi. Google has invested in numerous pharma start-ups, including "XtalPi (AI-driven calculations), BenchSci (AI-driven antibody search), Fulcrum Therapeutics (gene therapy), Spy Biotech (vaccines), Magenta Therapeutics (stem cells), Spero Therapeutics (bacterial infections), Arcus Biosciences, and Forty Seven" (Buvailo 2018). The thinking is that drug discovery and healthcare in general can be turned into another Big Data industry – making use of vast healthcare datasets and fast processing power to, in the case of pharmaceuticals, tear up the pipeline model and deliver a step-change in productivity.




Manufacturing overall is increasingly data-dependent, through the expanding use of digitised design and 3D printing in the production process, and the provision of in-service data after production. In aerospace, Rolls Royce generates most of its revenues from post-production services (Read 2016), continuously monitoring the

4 Taken from Lawrence and Laybourn-Langton 2018.

5 Deloitte estimate that returns on R&D in pharmaceuticals were just 1.9 per cent in 2018 – the lowest since it started surveying the industry (McConaghie 2018).

thousands of its engines in use. Bombardier's new C-series jetliner is expected to generate 844 terabytes of data from a single 12-hour flight, for example (Rapoolu 2016); a volume roughly equivalent to one-fifth of Facebook's daily data usage. Car manufacturing is increasingly dependent on Big Data, stretching from the growing sophistication of in-use monitoring of a car's performance through on-board computers and remote analytics, the further automation of production and supply chain management, right the way back to the use of consumer data to personalise sales (Deloitte 2015).

More traditional industries are also being reshaped by data. The longstanding economies of scale in manufacturing are being challenged by digitally enabled technologies, like digital printing in textiles, which allow manufacturers to produce smaller, customised runs of products at a price closer to mass production than bespoke (see data and textiles case study).

### CASE STUDY: DATA AND TEXTILES

A key driver of the industrial revolution, textile manufacturing still employed 900,000 in the UK as recently as 1977, with the industry concentrated in the industrial heartlands of the north of England. But the opening up of low-cost production across the globe and the falling cost of transport saw employment collapse by 90 per cent in absolute terms over the next three decades (Fitzgerald 2016; ONS 2014). The period since the financial crisis, however, has seen a significant recovery, driven by smaller-scale manufacturers, with digital technologies and advanced manufacturing techniques shrinking the cost advantages of production elsewhere. Changing consumer demand and the rise of fast fashion in particular have seen production lines shrink and clear economic advantages arise from placing designers and manufacturers in proximity, achieving production on fast turnaround but relatively short production lines. Exports rose 28 per cent (to £9.1 billion) in the five years from 2012 to 2017 (Alliance Project Team 2017), while employment in key areas like West Yorkshire has "surged", rising by 25 per cent in the four years after 2008 (BBC News 2012).

Research and development spending has increased significantly, and today the UK has the highest rate of textile patenting in Europe, and the third highest in the world, with most "technical textile" small businesses located across Greater Manchester, Lancashire and Yorkshire (Alliance Project Team 2015). The combination of smaller-scale viable manufacture with the massive expansion of the collection, retention and analysis of data is helping carve out a distinctive path for textile production in the future, away from the traditional presence of a few very large producers, towards a spread of smaller ones (Papahristou et al 2017).

But it is, perhaps, in forcing the shift of entire manufacturing business models that the data economy will be most disruptive. The global car industry is one of those unlikely to continue in its current form. Industry forecasts expect that ride-hailing and car-sharing will be the drivers of future profits, with established automakers, start-ups, and existing platforms racing to grab slices of a forecast $1.2 trillion global market by 2030 (Accenture 2018). Profits from the manufacture and sale of vehicles are expected to flatline or stagnate over this period, caught by rising costs and shifting consumer demand, leaving profits from mobility as a service shooting ahead. Data-driven technologies, from ride-hailing to self-driving cars, are expected to produce a profound shift in car usage, with those companies best able to exploit and analyse data best-placed to win. Google, Apple, and Baidu are among the platform giants currently investing in the automotive industry, looking to leverage their existing advantages in analytics into autonomous vehicles (CBI Insights 2018).

The underlying economics of data push the sector in this direction: since data becomes more valuable when combined with more data, and since the costs of collecting, storing, and analysing that data are low (and falling), simple economies of scale start to allow us to imagine a world in which a very few companies come to dominate most of the digital economy that exists.

## TAX AND COMPETITION POLICY ARE NOT ENOUGH

If the tendency of data economics is to push the digital economy towards giant companies, which occupy near-monopoly status in some markets, one response might be to look to traditional mechanisms for government to intervene. The rates of tax paid by the various digital monopolies have become a public scandal, with vast multinational enterprises seemingly able to pay only minimal taxes in any given jurisdiction. Pre-empting international action, the UK government has proposed the introduction of a digital services tax (DST), applying a rate of 2 per cent on the revenues of specific companies (providing search engines, social media platforms, and online marketplaces) where those revenues are derived from UK customers (HM Treasury 2018). Measures like this are not without controversy: after threats of tariffs against French imports to the US, France has postponed the implementation of its own unilateral (and slightly more aggressive) digital services tax, while the US has used the opening of negotiations over a post-Brexit trade deal as an opportunity to demand that the UK roll back on its own DST proposals (Elliot and Mason 2022).

The OECD has recently brought forward proposals to update the tax system internationally to cope with the activities of the digital platforms (OECD 2019). These would form part of the OECD's wider 'base erosion and profit-shifting' work, and would see national governments allocating tax liabilities by reference to revenues generated in their countries. But, while moves to push the major platforms into paying more tax are clearly welcome, they do not obviously address these fundamental problems; this approach assumes that the basic structure of the digital economy will remain much as it is, with large multinationals exploiting their ability to gather and process data for profits. If we want to shift the functioning of the digital economy itself, we need action that addresses the economic fundamentals of the sector, rather than attempting to clean up the mess once it has been created. This puts us into the realm of government regulation rather than the levying of taxes, since the problem is not only the capture of value, but also the way that value is created.

Traditional public utility regulation, however, has difficulty gaining a foothold against the platforms. It is, for example, hard to set a fair price for their output, given that so little of it is directly traded through a price mechanism. At the same time, it is frequently hard to attribute costs to a specific output – as traditional marginal cost pricing would demand. Traditional approaches to regulation and competition fall foul of the peculiar economics of the platforms (Evans and Schmalensee 2013). Regulators have been forced to think more creatively and are only now starting to catch up with the platform giants in particular.

For the UK government, the recent *Unlocking Digital Competition* review attempted to set out a new approach. The review's main recommendations, if taken together, would amount to a significant overhaul of existing consumer and competition law in digital markets. Aligned with the Competition and Markets Authority (CMA)'s own proposals of February 2019, the review suggested the following.

- Creating  a new digital markets unit with powers to set a code of conduct for companies with a "strategic market status" (which the unit would decide on), to promote data mobility and open standards, and to secure access to non-personal and anonymised data where this would promote competition.
- Updating merger policy so that the CMA is better able to intervene where proposed mergers have the potential to damage *future* "competition, innovation, and consumer choice". Companies with strategic market status would be obliged to inform the CMA of all future acquisitions and the CMA would develop more sophisticated tools for analysis, backed up by changes to competition law to allow it to block mergers where needed.
- Introducing interim measures to allow rapid action to be taken against digital monopolies and large companies where there is the possibility that their behaviour will be in breach of competition law. The review found existing processes to be too cumbersome to be of much use against "fast-moving" digital companies, so the intention here is to speed up the ability of regulators to intervene ahead of a full review.

**HM Treasury 2019**

At the time of writing, the government is expected to announce shortly that it will be establishing a new regulator (Murghia and Beioley 2018). The overriding concern of the orginal review was to introduce, as far as possible, competition into digital markets. So data held by major companies could be subject to being opened up by the regulators, and the major digital companies might find it harder in future to move into new markets through mergers and acquisitions. The design for the new digital markets unit has been significantly influenced by Jean Tirole's work on platform companies (Rochet and Tirole 2003), building in place the idea of "participative antitrust" (Schrager 2018), where regulators and firms work towards standards of behaviour rather than setting rules in stone. But, as Dan Hind has pointed out elsewhere, this imposes a requirement of "superhuman virtue" on the participants (Hind 2019) – regulators and platform businesses – in an environment where one could suspect that not everyone would be incentivised to behave virtuously.
At the very least, a relatively weaker form of regulation, attempting to pre-empt future actions by platforms, looks like an invitation to regulatory capture, particularly given that the platforms will, of course, know their own likely future actions far better than any regulator.

## ANTI-TRUST IS ONLY PART OF THE ANSWER

Should we, then, go further than the *Unlocking Digital Competition* review, and look to break these companies up? Unfortunately, it is hard to completely favour the classic anti-trust actions of the kind currently promoted (amongst others) by Elizabeth Warren in the US against Big Tech (Warren 2019). Using (she claims, successful) anti-trust action against Microsoft in the 1990s as an example, blocking its colonisation of the emerging world wide web, Warren has proposed a series of measures to take action against the existing Big Data giants. These would, first, debar the existing tech companies (designated 'platform utilities') from owning both the marketplace and suppliers into that marketplace; so, for instance, Amazon could not both offer a site to sell goods, and offer its own goods for sale on that site.[6] And her proposals would block, and potentially break up, some of the mergers and acquisitions that the tech companies have already undertaken – Facebook's deals for WhatsApp and Instagram have been cited (Stevens 2019).

6 This is also a recommendation in Statham et al 2020.

These proposals have not been universally welcomed: EU commissioner Margrethe Vestager said that breaking up the internet giants would be a "last resort", and Facebook's CEO Mark Zuckerberg was quoted as saying he would "sue" if the US government attempted to introduce Warren's proposals (ibid). But the plan's promise to take on the internet giants and potentially change their behaviour sounds appealing. Standard economic theory, broadly, expects that a competitive market will be more efficient and produce better outcomes for consumers (maximising their 'surplus') relative to less competitive markets, or monopolies and so breaking up monopolies has an easy justification in textbook theory.

But where 'classic' monopoly behaviour can, in theory, be undermined by the application of stricter competition laws and the breaking up of monopolists, the critical issues for data do not emerge around the classic issues of price-fixing and limitations of supply. As we have seen, the major issues about Big Tech's behaviour emerge some distance from conventional markets in any sense, and so – even at the level of theory – it is hard to see how inducing competition alone would induce better outcomes for society. There is *already* intense competition.

More likely is that an insistence on breaking up the existing tech giants will simply lead to a reproduction of the same problems, as each (somewhat shrunken) new giant would seek to maximise its own profits in exactly the same way as the former monopolist, facing no real price competitive incentives to behave differently. Each would seek – on a smaller scale – to maximise their own revenues from the network effects that drive platform behaviour (and profitability), without much reference to a conventional market. Moreover, the creation of separate, unconnected networks would have a negative impact on consumers, as there is a consumer benefit from being a member of a larger network. The very strong economic logic of data would lead firms to look for ways round the barriers to sharing data between different sites and markets.

The underlying problem is simply that the economics of data work hard against fragmented market structures, in a way that breaking up a more typical monopoly – say an oil company, or a steel manufacturer – might not. One oil pipeline does not become more valuable because it is placed next to another – indeed, we would, as a rule, expect the opposite, due to diminishing returns. It can make sense to break up an oil company, leaving different wells, pipelines, and refineries in different hands. But data *does* become more valuable when placed next to more data. We need different policy interventions – and, potentially, a different way of understanding the market.

Where the standard anti-trust case might work is in barring existing tech giants from moving into adjacent markets, whether in their own right or – as has been more frequent – through the acquisition of existing, smaller platforms. Warren's proposals for insisting that the regulators take a much harder line on mergers has significant merit, since it is at this point that regulators can meaningfully intervene and set in place the framework that will define future market growth. The response of central banks to Facebook's Libra cryptocurrency was a classic example: a firm response by regulators across the globe has already forced Facebook into a reconsideration, and one of its major partners, PayPal, has pulled out of the project (Binham 2019).

## ENERGY USE AND ENVIRONMENTAL IMPACTS

Demand from global computing and internet-connected devices now comes to between 3 and 5 per cent of the world's electricity produced. As the volume of data online increases exponentially, and as we move from a world of 3 billion online citizens to 4 billion or more in the next few years, that share will only increase. Researchers suggest this could reach 20 per cent of global electricity by 2025. The consequences for carbon emissions could be serious, with ICT accounting for 5.5 per cent by the same time period – more than any single country apart from India, China, and the US (Climate Home News 2017).

There is some evidence, highlighted by the OECD, of at least a correlation between the use of internet technology in a country, and the rate of emissions reduction (Malmodin and Bergmark 2015). One potential consequence of the move away from fixed information technology and into smaller and less energy-intensive mobile devices is a reduction in carbon footprints for individual users. However, this can come at the cost of increasing infrastructure demands and therefore the greenhouse gas burden, in addition to the raw materials demands of sophisticated electronic devices. There are some positive moves being made on the carbon burden of digital infrastructure specifically: Greenpeace have shown how major tech companies are taking steps to reduce the colossal energy requirements of their data centres. Apple has one data centre entirely powered by renewable energy. And Facebook has a new data centre in the far north of Sweden, cooled by outside air and powered by hydroelectric on-site. As vast volumes of data move out from personal and company servers and onto the cloud, the efficiency savings here could be immense (Greenpeace 2017).

Meanwhile, a less obviously high-tech industry is being significantly disrupted by new, digital technologies. Sensors in the ground already allow the precise monitoring of soil moisture and acidity for agriculture, while drones allow the 24-hour monitoring of crops. This intensity of monitoring generates more data, the analysis of which allows the use of water and fertiliser to be optimised. Studies suggest that US farms using these 'digital agriculture' technologies reduce energy costs by almost one-third per hectare, while water use is reduced by 8 per cent (Meola 2020). And, as we will consider later, the specific challenges of decarbonising the electricity supply through smart grids and the smaller-scale production of electricity will add to the flood of data across our economy and society.

## THE THREAT TO PUBLIC DATA

In addition to the creation of a privatised and quasi-monopolised digital economy, there are rapidly emerging threats to publicly held data. The UK's health data, held principally by the National Health Service, is of particularly high value, being perhaps the biggest and longest-duration set of longitudinal data on patients held anywhere in the world – and with the NHS itself enjoying a uniquely high degree of public trust. As medical research becomes increasingly data-driven, as we have discussed, the value of this treasure trove will continue to rise. NHS data has been conservatively estimated by Ernst & Young as worth £9.6 billion annually (Wayman and Huneriach 2019); in principle, the data can be put to public service in, for instance, developing new diagnostics techniques, or allowing in-depth study of genetic conditions. As new research from Imperial College has argued, "the UK is the best placed large economy in the world to use its health data assets for transformative health, scientific and economic impact" (Ghafur et al 2020). As we describe below, the development of machine learning and AI will only boost the potential value of NHS data.

Successive UK governments have, over the last decade or more, begun to identify the immense potential of the NHS data, and to organise and regulate its use – for example, in the creation of the NHS Biobank, established in 2006 and now with 500,000 volunteer respondents who provide a rich resource on their own health for use by researchers.[7] More recently, the government has created NHS Digital, HDR-UK and Genomics England to oversee datasets and data policy, while last year the secretary of state for Health announced the creation of NHSX to oversee the digitisation of healthcare in the UK. The latter's aims are laudable, on the face of it – creating a single authority to bring together data management, overseeing the implementation of the latest technology, and allowing cutting-edge research to take place within the NHS.

But there are troubling signs that the desire to make effective use of NHS data has also seen major tech corporations move in on it. Amazon has been apparently granted free access to NHS data, in return for turning its Alexa home assistance to also offer tailored medical advice (Walker 2019). The aim is to reduce pressure on GPs and front-line staff in general, but the upside of the deal for Amazon is an opportunity to develop "new products, applications, cloud-based services and/or distributed software" that the NHS would not benefit from financially. Many of the big healthcare firms across the globe have paid the NHS for access to de-identified NHS patient data for their research wing. And the Royal Free NHS Trust received a reprimand from the Information Commissioners' Office for the use of 1.6 million patient records in developing an AI-assisted diagnosis software for the detection of acute kidney injuries. The Royal Free and DeepMind have been required to develop more robust procedures for the use of personal patient data in research of this kind (ICO 2017).

In all these cases, the stated aims are laudable. But achieving them raises two sets of issues: the first, which has so far sustained the most public attention, is the use of very personal and private data by third parties, and the degree of consent NHS patients might be presumed to have given to the use of their own data. The second, however, is more directly economic, and concerns the ownership and acquisition of value from the data when it is applied. Without clear guidance on how data can be valued and used, it is entirely possible that this resource will be largely given away for profit elsewhere before we, as a society, have really begun to value it.

A very specific version of this problem has emerged in the context of Brexit, with the UK government stating that it will take the option of deviating from the EU's current standards for the management of cross-border data flows. Digital services themselves are now a major export earner, with £44.8 billion of exports last year (DCMS 2019), of which 43 per cent went to the EU (Stolton 2019). There have been few further details on this, but according to the secret US-UK trade negotiation papers leaked during the 2019 election campaign, "obtaining commitments on the free flow of data is a top priority" for the US (DIT 2017). Combined with the US insistence that copyright and patent law should be strictly enforced under a future trade deal, Alan Winters of the Trade Policy Observatory has noted that this could create a situation where the UK cannot access or meaningfully use its own data without paying a royalty to Silicon Valley for use of an algorithm derived from it (Aldrick 2019). The EU currently has fairly strict controls on the international transfer of data, principally via its enforcement of the General Data Protection Regulation, but with technology advancing rapidly it is not clear what future protections would be available to a post-Brexit UK. A looser arrangement with the EU, of the kind the present government seem to be seeking, and a close deal with the US would at least create the possibility that these protections could be minimal.

As an EU member, the UK was automatically signed up to follow EU regulations on cross-border data transfers and data management inside its borders. But, once

7 See: https://www.ukbiobank.ac.uk/

the UK is outside the European Economic Area, it will need to win 'data adequacy' approval from the EU – meaning that the EU considers it to have sufficiently good standards for the management of data so as to require no further safeguards when transferring data across borders. 11 countries currently have data adequacy recognised (European Commission 2019), but adequacy decisions for non-EU members can take a long time – the quickest, Argentina, was only made in 18 months. In the event of leaving the EU without a decision on adequacy, the free flow of data between the UK and the EU will end, at least from the EU to the UK, and the UK-EU flow accounts for two-thirds of all UK cross-border data flows (IfG 2019). There is a significant incentive for the UK government to try and win approval inside the transition period, ending on 31 December 2020, which in turn may stay its hand in negotiations over data access with other countries. The situation is fluid, and while 'technological sovereignty' has been raised as an issue in debates of Huawei's supply of potentially sensitive 5G equipment, the related issue of 'data sovereignty' should be raised in the context of ongoing trade negotiations and the risks of harm created by poorly understood and weakly regulated cross-border data transfers.

## ACTION NEEDED NOW

It is this colonisation of future digital spaces and the interaction between the platforms and existing markets that pose a regulatory and policy challenge. Competition policy alone will not solve this. Nor, as we will suggest, will tax policy. The platform business model that has evolved depends on a fundamentally extractive and unaccountable form of profit-generation. Neither regulation nor taxes will significantly shift that, and if it is left to regulators to attempt to play catch-up with the existing platforms as they move into new areas – or even if they try to pre-empt future behaviour – the fundamentals of the data business and its dynamics will not change. Already we can see a cat-and-mouse game between different national and international regulators and the platforms, as with the recent attempts of Facebook to steer its Libra project to fruition, or between platforms and the tax authorities, as with the notoriously complex structures the data giants use to maximise their tax efficiency.

Building on IPPR's *Digital Commonwealth* report (2018), we propose an alternative mechanism: to treat data as a *commons*, to which various forms of access can be provided. This may, at first glance, seem counterintuitive: data is generated throughout the economy, and much of it is held and generated by private corporations, using their own software and infrastructure, to which they temporarily provide access. But we should separate two things here: first is the technology to generate that data, which is usually something we personally hold and own: a smartphone, a computer, a contactless payment card. Second is the ability to store and process that data. And it is here that the idea of a data commons becomes most apparent: because while the infrastructure needed to mine and harvest the data itself is generally privately owned, the major economic value of that data is in the *relationships it can describe*. A dataset has an intrinsic value: it is useful to know something about someone or some object. But its value is maximised when it is placed in a relationship with other data.

This is the most significant economic fact of data, which is that *it becomes most valuable when it is combined with other data*. It is the relationships that are developed that are the most valuable part of the data, and it is because of this that machine learning can unlock the potential of such economic returns. But the relationships between data are not the same as the data itself, and rights to the relationships – to describe and analyse how the data is used – are not intrinsically a property of whoever generated or owned the data. The entire system of data, in other words, is what should be considered as its real social value – not the happenstance that certain parts of the whole data system are claimed as private property. It should be subject to specific regulations, but nonetheless with private rights of access to the whole space.

Of course, this is to ignore some of the obvious features of data considered generally: that at least some parts of it (like medical records) must remain personal, and kept away from the common pool. The *personal* control and use of some of this data is fundamental to maintaining a meaningful, transparent, and broadly democratic *social* control over its use. But once the standards of privacy are established and enforced, as, for instance, through regulations like the GDPR, the next question is to establish the ownership and management of the relationships the data contains.

We describe this digital space as a data commons, because this stresses not the content of the space itself, but the system of relationships it embodies. As the P2P Foundation describe it: rather than being only a different form of property, a commons implies "neither the resource, the community that gathers around it, nor the protocols for its stewardship, but the dynamic interaction between all these elements" (P2P Foundation et al 2017). To manage this data commons properly will require the construction of appropriate forms of ownership and access – shaping different relationships between those who produce data, those who store and process it, and those who seek to apply insights gained from it.

The practical implications of this are that a range of different options for the ownership, control, and management of data should be applied. Much of this data commons should (and in any case probably will) remain in private and corporate hands. But parts of it, looking into the future, will be more appropriately managed under different forms of ownership, closer to the collective and common forms of ownership and management that we see elsewhere in the economy. This collective space for the data economy is what IPPR has called the "digital commonwealth", comprising a range of different forms of ownership and control, catering for the range of different uses to which data can be put, and with the goal of supporting a society that is both prosperous and socially just.

# 2. EMERGING CHALLENGES

## INTERNET OF THINGS AND 5G

Already, vast volumes of global data are expected to grow exponentially as the internet pushes its way deeper into our economy and society. Every device we use has the potential to become internet-enabled, while ubiquitous connections are a bedrock technology for the development of self-driving vehicles. The underlying technical breakthrough needed for this 'internet of things' (IoT) to become a reality has been a collapse in the price of high-resolution sensors – from accelerometers, to GPS, to digital camera cells. The average selling price for a sensor of any kind fell from $1.30 in 2004 to $0.38 by 2019 (Rishi and Saluja 2019), and further price declines are expected across the board. At the same time, the sophistication of sensing technology, and the reduction in size, has opened up a vast range of new applications. Combined with the wider infrastructure of the internet – faster computers, access to massive datasets, and rapid digital communications – the stage is set for sensing and processing technology to become ubiquitous, with enormous economic (and social) consequences; Ernst and Young estimate the global IoT market to be worth $1.1 trillion by 2025.[8] The number of connected devices is forecast to grow from 15 billion devices globally today to 75 billion by the middle of the this decade (Columbus 2016). The flood of data we currently generate will seem like a trickle compared to the tsunami of 5G and ubiquitous sensing. It's predicted that IoT devices would generate 90 zettabytes of data, accounting for half of all data generated, and significantly bigger than the 66 zettabytes the entire internet generated last year (Patrizio 2018).[9]

The move away from fossil fuels towards renewable technologies, backed up by smart grids, will further balloon the production of data. Smart grids refer to power systems in which, instead of the one-way flow of electricity into devices, smart devices communicate back to the grid about their use and – where batteries or small-scale generation are available – their own capacity to produce electricity. By enabling this flow of data, the whole grid can be made significantly more efficient than standard, centralised production, and – more importantly – optimised for smaller-scale, renewable electricity generation (Zhang et al 2018). The data giants have a longstanding interest in the development of these technologies – implying, as they do, a major expansion the volume and type of data they can obtain from their users (St John 2014).

But the ubiquity of cheap, interconnected sensors is already spreading beyond households and businesses, and into the public sphere more generally. 'Smart cities' have been a buzz phrase in urban planning for a decade, but the technology has only recently got to the point where the possibility of integrating many different sensors and analysing their output become a potentially transformative option. Google launched Sidewalk Labs just over two years ago to promote the use of ubiquitous sensing and data analytics in urban environments. Its first project in Toronto will see 12 acres of the Quayside area redeveloped as a high-tech enclave. The project has, however, been "beset by controversy", precisely over the perceived lack of clarity about Google's intentions with the immense volume of data that the digitally-enabled city space will gather, and the planning process has been fraught (Shieber 2019).

This near-unimaginable quantity of data will create enormous opportunities for the existing platforms, potentially reinforcing their current dominance. Storing, organising and processing this flood of data will be immensely valuable, and the strong tendencies towards path-dependency in the existing digital economy could only be reinforced. The critical moment for governments and policymakers to intervene is now, ahead of a more generalised rollout. But it is the current models of AI, reliant on machine learning from vast pools of data, that are poised to be able to exploit this, both to organise the enormous complexity of the internet of things, and to learn from it.

## THE RISE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence describes the capacity of a machine to mimic intelligent, problem-solving behaviour. Modern AI research essentially began after the second world war, with the confluence of breakthroughs in information theory, computation, and cybernetics suggesting that a self-regulating intelligent machine could be built. Alan Turing's 1950 paper, in which he described the minimum standard needed for a machine to be considered 'intelligent' (the now familiar Turing Test), clarified the boundaries of the emerging field of research (Turing 1950). After repeated stalls and disappointments over subsequent decades, research in AI has advanced very rapidly in recent years by applying the techniques of machine learning enabled by fast computers and, crucially, the exceptionally large datasets the internet (in particular) has generated. Machine learning can be defined as when a system improves on a given task, assessed with a quantifiable measure, over a period of time (Larson no date). The learning process is iterative: over time, the system should get better at the task, each round of learning checked against the assessment criteria and feeding into the next. This is 'reinforcement learning'. 'Deep learning' techniques are a subset of general ML in which the process of learning itself is not structured beforehand by the operator, allowing the machine to detect previously unseen patterns. Artificial neural networks (mimicking the neuron structure of a biological brain) are typically used in deep learning to steadily refine the data provided into successively more and more structured forms.

Very rapid advances have been made on specific tasks using ML techniques in recent years, including natural language processing and translation, facial recognition, medical diagnostics, and gameplaying – most notably, the AI 'AlphaGo' in defeating the human world champion at Go, a notoriously open-ended boardgame that the best human players had previously always beaten the best computers at. AI capabilities in these types of well-defined tasks are improving exponentially: "The best AI result on a popular image recognition challenge improved from a 26 per cent error rate to 3.5 per cent in just four years. That is lower than the human error rate of 5 per cent" (Executive Office of the President 2016).

These forms of task-specific problem-solving are often labelled 'narrow AI', as opposed to 'general AI', and it is the narrowness of the application that defines them. A machine trained in one task – facial recognition, say – cannot use what it has learned to switch to another. Artificial general intelligence (AGI), on the other hand, describes a machine able to think not just about the task that it has been assigned, but which can intelligently perform any task a human can – the intelligent computers familiar from science fiction. A significant amount of research effort is being applied into achieving AGI, but current expert forecasts suggest we remain "decades" away from a genuinely intelligent computer (ibid).

The technical barriers to AGI from existing ML techniques are known to be very high[10] – although the ethical concerns such an intelligence might present are already receiving attention.[11]

ML becomes more effective when the data it is given is both comprehensive and of a high quality – in other words, it already contains meaningful information about the task to be completed. 'Structured machine learning' is an extension of the basic principle in which a human operator guides the machine through the learning process by organising and flagging data appropriately. Structured ML is currently the most efficient way for a computer to learn but requires significant prior effort from the trainers (for example, in appropriately labelling large volumes of data).

The economic consequences of this are clear, and deepen the patterns we have already seen established in the digital economy: the spread of ML increases the potential value of any dataset, since it can now be analysed alongside other datasets, and relationships between data developed to build new knowledge for the machine. Of the greatest economic value are datasets that are clean (not riddled with errors); trusted (contain an intrinsic value beyond the data); and, obviously, very large. Trusted public sector institutions like the NHS have exceptionally valuable data; 'scraping' data from Facebook accounts is much less valuable, but can still be put to use, as the Cambridge Analytica scandal demonstrated.

The implication here is that scale matters a great deal in ML, since – other things being equal – bigger datasets are better; and therefore that there will be a tendency towards monopolisation in the development of AI. Since the software that ML generates (for example, in being able to recognise facial expressions) can be spread almost for free after first being developed, there are also likely to be strong network and first-mover advantage effects – again, mirroring the pattern already seen in the wider digital economy.

More generally, the type of AI that has come to dominate the sector is focussed on what Agrawal, Gans, and Goldfarb have called 'prediction machines' (2018). Prediction is, in their general definition: "when you use information you do have to produce information you do not have" (ibid). Amazon's recommendations system is a typical example: the site analyses previous purchases to predict what any given customer might want next. Current developments in AI are fundamentally refinements of this prediction process, resulting in a falling cost of making predictions, with impacts on labour productivity and – critically – drawing a line between 'prediction' (based on information) and 'judgement' (based on analysis, experience, or even general intuition) that defines whether AI is likely to be a substitute or a complement for any given task performed by humans.

## THE ECONOMIC IMPACTS OF ARTIFICIAL INTELLIGENCE

Forecasts of AI's impact tend to offer a rosy overall picture of the potential gains to the economy. McKinsey estimate that the widespread adoption of AI and robotics could raise productivity growth by 0.8–1.4 per cent globally between 2015 and 2065. (By comparison, the steam engine helped raise global productivity growth by 0.3 per cent between 1850 and 1910.) This is equivalent boost for growth (in the 19 largest economies) to adding the equivalent of an additional 1.1 billion–2.3

10 Crucially, deep learning involves variants on pattern recognition, but most problems in cognition – for example, in natural language comprehension – fall outside of being able to recognise patterns. Contextualisation remains far beyond the capabilities of existing AI, and this is even before considering the technical limitations inherent to current ML techniques (principally, the dangers of overfitting data and spurious correlation).

11 See, for example, Bostrom and Yudkowsky (forthcoming).

billion full-time workers by 2065 (Manyika et al 2017). PwC estimate that AI could add 10.3 per cent to UK GDP by 2030 – equivalent to £232 billion in 2017 figures. This will result from 1.9 per cent productivity gains and 8.4 per cent from "new firm entry stimulating demand" (PwC 2017), with 45 per cent of the total gains coming from what PwC expect to be significant improvements in the quality and variety of products brought to market.

Set against the forecast general impacts to GDP and productivity, warnings over the likely scale of job losses (and wider economic disruption) from AI have become louder and more frequent. The dominant approach here builds on the task-based analysis of Zeira (1998), and Acemoglu and Restrepo (2018), in which jobs are treated as bundles of specific tasks that can be more or less open to replacement or augmentation by AI. Based on this method, the pioneering work by Carl Frey and Michael Osborne estimated in 2013 that 47 per cent of US jobs were at risk of automation over the next few decades (Frey and Osborne 2013). Applying the same methodology, Jeremy Bowles estimated that 54 per cent of jobs in the EU were at risk of automation (Bowles 2017). The UK tends to have a lower risk of job losses compared to the global average as a result of its industrial structure, which is heavily concentrated on currently hard-to-automate service sector jobs. PwC have estimated that are about 30 per cent of UK jobs will be at high risk of automation by the 2030s (PwC 2018), and Future Advocacy has estimated that one-fifth of UK jobs are at "very high risk" of automation, although constituency-level data suggests some serious blackspots, with up to 40 per cent of jobs at risk.

However, other forecasts predict a net gain in jobs. The OECD estimates that only 14 per cent of jobs in member countries are at "high risk" of automation over next 20 years, but losses will be concentrated in lower-skilled occupations (Jackson 2018). Analysts Gartner predict that by 2020, automation will be creating more jobs than it is destroying globally, with job gains in healthcare, education, and the public sector outweighing losses in manufacturing. They argue that AI and automation largely complement existing human labour, particularly in higher-skilled occupations (Flinders 2017). PwC forecast that the UK will lose 7 million jobs from automation by 2037, but gain 7.2 million, creating a net gain in jobs overall. These gains will be concentrated in healthcare, science, and education, and concentrated in higher-skilled work (Kollewe 2018).

IPPR's survey of the evidence concluded that automation is more likely (for most jobs) to change the type of work being performed, than the elimination of jobs altogether (Roberts et al 2017). Automation today (particularly linked to AI) augments and supplements existing skills, rather than replacing them outright. The 'hollowing out' of the labour market (in which medium skilled jobs disappear, leading to a polarisation of work) could worsen under some AI forecasts (ibid). Given the current gender division of work, women in particular are more likely to be affected first (Roberts et al 2019).

It is, of course, difficult to make these sorts of forecasts over significant periods of time, and fairly small changes in the initial assumptions made about the future capacities of AI can lead to radically different predictions about the future. But at the very least such forecasts point to significant economic disruption stretching over the next few decades. This will apply even where forecasts predict net job creation, since some jobs will be lost and many individuals will face the prospect of no or significantly worse work. But unlike previous economic dislocations – from the first industrial revolution, to smaller (but still painful) shifts like deindustrialisation in the last decades of the last century – the aim should be to manage the process to the benefit of all, rather than creating (as automation presently is) new categories of 'winners' and 'losers'. In particular, as Bank of England chief economist Andy Haldane and others have pointed out,[12] the decisive difference in automation this time round is a move into the automation not only of mechanical processes and tasks, but also of cognition – of machines mirroring the capacities of humans to think. This is a qualitative shift, and one that potentially places this 'fourth industrial revolution' far closer in its social impact to those of the first, with machine-breaking, mass discontent, and three-generation decline in living standards for most people (Frey 2019).[13]

## AGAINST THE 'ROBOT TAX'

The policy response to automation will need to move beyond simply a redistribution of the income or wealth arising from the process, since we are looking at a process that threatens to upend what we think of as work. The suggestion to impose a 'robot tax' have become popular in some quarters but falls short of what is required for a desirable intervention. The thinking behind this suggestion generally starts from the premise that if robots (or at least automated processes) are increasingly taking the place of human beings in work, but that these robots are not taxed at the same rate as human labour, a bias is built in to the tax system favouring excessive automation. Just as national insurance contributions (NICs) are levied on an employer for employing labour in the UK, something similar would need to be applied to an employer using robots.

Superficially appealing, the idea has attracted the support of former French Socialist Party presidential candidate, Benoit Hamon, and Microsoft founder Bill Gates. However, a robot tax was considered, but rejected, by the European Parliament (Prodhan 2017), and there are three basic problems with the design of such a tax, and one conceptual flaw. On the design side, first, since the robot presumed to be replacing the human is not, in fact, getting paid, it is difficult to know what should be taxed. A worker earns a wage, and that can be taxed. A robot replacing the worker does not, so the level of the tax would need to be fixed by some other means.

Second, it is not clear what the reference value of this tax would then be – the wage of the worker being replaced? Some fraction of this? And what if the robot is significantly more productive than the human – should the value be revised? It is easy to imagine this becoming an arbitrary figure.[14] Third, given that there is no income to be taxed, and that the level has to be fixed arbitrarily, the amount actually levied and paid is liable to be subject to a process of bargaining – both in setting the level of the tax nationally, and, potentially, by individual employers. And that, in turn, creates problems around the likely incidence of the tax.

But it is the conceptual difficulty that creates the most fatal flaw in this idea. It is not clear at what point a 'robot' should become subject to a tax: most automation today occurs primarily as a result of changes in software, rather than through the presence of a physical machine. But while this sort of automation could, in theory, also be subject to a tax, it is not clear where the boundary between 'automated' software and any other software could be drawn, as a principle. Similarly, it is not clear – even if a single robot is clearly performing a task that was previously performed by a human – where the boundary between this automated machine and any other machine could be drawn. Why should one be subject to robot tax (say NICs, or income tax), while another is not?

12 Remarks by Andy Haldane on the *Today* programme, BBC Radio 4 (19 August 2018).

13 This is the argument developed in Frey 2019.

14 Following Varoufakis 2017.

## PREDICTIVE ALGORITHMS

Much of the automation already taking place is appearing some distance away from what we might think of as robots, or even machines. At least 53 local councils are using predictive technology, along with almost one-third of the UK's 45 local police forces. Police forces use AI to help guide them on tasks like deciding which crimes to investigate, while local authorities increasingly rely on computer guidance to cover a range of their services (Manthorpe 2019). Bristol City Council uses a predictive algorithm that collects data on things like benefits claims, school attendance, and reported mental health to help it assess when a child is at risk of domestic violence, sexual abuse, or of going missing. The system is advisory for experienced case workers, but this and similar procedures create profound ethical issues around the use of such data on the input side, and the possibility of predictive mistakes and misdiagnoses on the other side. Following smaller-scale trials, London's Metropolitan Police are rolling out facial recognition technology in key areas across the capital, despite complaints from civil liberties campaigners and serious concerns raised about the accuracy of the software in trial assessments, with only 19 per cent of cases verifiably accurate (Dodd 2020), and significant problems of racial bias identified in systems deployed elsewhere in the world (Fung 2019).

A particular concern with the use of AI and Big Data analytics in attempting to address social concerns is the intractability of the results: a relationship determined by an algorithmic analysis of data is going to be beyond the capacity of human analysis to describe and explain how a decision was reached. And while, in theory, purely financial decisions – for instance, the decision to make a trade or not, as reached by an algorithm trader – can be reversed, decisions over investigating crimes or staging interventions for specific children could have profound and permanent consequences. AI forecasting, by its very nature, lacks a clear means to create an explanation as to *why* certain results emerge, and so mistakes cannot easily be seen or even understood once they are made. The basic requirements of natural justice, including the necessity of seeing and understanding judgements once they are made, is laid open to challenge here.

## OPACITY AND SYSTEMIC RISK

This opacity is itself a potential source of new systemic risk, occurring at the boundaries between the uses of different data sets. If, for example, new and supposedly more accurate credit scoring becomes available on the basis of users' social media data, it is quite possible that the highly complex and opaque models used to generate these scores will systematically understate risks in some fashion. Where these unknown risks correlate across users, a new form of systemic risk would be created, unknown to the system as a whole. A rough analogy here is with the credit scoring techniques applied, pre-2008, to score sub-prime mortgages. While credit scoring could attempt to score individual risks, it could not deal effectively with a situation in which all those scored faced a common risk, resulting in a systemic risk for the entire banking system. But, since the mechanisms used to generate the analysis are likely to be opaque, the risks involved will be even more obscure.

Similarly, where AI trading strategies are used, it is likely to exaggerate market cycles, since AI bots trained on the same (or similar) underlying data will react in the same way (Wigglesworth 2019). As a result, automated trading is steadily making markets more volatile. Poorly understood eruptions, like the 2010 'flash crash' or the precipitous drop in US equity prices of December 2018, are becoming more likely over time as automatic trading is both intractable and liable to herd-like behaviour. But Big Data allows far more lateral thinking and creativity – like the hedge fund using AI trained to recognise cars to forecast the volume of trade at a supermarket chain from the number of vehicles parked outside its stores.[15]

Consumer-focussed AI financial services are already here: Chinese internet giant Alibaba's affiliate, Ant Financial (previously known as Alipay), has developed from simply offering payments services to Alibaba's customers into a fully-fledged quasi-bank, currently valued at $150 billion. It has begun offering a range of AI-enabled services, like an insurance feature that can determine in seconds whether a payment should be made and how much in the event of a car accident – a user simply submits a photo of the damage for an AI assessment (Lee 2017). And, in the absence of a developed credit rating system, Ant has put together a "private social credit system… Ant can deploy its AI and machine learning capabilities to track and analyse consumer's spending habits, payment history, and other personal information to algorithmically produce a consumer's score", which in turn can grant or deny access to the other services that Ant controls, such as credit on its Huabei platform, or loans through MyBank (Cheng 2018). The need for transparency here appears both as the need to understand how potentially major decisions over individuals' lives are being taken, and how institutions develop their own understanding of an individual's life decisions.

The specific issues here fall into two parts. First, the need to provide adequate and publicly available records of data being used, to assist with outside observers understanding the nature and types of data being processed. Secondly, the need to flag and make publicly available the algorithms being applied, since this is the best means available to track (and potentially even reverse-engineer) some outcomes. Increasingly, researchers are looking into the means to make algorithmic decisions tractable – for example, DeepMind is developing techniques that enable the visualisation of potential sources of bias in a machine learning system (Chiappa and Isaac 2019). But these will require regulatory intervention to become standardised.

### AI FUNDING

Extraordinary sums are now flowing into AI research, egged on by the significant first mover advantages the technology creates. IDC estimate that $35.8 billion will be spent on AI systems globally in 2019, a 44 per cent increase on 2018, and there is little chance of this slowing down (IDC 2019). On investment, McKinsey estimates that the leading global tech companies spend $20–30 billion on AI (90 per cent on research and 10 per cent on acquisitions) (Bughin 2017). Britain has world-leading AI companies, with (for example) Google's DeepMind subsidiary based in Kings Cross, London. Relative to the rest of Europe, private sector investment in AI in the UK is healthy, with £1 billion in venture capital deals signed in 2018 – almost as much as the rest of the EU combined (Nicolle 2019). However, AI companies and start-ups are overwhelmingly clustered in London and the South-East (GFC and Clearpoint 2017). Moreover, a few superstars will not translate to more general prosperity and there are signs that tech economy growth concentrates in already-existing hotspots. The danger, already manifesting itself, is that the few winners from AI concentrate in a few gilded locations, whilst its many and varied losers spread themselves across the country.

The economy as whole is not necessarily well-placed to gain from the benefits from AI and automation. For example, Britain currently has the lowest rate of industrial robot use in manufacturing of any OECD member. This can be partly attributed to persistently low, economy-wide rates of capital investment

15 See this example given by the Financial Stability Board: http://www.fsb.org/wp-content/uploads/P011117.pdf (p5).

(OECD 2017). The Centre for Economics and Business Research found that the UK has just 10 robot units for every 1 million hours worked, compared with 131 in the US, 167 in Japan, and 133 for Germany. The RSA found that sales of robots to the UK decreased over 2014 to 2015, with British firms falling behind the US, France, Germany, Spain, and Italy.[16] Indeed, the Council for Science and Technology believes that "the UK has missed the opportunity to play a significant role in designing and deploying industrial robots" (Council for Science and Technology 2016).

The UK is an international laggard in the public funding of AI, which, over time, is likely to translate into a significant competitive disadvantage. France has announced $1.8 billion of new funds for AI (Vinocur 2018); the US Department of Defense spending alone on AI was estimated at $2.4 billion in 2017 (Pawlyk 2018). China is currently estimated to be spending $17 billion in total on AI, rising to $70 billion by 2020 (Vinocur 2018). China already has more AI start-ups than the US, with the government's aim is to make China the leading AI nation by 2025.

But the UK's £1 billion sector deal for AI, announced with some fanfare in April 2018, contained no new funding, and the funding already available has been criticised for its lack of strategic focus (Walker 2018). Strategy matters; since resources are limited (and there is little prospect of the UK outspending the US or China), and first-mover advantages are so large, it is essential that funding is directed to the areas of most need or biggest potential gains. The 2017 independent review, *Growing Artificial Intelligence in the UK*, identified a number of steps government could take to focus its efforts (Hall and Presenti 2017), and has had some impact on policy, while there has been a renewed focus by the Conservative government on science funding since the election. The Conservative manifesto contained a pledge to meet 2.4 per cent of GDP spent on R&D by the mid-2020s, and announcements made in the 2020 Budget have indicated that there will be significant funding for fundamental science, potentially including data-focussed research.

## DATA, AI, AND INTELLECTUAL PROPERTY

At the core of the current platform business model is the creation and maintenance of monopolies over access to the data commons. Typically, this depends (as we have seen) on, first, relying on network effects to reduce the relative cost of participation to the point that no plausible competitor can emerge; and, second, on the maintenance of exclusive access to data generated by users. Little of this depends directly on the formal systems of legal monopoly powers, in the form of copyrights and (especially) patent rights. But the major platform companies are becoming more aggressive in their use of patenting: since 2009, at least 52,000 patents have been filed by the 'Big Five' (Alphabet, Apple, Facebook, Amazon, and Microsoft), and the annual rate of patenting has been increasing, from 3,565 in 2009 to over 10,000 annually by the mid-2010s (Brachman 2016). But it has been in AI research specifically that the rush to patent has been most apparent in recent years – more than half of all AI patents worldwide have been filed since 2013 (Cookson 2019). This shift in the platform business model, accompanying a shift (or at least a development) of their underlying technologies, poses further challenges for policy.

AI research has a long history of commitments to open source principles, and this has undoubtedly helped to spur on further research, with even major companies' key algorithms publicly available (World Economic Forum 2018). Legal devices used to restrict access to algorithms should be considered as generating both potential

16 These appear to be latest available figures – see RSA 2017.

financial and economic systemic risk, since they introduce a further layer of opacity to an already opaque system, and create a social risk around the opacity of decisions reached by – or assisted by – algorithmic processes.

Existing copyright law only covers the code behind an algorithm to the extent that the exact code being used is protected, and this 'literary copyright' is well-established and routinely recognised by the UK courts. Copyright does not legally prevent reverse-engineering of an existing algorithm. There seems to be little reason to challenge existing law or policy on this issue.

## PATENT RISKS

Patents, however, present a specific and systemic risk, since these cover not only the actual code being used to implement an algorithm, but also the technique being used. In this way, they act to legally prevent and restrict the reverse engineering of any given algorithm, and therefore introduce a layer of additional, legally mandated opacity into the system. By providing the means to enforce the exclusive use of a specific technique, AI patents of necessity weaken the ability of non-patent holders to understand how a process operates. At best, a rival could develop a system that mirrors the features of another; but the specific paths by which the rival AI arrived at the same ends – providing natural language recognition, say – could easily vary wildly from a different process generated from different data at a different time, and therefore would be little use in understanding how any specific outcome was achieved by a different machine learning process.

But, as we might expect in a rapidly growing new technology field, AI patents are booming. Almost 30,000 AI patent applications were made globally in 2017 alone (IPO 2019), and a significant and growing public and commercial value is now tied up in patents related to AI.

However, the patentability of AI varies substantially across jurisdictions, albeit with some common features (Hashiguchi 2017). In the UK, patentability remains covered by the 1977 Patents Act, introduced to give effect to the European Patent Convention. The UK courts in general seek to follow the decisions of the European Patent Office (EPO)'s Board of Appeal (a situation that will not change with Brexit),[17] which, as a rule, does not allow the patenting of software except where it can be shown to be of a 'technical character' beyond the 'normal' interactions of software and hardware (Gowling WLG 2019). This would be interpreted to exclude, for example, a new technique for sorting data, but would include new software to improve anti-lock braking systems on a car, since the latter involves changing the relationship of the computer to its own hardware, rather than merely changing its software. Alternatively, it can be granted where a patent shows that a piece of software is specifically adapted to a piece of hardware (Cupitt 2019).

Applying this ruling has brought some AI into the scope of the UK patents system, and the UK Intellectual Property Office (IPO) figures suggest that nearly 600 AI patents were filed in the UK last year. Some AI applications are easier to patent than others, and within AI applications there is a certain amount of variation between different techniques. Natural Language Processing (NLP) is easier to patent when speech recognition is included, since the EPO considers this to be of 'technical character', but harder when NLP is being applied only to written text (ibid). Following the EPO guidance generally places the UK in the less patentable jurisdictions for AI applications.

17 The European Patent Office is not an EU institution and is therefore unaffected by Brexit.

Features inherent to the current direction of AI development, via ML, tend to place it beyond the usual bounds of patent eligibility. The lack of tractability, in particular, makes writing an eligible patent application difficult (Hashiguchi 2017). Similarly, the 'technical' requirement for a new creation to be eligible for a patent tends to place many of the areas where AI has the most immediate potential – particularly in the creative industries – potentially beyond the scope of the existing patent regime.

## PATENTS AND INTELLECTUAL PROPERTY LAWS ARE NOT DRIVING AI

There is a long-running debate in economics as to the correct balance in intellectual property (IP) between the temporary monopoly of a patent granting an incentive for invention – and the fact that these patent monopolies hamper further research in an area. Recent research on firm- and industry-level data suggests that the true impact of patenting varies across industries in the US, with computer technology one of those adversely affected by excessive patenting. But, beyond the generalities, there are specific reasons for thinking that a less restrictive IP regime is appropriate to AI.

First, the exceptionally strong 'winner takes all' and first mover economics of AI already create a significant tendency towards monopoly, as they do in the data economy more generally. Second, it is not at all obvious that tighter restrictions on the use of AI IP would induce companies to expend more research effort. At present, the major incentive for research is, as we have suggested, the huge value of the data and its analysis itself, rather than the need to enjoy a monopoly on its use. Major AI companies already make significant use of open source principles and there seems little reason to believe that shifting this towards a more 'closed' IP approach would seriously change their preferences. It is competition between platforms – and those seeking to establish new platforms – that has driven innovation so far. This can occur some distance outside the existing data economy: the car industry, for example, is "in a headlong race, involving incumbents and tech-focussed new entrants, to achieve the winning 'platform' business model for 'mobility as a service'" (Gowling WLG 2019).

Relatedly, the issue of inventions generated by AI themselves poses a serious question for patent law. At present, the IPO insists that any invention granted a patent must have a named human author. But, recently, the group of scientists overseeing an AI that devised new food containers that are easier for other automated machines to handle and use have put in a claim that the AI itself should be awarded a patent, as the machine was the source of the discovery. The lead scientist on the project claims the bar on non-human applicants is 'outdated'.

The machine in question, 'Dabus' (otherwise best known for generating surreal artworks from internet graphics), has not been trained to solve specific problems (Kelion 2019). It is this open-ended nature of its learning process that gives the patent application in its name particular force, since the machine was not guided to a specific solution by a human operator, but made its own way there. This closely mirrors the process of new discovery and invention that patenting aims to capture and protect, when undertaken by humans. The legal issues involved in this case touch on far broader philosophical concerns (as the researchers intended), but as far as this paper is concerned they further illustrate the inadequacy of existing IP laws when confronted by AI.

Due to the evolutionary nature of current AI techniques, in which an initial algorithm can be refined and developed, and the ability of algorithms to refine and develop themselves, it may be the case that even where an initial patent is given to a named human inventor, somewhere down the line a further patent for a machine-developed refinement of the original could be required (Tull 2018). We are still some distance away from this theoretical problem having real-world economic implications, but the implication of the winner-takes-all dynamics of AI is that, were AIs to be granted patenting rights, a company could very rapidly claim a first mover advantage on some AI technology and then make its position unassailable through aggressive, automated patenting of further AI-led refinements of an original product.

Under the circumstances where transparency is desirable, in the need to improve the ability of future researchers or investigators to see and understand decisions and outcomes from AI – or indeed simply for affected or concerned members of the public to see the same – patents on AI applications should be subject to weaker, rather than stronger, enforcement.

# 3. RECOMMENDATIONS

The case for reform and action today is urgent. If the predictions for the internet of things are accurate, and if AI continues down its data-dependent path, we are only in the very first years of a new, data-dependent economy. Given the immense path-dependencies of technological development and the forms of path dependency that the data economy has thrown up, it is essential to try and get the forms of regulation, management, ownership, and control correct now. If we don't, we will find ourselves lacking the tools or even the capacity to fix mistakes years down the line.

The development of a digital commonwealth means looking beyond the current ownership model for data, and into developing more appropriate models for the different uses to which data can be put.

### Recommendation 1: Creating an Office for the Digital Commons

Building on the recommendations in *Unlocking Digital Competition* (HM Government 2019) and IPPR's *The Digital Commonwealth* (Lawrence and Laybourn-Langton 2018), **a new Office for the Digital Commons should be created to oversee the effective management of the digital commons in Britain**. This should include the functions of both the competition authority proposed by *Understanding Digital Markets* and the similar 'Office for Digital Platforms' proposed in *The Digital Commonwealth*. It should also establish a broader remit to regulate the existing provision of digital services through the platform utilities in particular, and develop a forward-looking approach to the future development of the digital commons.

**Any new regulator should be charged with a 'stewardship' role over the digital commons,**[18] using its powers to intervene in favour of open data and the broader public good – defined not only by reference to reduced costs, but the broader public benefits of data. This would include a specific remit to intervene to prevent the "enclosure" of future digital spaces; for example, by blocking mergers that would lead to the private collection and extraction of data. Its powers and remit would therefore be broader than the narrow focus on securing competition currently held by the Competition and Markets Authority. The Royal Society and British Academy's recent joint report (2017) identified the need for a strong stewardship role in the management of data; we share their belief in the importance of clearly understood data governance principles, but think a new body should have stronger regulatory powers for the public good than that report envisaged, given the serious potential for social harms that we have identified earlier.

IPPR's 2018 report recommended the creation of a 'Digital Britain' service to "curate the nation's data" (Lawrence and Laybourn-Langton 2018). The Office for the Digital Commons proposed here extends IPPR's idea and suggests giving this organisation a stewardship role, looking across public, private, and third sectors. We recognise the continued need to preserve and curate the immense public sector data trove created in the UK, with a particular need for maximising the public value from consumer-focussed digital content, principally through the BBC. Common Wealth's more recent proposals for a British Digital Cooperative gave an outline on how such an institution might function, breaking open the public corporation model of the BBC to provide a greater access to both content produced and options for producing content (Hind 2019). The government's proposed regulator will reportedly stick closely to the recommendations of the *Unlocking Digital Competition* report; it is suggested here that it should, as a minimum, also take on a role for the stewardship of data nationally.

## Recommendation 2: Building local digital commonwealths

### Procurement to help build a local digital commonwealth

From being one of the first widely touted 'smart cities', seeking to digitally integrate local services but doing so on a fairly standard commercial basis (Ramon 2017), Barcelona is actively aiming to create a new, more accountable, and publicly focussed digital city. There, major tech companies have a growing interest in the provision of services and technology to urban areas: Google is moving in to the provision of urban services, through its Sidewalk Labs project in Toronto, while both Google and Amazon are exploring the provision of smart grids (Olson 2019).

Barcelona's approach, clear since the election of housing activist Ada Colau as mayor in 2015 and the appointment of Francesca Bria as the city's chief technology officer, has been deliberately pitched as an alternative to the conventional smart city model, which Bria and others have criticised as little more than a digitised version of existing "neoliberal" models of city governance (Bria and Morozov 2018). Tensions in the model had already become apparent in the city: for example, around the city's ambitious programme to establish 20 "makerspaces" as part of its Ateneu programme, turning otherwise abandoned buildings to provide community 3D printing and other small-scale production facilities. One of these spaces was established in Ciutat Meridiana, one of Barcelona's poorest districts, in a building otherwise used as a foodbank. Protests and an occupation ensued (Smith 2015), highlighting the clash between the plans of a 'modernising' council (however well-intentioned), and the needs and wants of local residents.

Instead of this top-down model of a digital city, Barcelona has attempted to put data and civic digital technologies into the hands of its citizens, inverting the usual flow of city governance. The DECODE program aimed to develop an "open source, distributed and privacy-aware technology architecture for decentralised data governance and identity management" (DECODE 2016). The front end of this is software designed to make visible to Barcelona's citizens the data the city is collecting: so, for instance, the city's Sentilo project, placing air quality and noise sensors across the city, has supplied information on noise levels back to the council, which in turn has been able to match residents' complaints about noise and pollution with precise data and take action on the problem (Grantham 2018). More ambitiously, the Decidim platform attempts to take the same principle of making data visible and apply it to the decision-making process itself. Decidim provides a virtual space to establish meetings, discuss proposals from the city council, and make proposals back to the city government. The front end for the software integrates with the municipality's store of data, presenting different information as (for example) maps of proposed rezoning exercises, and the virtual meeting points can be turned into real-world citizen's assemblies.[19] At present, Decidim has 31,000 registered users, and 9,000 citizens' proposals have been generated since its launch in 2016. Built on open source principles, the software is easy to adapt to other circumstances and, at present, 50 different organisations (from city councils to cooperatives) are making use of the software

19 See: http://decidim.barcelona

where distributed but democratic decision-making is required (Ajuntement de Barcelona 2019).

Barcelona has also successfully used its procurement powers to open up the data commons. Vodafone, provider of telecoms services to the city council, is now contractually obliged to hand over the data it collects to the council for anonymised access via the city's open data portal. The city has rewritten its procurement guidance to build in considerations of public access to data, which then in turn integrate back into the city's tools for digital participation (Grantham 2018).

Local authorities in Britain have fewer powers than is typical in the rest of Europe, but procurement remains one of the areas where significant controls can be exercised. In the UK, the 'Preston model' has seen the Lancashire city in the vanguard of local councils seeking to use their procurement powers more thoughtfully, and working with major local buyers to support businesses. This approach could be usefully extended into the digital realm; major local authorities, like the new combined authorities, work at a sufficiently large scale as to hold significant power over suppliers. For the smaller councils it may be necessary to collaborate with others, or to work with anchor institutions on procurement.

**We recommend that local authorities, combined authorities, and metro mayors build consideration of the use of data for local public good into their procurement guidelines.** Local authorities should consider cross-boundary collaboration to achieve scale in negotiations where necessary, and central government procurement guidance should include provisions for the local and public use of data in procurement contracts. Local development plans and local economic strategies should build in specific planning policy for the data economy, including requirements for developers to allow public use of their data via planning obligations and section 106 agreements.

### Local licensing should include data provisions as standard

Increasingly, providers of services in a locality will be digitally-enabled – such as companies offering meal deliveries, or ride-hailing apps. But local licensing regimes have been slower to build in a consideration of the digital part of a local operator's functions, with the result that potentially valuable data is being extracted from an area without the public receiving a fair slice of its value.

Local authorities should look to include provisions for the fair access and use of data generated by licensees in the provisions of licences to operate. National government guidance and training should be provided for local authorities to enable them to better understand the types of data being generated locally.

### Open data as standard

Transport for London has committed to making the data generated from its services open to use for developers and researchers, and provides a bespoke Application Programming Interface (API) to enable this. Over 17,000 developers have registered to use TfL's data, and TfL estimate that 42 per cent of Londoners use apps reliant on their API, covering such things as live timetable updates and route-planning (TfL no date). Deloitte estimate that the economic benefits of TfL's open data policy amount to £130 million of economic benefits and savings across London annually (Deloitte 2017).

The same principles can be extended to other data collected locally, and local authorities should be seeking, where possible, to place the data generated by their activities in an anonymised and open form as a matter of course. The new combined authorities, in particular, have the scale needed to generate significant benefits for their constituents, as the example of TfL has demonstrated. Central government guidance should be provided for local authorities seeking to build their own open data resources.

### Common ownership of digital technologies

In addition to the creation of a data commons, containing a variety of different forms of data ownership appropriate to the tasks at hand, there is a solid case for placing the technologies generating such data into public and collective ownership. Work by Nesta has identified the use of drones in urban areas for the public good – for example, in traffic management – as part of the emerging digital infrastructure (Nesta 2018). Similarly, the development of smart grids for energy generation and distribution creates opportunities for new sources of local value. However, the risk in these and other instances of emerging new data technologies is that the ownership of the technologies themselves, as well as the valuable data they generate, will be held outside of the places actually generating the wealth, and placed beyond the control and management of the local population. Nesta highlighted the potential for a local authority-owned drone service (ibid), and, with the cost of smart, digitally-enabled and connected equipment continuing to drop, there is a solid economic case for local authorities and communities to look into the direct ownership of new digital technologies.

**We therefore recommend that local authorities, either individually or in partnership, as well as combined authorities and metro mayors, identify the key points for intervention in new digital infrastructure and, where appropriate, commit resources to ensuring infrastructure is under local and democratic control.** Retention and effective management for the public good of new infrastructure will be essential.

## Recommendation 3: Creating common ownership of digital spaces

A genuine digital commonwealth would seek to encourage this expansion of public value wherever possible. This section proposes a number of measures intended to push digital policy towards the creation and maintenance of commonly held digital spaces.

### Open banking as a provisional success story

Open banking was introduced following a CMA report on competition in UK banking in 2016, and has been effective since January this year. It has created a common standard to allow the secure, private sharing of a user's financial data. This means that third parties, such as app developers, can read a user's data and provide services based on it, but only with the user's permission. One example would be the apps that monitor spending activity and make automatic decisions about how much a user can afford to save in a month.[20]

Along with the EU's Revised Payments Services Directive (PSD2), these regulatory changes could break open existing models of retail banking. Instead of any individual customer using a single bank for all their services, secure data sharing could allow a proliferation of choice between different companies. This is where government has a role to play: to facilitate open standards for data and to support better data readiness and accessibility, while ensuring safeguards such as in the General Data Protection Regulation are adhered to. Barriers to entry to the market would be reduced, allowing new challengers to enter (in theory), and the scope for innovation would be widened. The hope of the CMA is that by breaking open banking data

20 Some examples are given in Warwick-Ching 2019.

silos, competition alone will produce better outcomes for consumers. One industry analysis puts the potential loss of profits for incumbent banks at over £6 billion a year – from squeezed margins and the loss of customers to competition. Combined with Big Data, open banking has the potential to undermine existing structures of the financial industry.

It is critical to note that the presumed benefits of open banking are framed around the promotion of competition automatically creating more desirable outcomes. Britain has an unusually uncompetitive retail banking sector, with a very small number of companies dominating the markets for deposits (four banks account for 70 per cent of retail bank deposits in the UK) and a very low rate of switching between banks by customers (CMA 2016). In these circumstances, there can appear to be immediate gains – through a loss of economic rents accruing to major banks – from creating more competitive market conditions. However, as the Finance Innovation Lab and their partners have argued, for wider social gains to be realised, the use of open banking and wider access to data will require the sector and government to engage more constructively with civil society (Finance Innovation Lab 2018a). They argue that this should include the creation of a 'third party code of conduct', and significant investment in organisations looking to apply open banking for non-commercial and socially focussed use (ibid 2018b). IPPR has called for more inclusive Fintech innovation, perhaps through the use of a challenge fund to incentivise socially motivated innovation (Statham et al 2020).

The provisional success of open banking should be studied, and could potentially be applied to other data-intensive parts of the economy where there is a need to break open possible monopolies on the use and exploitation of data. Transport use is one possible future example – in addition to public transport use data, anonymised private car use data is a potential source of value – but, more generally, a move towards the internet of things will require robust, publicly trusted standards for the use of data to allow the full value of it to be realised. **We recommend a close study of open banking with a view to replicating its functioning in other data-intensive markets, potentially overseen by the new Office for the Digital Commons, building in specific provision for the creation of social value.**

### Weaken patent enforcement and support open source

As we have discussed, AI creates specific difficulties for the conventional framework of intellectual property rights, notably around the assignment of patent rights and the risks to tractability from over-patenting. This suggests that the existing patenting system should be made *less* rather than *more* restrictive in its application to AI patenting rights. Leaving aside the question of whether AI itself should patent (involving broader issues of personhood under the law), more rigorous enforcement of AI patents and other IP rights will most likely lead to the reinforcement of existing monopolies, at the potential expense of future innovation, and potentially also make resolving and understanding conflicts around the application of AI more difficult.

**We therefore recommend that the UK's Intellectual Property Office adopt a lower enforcement standard for the application of patents to AI, and potentially move towards their removal altogether.** The creation of a digital commonwealth is not just the creation of an open, democratic economy of data – it should also encompass, as far as possible, the opening up of the applications and use of that data. Already, AI research depends on open source principles and collaboration among researchers, with even major corporations choosing to publish their findings on free and open web archives like arXiv, and making open source software available on GitHub (WIPO 2019). The principles of open source should be encouraged, and expanded. **Government should prioritise procurement from providers using open source, where this does not**

**conflict with other objectives, and look to build open source principles into its own future data and software use.**

### Data trusts to steward data use

The fundamental economics of data create a problem: any single individual's data is close to worthless, and has to be aggregated and analysed to be of value. But the process of aggregation leads automatically to the creation of monopolies, as single institutions – in our case, the platform giants – aggregate the available data and develop exceptional skills in its analysis. This, in turn, creates some of the economic and social problems we have described in this report, but appears unavoidable for as long as data needs to be aggregated.

Data trusts are one way to try and avoid this problem. Sitting between an individual generating data and the company or other institution wanting to use it, a data trust is when control over data is transferred to a third party who is legally-bound to use it for some predefined purpose. Ideally, a trust could take data from multiple sources and find a fair and independent means to steward its use for all, balancing out potentially conflicting interests. There are other, similar trusts in the non-digital world: community land trusts have existed for a number of years to steward gardens, civic buildings, and other community assets, while 'trust ports' are operated by independent boards for the benefit of their own stakeholders. Data trusts take that model and replicate it digitally (ODI 2019). The Hall and Presenti independent review for government, *Growing Artificial Intelligence in the UK*, came down strongly in favour of the creation of data trusts, with specific policy recommendations for government to "share data in a fair, safe and equitable way" that will promote the development of AI (Hall and Presenti 2017).

The trusts themselves could take different forms; for example, Alphabet's Sidewalk Labs has proposed managing the data collected from its Toronto development through an "independent civic data trust", which would also extend its powers into governing which companies had access to the development. Alternatively, data trusts could be built from the bottom up, where a group of users come together to pool their data for a specific purpose (ODI 2019).

The Open Data Institute has recently piloted three data trusts in the UK: one in Greenwich, to gather data from urban infrastructure use; one working with Wildlabs Tech Hub to gather information on the illegal wildlife trade; and one working with food and drink manufacturers to gather data on food waste. The sheer range of the issues covered gives a sense of the potential here, while the ODI findings suggest that the model can become broadly applicable (ibid).

However, there are barriers to doing so. First, the legal definition of a 'data trust' is not yet clear, partly also reflecting the difficulties around defining the ownership of data. Second, the business or social case for a trust is not always easy to define. And third, the financial and legal barriers to establishing a trust may make them inaccessible for those who would otherwise benefit. There is also some confusion over the term 'data trust', particularly given the separate, legal definition of a trust under British law, which the ODI found to be unhelpful for the purposes of establishing a data trust (ibid). The relative complexities in establishing data trusts may well limit their use to relatively specialist purposes, although the sheer spread of data collection suggests that this would still imply a relatively wide spread of use. The independent review recommendations on creating and supporting data trusts are valuable (Hall and Presenti 2019), but if they are to spread and become a more conventional means to steward data in the public good, they will need to be placed on a more solid legal footing.

**We therefore recommend that the government move to establish a widely understood definition of a 'data trust', distinct from conventional trusts as defined under British law, and that resources are made available to promote their creation and use.** This, again, could be done under the aegis of the new Office for the Digital Commons, integrating data trust policy with its wider remit. **Future moves to extend the rights of citizens over their data should include the right to establish, with others, a data trust for the purposes of managing and regulating their data.**

### Protecting data sovereignty

**Stewardship of the digital commons should extend to protection from unfair international exploitation.** Negotiations for future trade deals should, as a point of principle, look to improve and extend existing protections for cross-border data transfer, as a means to preserve the value of data held in the UK for the benefit of its citizens. Priority should be given in negotiations to the preservation of existing data rights and protections, with a clear focus on anticipating future developments and progressively extending protections as needed. Data sovereignty has become a core element of sovereignty in general and should be prioritised in trade negotiations.

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