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Adjusting to the digital: Societal outcomes and consequences

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ABSTRACT

Innovation in digital technologies is central to contemporary debates about the need for policy and regulatory adjustment in response to the consequences of the centrality of these technologies in contemporary societies. Christopher Freeman's research in relation to changes in techno-economic paradigm and, specifically, in relation to the information and communication technology (ICT) paradigm, cautioned that assessments of these changes needed to go beyond market dynamics to examine social, cultural and political issues. In this paper several predominant themes in his work are foregrounded – the ambiguity of changes within the ICT paradigm; the role of guiding principles in influencing expectations about societal outcomes; and the importance of political factors in shaping the consequences of technological innovation. These three themes are then deployed in a discussion of recent innovations – two technical (5G mobile networks and artificial intelligence-as-a-service) and one institutional (proposals for changes in the international taxation regime in response to claims that the existing regime is inappropriate in the face of global online service provision). In each instance, the aim is to illustrate how following Freeman by giving attention to the themes operates as an important guide to analysis of adjustments to novel deployments of digital technology. The conclusion emphasizes the value of Freeman's contributions to shaping research agendas that acknowledge the need to humanize technology, to consider alternatives to taken-for-granted principles and practices, and to take into account the role of political power in tandem with concentrated economic power.

Introduction

In the third decade of the 21st Century digitalization and online connectivity (when accessible and affordable) support services yielding enormous quantities of data. Companies are appropriating these data for monetization purposes. Governments are seeking access to them in support of public services. And artificial intelligence (AI), machine learning techniques and data analytics are permeating decision making. Commercial datafication practices are being employed by a small number of dominant digital platform companies originating in the United States or China. Accompanying these developments is debate about the societal benefits, the harmful consequences and the appropriate policy responses.

One view of these developments is that if adjustment to these changes is sufficiently rapid, destabilizations in the economy and harms to the polity will be mitigated as the economy returns to equilibrium following the shock of rapid digital technology innovation. This, it is argued, will ensure that benefits for all are maximized to yield valued societal outcomes. A different view is that the application of these technologies for commercial purposes is producing multiple social and political harms. These include the proliferation of mis- or dis-information, hate speech and an overreliance on algorithm-derived biased information as a result of behavioral surveillance (Mayer-Schönberger & Cukier, 2013; Van Dijck *et al.*, 2018). In this view, the harms of ubiquitous digital services cannot be mitigated without policy intervention. This is because the outcomes of datafication as practiced especially by the largest digital platforms are deemed to jeopardize public values including rights to privacy protection, non-discrimination and equitable treatment of citizens and consumers.

The study of how innovation has produced the microelectronics-based information and communication technology (ICT) paradigm is at the heart of Christopher Freeman's work (Freeman, 2007). At the time he was writing, these developments were captured under the label information society revolution. They are more likely now to be characterized as the 4th Industrial Revolution (Schwab, 2017) or, critically, as 'data colonialism' (Couldry & Mejias, 2019). In this view, the principal

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ambition of continuous innovation within the ICT paradigm – and now an AI-inspired paradigm – is a logic of accumulation based on the extraction of economic value from data with returns accruing disproportionately to the owners of digital systems located in the global North. The outcome of this market dynamic is seen as presenting multiple challenges for the future of human autonomy and welfare in the wake of computerized operations generating 'behavioral surplus' for the benefit of 'surveillance capitalism' (Zuboff, 2019). Notwithstanding criticism of the business models of the 'big tech' and many other companies that apply digital technologies and services and policy debates about how datafication activities should be regulated, citizens and consumers are persistently exhorted to adjust to the shocks of technological change in the digital infrastructure (the internet, fixed and mobile communication) and in service applications (social media, electronic commerce, search engines and data analytics) (Mansell & Steinmueller, 2020).

In much of his work in the systems of innovation tradition (Borrás & Edquist, 2019), Freeman focused on the R&D system, on firm-level innovation and on policy designed to influence firm-level innovation. However, especially in his work on the determinants of the ICT paradigm, he frequently encouraged research intended to answer questions about why and how new technologies, institutions and practices come into being with the aim of investigating their broader consequences for society (Freeman, 1994). He insisted, with Carlota Perez, that the societal adjustments needed to benefit from or mitigate harms accompanying the ICT paradigm are hard to achieve (Freeman & Perez, 1988) and that they emerge from 'experiments, enthusiasms, theories, beliefs and interests' of multiple actors (Freeman, 1994, p. 11). He was clear that benefits and harms linked to the ICT paradigm cannot be assessed adequately when analysis is restricted to technology-driven shocks to the economic system, and he often commented upon the importance of cultural, social and political factors.

Of numerous prominent themes in Freeman's work signaling the complexity of ICT paradigm-related adjustment, three are selected for consideration in section 2 to highlight the attention he gave to determinants of change beyond the economic analysis of market dynamics. A first theme is the attention Freeman gave to the ambiguity of technological innovation outcomes. A second theme is the need to understand the principles that become embodied in institutionalized norms and how these condition expectations in relation to the design and use of ICTs. The third theme is the importance of politics in the innovation process and, particularly, the interpenetration of political and economic power. These themes are used as a guide in section 3 for an examination of contemporary developments in the ICT paradigm (5G mobile networks, artificial intelligence-as-a-service (AIaaS) and taxation policy). These are selected not only because of their topicality at the time of writing, but because each is the focus of contentious debates in areas that go beyond innovation policy. The first two exemplify novel digital systems that are accompanied by high expectations of benefit and of harm. The third, taxation, is an area of policy that is being destabilized by the ICT paradigm. Each is an instance where analysis emphasizing these themes helps to clarify that there is always a potential for alternative choices to be taken about the technology innovation pathway. This is especially so when it is recognized that such choices are informed by values in addition to economic valuations (Freeman & Louça, 2001).

2. Ambiguity, principles and the political as paradigm adjustment themes

Adjustments to changes in any techno-economic paradigm are understood to be uncertain and to give rise to ambiguous outcomes in Freeman's work. Outcomes are treated as a result of multiple interconnected causes, be they cultural, economic, political, scientific or technological (Freeman & Louça, 2001). In the face of a multiplicity of causes, the analysis of paradigm adjustment for Freeman required a shift 'from market economics to political and social economy' (Freeman & Soete, 1997, p. 411). This shift then encouraged him to emphasize the importance of changes in regulatory regimes, ideas and customs; that is, the rules[1] that condition technological and societal transformation. An analytical move beyond economic analysis of market dynamics towards additional facets of techno-economic and socio-technical transformation necessarily adds to the complexity of research. For Freeman, it meant acknowledging that the outcomes of ICT-inspired change may be positive or negative for different groups.

If ambiguity is unavoidable in the face of complexity, then analysis must depart from relatively constrained theoretical models that assume linearity between cause and effect. Ambiguity, the first theme highlighted here in Freeman's assessments of the ICT paradigm is illustrated, on the one hand, by optimism when he argued, for example, that ideas, ideals and foresight alongside technologies might help to avert 'gloom and doom' scenarios as suggested by models of human survival and human freedoms in the face of population growth (Freeman, 1974, p. 451; Heilbroner, 1974). He would be similarly optimistic decades later about the benefits of technological innovation: 'the economics of technical change still demonstrate the possibility of a bright future for human beings' (Freeman, 1992b, p. xii). On the other hand, Freeman's assessments of technological change were tinged by pessimism. In the early 1970s, for instance, he argued for 'social techniques' of policy making because 'the bias in the world research-innovation system is so great as to constitute a danger to the future of human society' (Freeman et al., 1971, p. 382).

He read J D Bernal's (1929/1970) utopian imaginaries of a future in which compound synthetic brains might be interconnected to guide choices that would overcome poverty with interest (Freeman, 1992a). When it came to assessing innovations in computational power, however, he signaled that these might be dangerous if they were to encourage a substitution of 'mathematics for knowledge and computation for understanding' (Freeman, 1973, p. 12-13). He identified problems if computer power and networks for monitoring behavior were to be used 'in the style of "1984"' to control populations (Freeman & Soete, 1987; 2005, p. 351). He also noted that invasive ICT systems could result in 'reductions in social solidarity' (Freeman & Soete, 2005, p. 351). Thus, despite his hope that adjustments accompanying the ICTs paradigm might result in a better world, Freeman's work displays a commitment to upholding fundamental human rights and social solidarity in the face of technological innovation. With his colleagues, he emphasized that neither technology nor innovation policies alone would solve social, political and economic problems (Freeman et al., 1982, p. 200).

A second theme prominent in Freeman's work is his attention to 'guiding principles' or 'commonsense practices' associated with techno-economic paradigms (Freeman, 1992b). Emerging prevailing principles and practices were treated not simply as 'an adjustment to transformations brought about by causes outside that system. Societies have, in other words, a say in the shape technology is likely to take' (Freeman & Soete, 1997, p. 429). He insisted that technical innovation 'first takes place in the minds of imaginative people' (Freeman, 1979, p. 211) and he emphasized the importance of examining mental models and biases arising from experiences that shape decisions about the design and deployment of new technologies (Freeman, 1973). Here his treatment of systems of innovation was informed by those who worked alongside him with training in sociology, psychology and political economy. Their work emphasized social and political determinants of changes in socio-technical paradigms and how ideas, values and norms come to infuse imaginaries or expectations in society. Freeman understood that some of these become dominant, shaping the moral order and what is

[1] Freeman rarely used the term 'rules'. This terminology is present in contemporary studies of socio-technical transitions (Schot & Kanger, 2018; Schot & Steinmueller, 2018) and it frequently appears in institutional economic traditions applied to examine digital technology innovation processes (Mansell & Steinmueller, 2020).

regarded as beneficial or harmful.[2]

Freeman commented that 'neither economists, nor sociologists, nor political scientists have satisfactory theories of social change', and he called upon academics to abandon their 'jealously guarded kingdoms' (Freeman, 1973, p. 6). In this way, interdisciplinary engagement might encourage a better understanding of prevailing mental models and principles and how they are implicated in harms such as social exclusion and the emergence of a 'large underclass' (Freeman & Soete, 1997). He emphasized that new ideas – guiding principles and practices – need to be tested against evidence through recourse to 'fact, experiment, experience and logical argument', not simply assumed to be beneficial for society (Freeman, 1992a, p. 29). In this context, he called for 'pluralistic political and social arrangements which deliberately tolerate organized criticism and opposition and the expression of alternative approaches' (Freeman, 1992a, p. 29). Otherwise, he suggested, alternative pathways for technological innovation would be unlikely to be discovered or taken up because of the dominance of prevailing guiding principles.

In his assessments of technological change and, specifically, the ICT paradigm, a third prominent theme in Freeman's work is the salience of political power and values. As he put it, it is 'essential to look at the political bias and the values implicitly or explicitly present in any study of social systems' (Freeman, 1973, p. 12-13). He expected the outcomes of techno-economic change to vary in relation to the politics of 'regimes of regulation' (Freeman, 1989) and with the 'uneven and varied response of governments, firms and industries' (Freeman & Perez, 1988, p. 64), and, of course, also consumers and citizens. He also noted the inertia of institutions in response to harms or threats and 'the political power of established interest groups' (Freeman & Soete, 1987, p. 58). For example, in contrast to those who imagined a potential for a horizontalization of power relations in the wake of digital networks and their applications, he observed that these developments did not 'dispose of the question of power within networks' (Freeman, 1998, p. 464-465).

Freeman's observations about asymmetrical power relations and their potentially harmful consequences were informed by a departure from the theoretical assumption that private individual interests tend to coincide with social interests, and he cited Keynes approvingly:

> 'the World is *not* so governed from above that private and social interests always coincide. It is *not* so managed here below that in practice they coincide. It is *not* a correct deduction from the Principles of Economics that enlightened self-interest generally *is* enlightened …" (Freeman & Oldham, 1991, p. 4, emphasis in original) citing (Keynes, 1926/2010, p. 288).

He was clear that when a prevailing set of guiding principles overemphasizes individual and corporate interests, this can contribute to wealth and income inequalities and other social harms. For example, it can threaten civil liberties, endanger industrial and national security, and limit the scope for technological choices and alternatives (Freeman, 1992c). With regard to the governance of powerful corporate actors, he suggested that 'the world is ready for a "Global New Deal" and no longer trusts neo-liberal solutions' (Freeman, 2001b, p. 477). This implied that 'market demand is not necessarily the sole, or even the principal, determinant of the scale and direction of inventive and innovative activity - still less of scientific activity' (Freeman, 1979, p. 206). Political and economic power are treated in Freeman's work as interdependent and this was especially evident when he turned to technological unemployment and its links to human immiseration ((Freeman, 1994; Freeman & Soete, 1994); see also (Frey, 2019)). He recognized that there are always alternatives, inspired by contending ideas, values and norms that may help to avert harm. As he put it, although it is 'impossible to foresee the future precisely', it is possible to take action to support outcomes 'which seem desirable and profitable, or prevent those which seem dangerous, unwelcome or damaging' (Freeman, 1995, p. 3).

In summary, using an analytical approach embracing ambiguity, an understanding of emerging principles that shape expectations, and a consideration of the politics of innovation alongside its economics, Freeman concluded that 'there would have to be a massive change in social justice on a global scale' if a 'golden age' is to emerge from the ICT paradigm (Freeman, 2007, p. 50). This conclusion was informed by his assessment of the prevailing values and practices associated with progressive shifts within an ICT paradigm. He noted that where such shifts were inconsistent with rights such as privacy protection, the equitable treatment of human beings and the implications for social solidarity and democracy, action would be necessary. The next section employs the three themes discussed here to developments in the ICT paradigm where societal benefits and harms and appropriate adjustment responses are disputed.

3. Contentions in contemporary paradigm adjustment processes

If techno-economic and socio-technical change are continuous within the ICT paradigm – not shocks requiring mechanistic market adjustments – analytic attention to the themes discussed in the preceding section sensitizes research to benefits and harms, to the need for an assessment of likely outcomes and the necessity of policy responses. As we have seen, Freeman cautioned against mono-causal explanations of ICT paradigm change, its origins and its consequences. By focusing analytically on the themes - ambiguity, guiding principles and political power – in an examination of components of the ICT system - 5G mobile, AIaaS and the operation of the taxation regime – issues come to light that would go unnoticed or be underplayed if analysis were to focus mainly on market dynamics. In these examples, consistent with Freeman's emphasis on the themes, it is not assumed that private (marketized) interests always coincide with broad and often conflicting societal interests.

3.1. 5G innovation adjustments

5G mobile networks are set to become the communication infrastructure upon which government and industry depend and wireless connectivity is now a vital feature in many consumer and citizen lives. 5G deployment is estimated to generate some USD 250bn in revenue by 2025, providing a major boost to the data economy. 5G networks can support person-to-machine and machine-to-machine communication (the Internet of Things) with multiple applications envisaged across and within vertical sectors of the economy (transport, logistics, automotive and other manufacturing, media and entertainment) and within the public sector.

5G uses a new network architecture with software-defined virtualization techniques and proprietary and / or open interface standards. The technical standards for 5G have been evolving for some time with the International Telecommunication Union (ITU) publishing its *IMT for 2020 and Beyond* vision for 5G in 2015 (ITU, 2015). Standardization work has coalesced internationally around a global partnership uniting numerous standards development organizations.[3] 5G is sometimes depicted as 'the realization of a datafied dreamworld' (Mattern, 2019, p. np) with improved data security, resilience and reliability and multiple benefits for industry, consumers and citizens (EC, 2016a; ITU, 2015). But 5G is also linked to intense concern about harms in relation to data protection, privacy and surveillance (Mansell & Plantin, 2020).

[2] Freeman's work on ICT paradigm guiding principles was influenced by his association with SPRU colleagues with training in numerous social sciences disciplines beyond economics and by a similarly interdisciplinary network of research centres under the ESRC's Programme on Information and Communication Technologies, e.g., Dutton (1999, 1996); Mansell (1994); Miles (1988); Thomas & Miles (1990) and see Mansell (2002, 2012).

[3] See 3GPP: A Global Initiative, https://www.3gpp.org/about-3gpp/about-3gpp. For a review of mobile service history, see Lemstra (2018).

Ambivalence about the outcomes of 5G for society depends upon which analytical lens – market economics or political and social economics – is used to assess the impacts of this change in network design within the ICT paradigm.

In some instances, it is assumed that the commonsense principles guiding the 5G innovation pathway are such that this new technical system will be designed and implemented to balance public values (privacy, data protection and safety) with economic values (stimulating global competitiveness of hardware manufacturers and software developers). While it is recognized that 'technology is a manifestation of the values of those who design it' in much of the promotional 5G literature (Watts, 2020, p. 18), it is also often argued by observers in the Western democracies that authoritarian states will 'take advantage of preferred relationships with technology firms to build backdoors for government access that allow them to surveil the private lives of citizens and political opponents at home and abroad' (Cyberspace Solarium Commission, 2020, p. 17). Assessments of benefits and harms of 5G deployment are politicized around conflicting values and there are substantial uncertainties with very little public domain evidence that can be used to verify claims about harms such as threats to privacy or national security.

Freeman's emphasis on a wider analytical lens beyond the economic, also helps to direct attention to social and cultural issues such as resistance to the roll out of 5G due to claims about harms to health. Unverified claims, often circulated by celebrities, concerning harms linked to electromagnetic field exposure or radiation have circulated with previous generations of mobile services, but as 5G trials began there have been attacks on 5G equipment installations and on workers (some of these targeted 4G technology, not new 5G equipment) (Waterson, 2020). The role of social media in amplifying the circulation of inaccurate information about potential health threats quickly was linked to conspiracy theories spread by QAnon and others, fomenting political dissension and becoming entangled with origin claims about the Covid-19 pandemic, notwithstanding the World Health Organization's insistence that there is no health effect causally linked to exposure to 5G or other wireless systems (WHO, 2020).[4] This is a clear case in which geopolitical, economic and social interests become entwined with decisions concerning investment in a new digital technology architecture and the commonsense principles that should inform corporate and government policy action (Mansell & Plantin, 2020; Meese et al., 2020).

Different views about the outcomes associated with 5G permeate conflicts among government and industry advocates of 5G standards. Their ideas and values influence whether open standards (e.g., for the 5G radio access network (RAN)) are preferred over proprietary standards. Open standards, according to some, are expected to facilitate competition among equipment suppliers, boosting efforts to reduce reliance of mobile service operators on one of the most prominent leaders in the 5G equipment market, the Chinese-owned company, Huawei (Fried, 2020).[5] Equipment manufacturers, service providers and government representatives have been developing consensus-based 5G standards for some time. The standards relating to cybersecurity are being agreed internationally recognizing that the 5G virtualized service architecture presents risks to privacy and security for any country that deploys this new technology system (FCC, 2020).[6] China was an early active contributor to a TDD (time division duplex) standard (reducing interference between radio base stations) which is central for 5G, while the United States and Europe focused their efforts on FDD (frequency division duplex) for earlier generation mobile architectures. As a result, Huawei and the Chinese Institute of Telecommunications Research established a leadership position in international standardization activities, including standards for data protection and privacy in relation to the 5G architecture and then in equipment production (ETSI, 2020; Forge et al., 2019). In contrast, the United States government's participation in international 5G standards setting regarding security standards has involved limited observer participation in recent years. In relation to 5G standards Rutkowski notes that 'Washington's biggest cybersecurity challenge is itself. It exists in a bubble of non-stop, self--similar chat-boxes that have minimal knowledge or apparent interest in the history, the actual underlying technologies and ongoing [international] activities, or its own culpabilities in the global cybersecurity ecosystem' (Rutkowski, 2020, p. np).

Despite the expectation of benefits of 5G services, there is uncertainty about how consumer and citizen interests in privacy and data protection will be addressed. Much will depend upon the policies and practices that become embedded in regulatory regimes. In the United States, the aim is to ensure that the government sets 'the path connecting cybersecurity with profitability' for US-owned companies in the 5G market (Cyberspace Solarium Commission, 2020, p. 74) and 5G deployment is caught up in a United States – China 'trade war' initiated by the Trump Administration. This is justified by data security concerns, but also by a competitiveness challenge and, typically less prominently, by China's human rights record. In the United States the expectation is that '5G infrastructure will be an attractive target for criminals and foreign adversaries due to the large volume of data it transmits and processes as well as the support that 5G will provide to critical infrastructure' (The White House, 2020, p. 1). In invoking national security threats, the use of Chinese technology in 5G networks in the United States has been banned and, claiming risks to the Five Eyes security alliance, the United States government has sought to influence the technology choices of other countries.[7]

The United States government has lobbied to bring its Western allies into line with its geopolitical strategy, sometimes described as 'techno-nationalism'. For example, its national security adviser, Robert O'Brian, said, 'they [Chinese companies] are just going to steal wholesale state secrets, whether they are the UK's nuclear secrets or secrets from MI6 or MI5' (Sevastopulo, 2019, p. np). In early 2020, the United Kingdom's government sought a compromise with a parliamentary decision to approve limited use of Huawei's equipment in non-core parts of its 5G network (antennas and base stations) (Burgess, 2020). This was informed by its National Cyber Security Centre's assessment that security risks were manageable (NCSC, 2020). The vote was controversial: former Conservative leader, Sir Iain Duncan Smith, characterized the use of Huawei equipment as being like using a Nazi firm to develop Britain's radar system in 1939 (Sparrow, 2020). By July 2020 the British

[4] 5G uses higher radio spectrum frequencies than earlier wireless mobiles services similar to those used in airport body scanners. Standards set by the International Commission on Non-Ionizing Radiation Protection and the IEEE International Committee on Electromagnetic Safety regulate maximum exposure. The WHO is studying whether the specific 5G exposure levels are likely to exceed safety levels and is expected to report in 2022, but no harms are anticipated.

[5] Companies involved in OpenRAN initiatives include NEC and many US companies that currently do not hold global leadership positions in the supply of 5G hardware or software. Some companies such as Cisco (US), Nokia (Finland) and Ericsson (Sweden) are developing open and proprietary approaches, the latter two having strong market positions in the RAN equipment market and mobile technology generally.

[6] International standards in this area include, for example, a standard for lawful interception (ETSI, 2019b) and technical specifications for the interception architecture and functions and delivery of required information to law enforcement monitoring facilities (ETSI, 2019a,b).

[7] The US 1994 Communications Assistance for Law Enforcement Act (CALEA) (US, 1994) enables the government to impose requirements on equipment manufacturers and network operators to enable lawful communications interception and to make certain customer data available to law enforcement agencies. In 2019 the Federal Communications Commission named Huawei and ZTE as companies without protections against unauthorised surveillance and indicated that US-owned companies cannot operate in the United States or overseas using their equipment (FCC, 2019).

government had reversed its position, ordering mobile network operators to remove all Huawei equipment from their 5G (and earlier generation) networks. European-owned companies (Nokia and Ericsson) have since bid successfully to provide the necessary 5G equipment (BBC, 2020). Other countries including Australia have decided to ban or much reduce their reliance on equipment supplied by Chinese-owned companies, while others, such as Japan, resisted pressure. China meanwhile has published a security framework calling on countries to 'stand against ICT activities that impair or steal important data of other States' critical infrastructure, or use the data to conduct activities that undermine other States' national security and public interests' (Ministry of Foreign Affairs, 2020, p. np). Huawei and government officials maintain that Chinese technology is no riskier than that supplied by non-Chinese owned companies.

It is also claimed that the Chinese state unfairly subsidizes Huawei and other Chinese-owned companies' development of 5G technology and that this presents a threat to the bidding prospects of companies based in other countries. Yet the United States is considering financial support for American-owned 5G equipment manufacturers and mobile service operators (The Economist, 2020) and the United Kingdom government is providing funds to support companies undertaking 5G use case trials and early network roll outs. Domestically, there is evidence that China is ramping up its deployment of surveillance technologies, e.g., facial recognition and data collection about its citizens as part of its datafication strategy (Batke, 2020), but this does not constitute evidence that Chinese companies will be forced by the Chinese government to reveal data generated in their external markets (FCC, 2019). In this conflicted geopolitical context, to protect against 5G-related cybersecurity risks the United States is seeking to develop its own alternative standards (Rutkowski, 2020). As Mueller says, however, 'one is tempted to ask what would happen if the Microsoft or Android operating systems were exposed to the same level of scrutiny as Huawei' for security purposes (Mueller, 2019, p. np).

In the case of 5G innovation we see the clear interdependence of political and economic power. The expectations underpinning claims and counterclaims about national security threats, 5G network vulnerabilities and state subsidies are difficult to resolve empirically because much information is subject to national security protections. There are consequences for society, nonetheless. Whatever the guiding principles that will prevail and influence 5G standards and practices, by focusing debate on China and its companies, the United States (and other countries) suggest that Western 5G implementations are safe from the point of view of national security and consumer and citizen privacy concerns. The exercise of political and economic power (through trade sanctions and bans on equipment), achieves a naturalization of the 5G architecture as an inevitable (positive) next step in technological innovation. Yet this architecture has the potential for a step shift in the capacity for commercial datafication. It presents new risks to citizen privacy and to regulatory regimes for data protection insofar as the deployment of 5G by any country will confront policy makers with a very substantial expansion in the availability of both personal and non-personal data for monetization controlled by larger and smaller companies. This outcome receives far less attention when the focus in 5G research is predominantly on market expansion prospects.

3.2. Cloud innovation adjustments

Digital services in the cloud are an increasingly debated facet of contemporary change in the ICT paradigm. Data generated online are stored and processed in cloud infrastructures offering infrastructure, platform and software 'as-a-service'.[8] The cloud industry is dominated by a small number of American-owned companies, the largest by revenue being Amazon Web Services, Microsoft Azure and Google Cloud. Others, including Chinese-owned companies such as Alibaba and Tencent Cloud command a sizeable market share.[9] In the European Union there are more than 1,000 European-headquartered cloud service companies,[10] with European-owned providers taking a small share of the market. The value of the data economy in the European Union 27 countries is expected to reach €829bn by 2025 or 5.8 percent of GDP and to provide many opportunities for skilled employment (EC, 2020b; Alemanno, 2020).

An addition to these services is AIaaS (AI as a Service) which enables the monetizing of data using AI-driven algorithms.[11] This service is marketed as a cost-reducing on-demand service option that can scale to meet customer requirements and as providing benefits in the form of personalized health care, improved policy decision making and opportunities to boost the data economy (EC, 2017). These services also are accompanied by acknowledged data security risks, harms associated with biased discriminatory outcomes in decision making, and threats to personal data and privacy protection (EC, 2020c). In Europe, the policy goal is to promote a common European data space governed to secure both European public values and to promote a 'data-agile' economy (EC, 2020b). And in this region, the prominent guiding principle or expectation is that public values such as the rights to individual privacy and to non-discriminatory treatment of consumers and citizens as a result of algorithm-based decisions will be balanced with corporate and state interests in economic value.

The European response to the foreign-owned platform supply of AIaaS confirms that there is scope to pursue alternative pathways within the ICT paradigm; that is, departures from the approaches taken by the dominant cloud service providers. The guiding principles in Europe for the provision of AIaaS stress the retention of human agency and oversight of AI/algorithm-based decision making, safety, privacy assurances and non-discrimination. Ethical principles and legislation requiring transparency, accountability and privacy protection are being developed to pursue a European alternative (EC, 2020c).[12] As the French Minister for the Economy put it, 'we are not China, we are not the United States — we are European countries with our own values and our own European interests that we want to defend' (Delcker & Heikkila, 2020, p. np). A European Data Strategy is being put in place to ensure that Europe is 'a leading role model for a society empowered by data to make better decisions – in business and the public sector' (EC, 2020b, p. 1).

Privacy legislation sets the regulatory regime for AIaaS and other services provided by digital platform companies in Europe. Since the dominant cloud providers are headquartered outside the European Union, they host data beyond European boundaries. The General Data Protection Regulation (GDPR) (EC, 2016b) sets rules for commercial transfers of personal data outside the European Union and there are efforts to establish 'data sovereignty' to ensure that European public values are secured. Questions may be raised about how effective this legislation is in protecting citizens' personal data, but regarding data transfer outside the European Union, a European Court of Justice decision has confirmed that Europe's privacy legislation holds when data are transferred to another country, even for defense or state security reasons

[8] This is changing with the 5G software distributed network which enables data to be stored on devices at the edges of networks.

[9] See Statista (2020) which includes platform-as-a-service and infrastructure-as-a-service and hosted private cloud services, and see software-as-a-service Holst (2020).

[10] See SAP (2020), 1,187 companies.

[11] Both supervised AI for classification and statistical analysis of large data sets and unsupervised AI relying on deep learning to generate predictive patterns.

[12] The European Union sees itself as being well-positioned for global leadership in the AI field having influenced the OECD's (2019a) ethical principles and the G20's endorsement of these principles.

(EU, 2020b).[13] This legal interpretation has brought Europe into conflict with the data protections available to citizens in the United States. Under the US Cloud Act (US, 2018), cloud provider companies can enter agreements with other countries for data access, but they are required to release data to United States authorities for criminal prosecution without informing data subjects. There is disagreement concerning what Europe's legal interpretation will mean in practice, but it is indicative of a move towards 'data sovereignty'. The cloud companies are likely to have stronger incentives to store personal data within the European Union especially if European authorities are 'particularly vigilant to protect and assert the rights, obligations and interests of Europeans and companies' (EC, 2020b: 23). These and other guiding principles are being incorporated within a new legislative package – the Digital Services Act and the Digital Markets Act (EC, 2020a).

The perception that the European data market does not favor the growth of European-owned cloud companies due to the dominance of foreign-owned platforms, combined with ambitions for data sovereignty, have yielded an alternative cloud architecture, GAIA-X. Its development was led initially by the German and French governments to counter foreign dominance in the AIaaS market (GAIA-X, 2020). It aims to create a competitive set of standards and procedures that will incentivize European companies to store their data under conditions where the user 'can be sure that European law is applied, and the providers know about the security and the GDPR readiness of their offerings and the payment conditions' (Ksoll, nd, p. np). Offering a directory of service providers, identity management standards and quality monitoring guidance, it will establish an open data infrastructure with common minimum standards for security- and privacy-by-design. GAIA-X operates as a layer above the platforms of both dominant foreign and European companies, with the former joining if they commit to GAIA-X's values and standards (Amaro, 2020; Bedingfield, 2020; Delcker & Heikkila, 2020).[14]

Adjustment to the ICT paradigm in this instance involves an *ex ante* data protection regime and a concerted effort to mitigate the risk of harms to consumers and citizens in relation to data privacy. Yet it does little to alter the core AIaaS guiding principle of the dominant cloud providers' business model. This requires end-user consumers to opt out of the data economy or to use privacy protection technologies requiring relatively high levels of data literacy if they want to maximize their individual data protection. For some analysts, this approach sustains the prevailing commonsense principles that 'perpetuate neoliberal regimes of responsibilization' (Flyverbom et al., 2017; Martin & Nissenbaum, 2020, p. 193), shifting responsibility disproportionately to individuals to secure their rights. For instance, auto-deletion of users' location data limits Google's accumulation of users' online data, but users must change their settings manually to opt out. This allows Google to claim that it performs privacy protection assurance that meets the required standards (Hern, 2019), even if data are not held within the European Union's cloud infrastructure.

The European response to dominant American and Chinese-owned cloud providers involves guiding principles for the data economy that are both economically motivated to achieve growth and politically or socially motivated to support European public values. The success of GAIA-X and other European policies (including antitrust measures) in addressing the asymmetrical power between foreign-owned and domestic cloud platforms in a way that enables competing values to be balanced is speculative at the time of writing. The outcome will depend on policy makers' enforcement capacity. These guiding principles may be actualized only as performative discourse that is not carried through in the practices of the companies (Helm & Seubert, 2020, p. 193). Harmful behaviors may go undetected due to the complexity of the digital system and the challenges of producing evidence to hold the companies to account. The commercial cloud providers are unlikely to forego opportunities to reap financial rewards from the monetization of personal and non-personal data if they can innovate to create novel ways of collecting and processing data that circumvent the policies that are put in place.

3.3. Taxation adjustments

Paradigm change is accompanied by changes in areas of the societal system less directly connected with choices about technical standards and regulatory regimes for digital services. Consistent with the need for institutional adjustments, international taxation rules have been under discussion as the ICT paradigm has enabled the global supply of services. The centrality of commercial datafication strategies and the dominance of very large foreign-owned digital platform companies are presenting challenges to the sustainability of the tax base.[15] By market capitalization and by value of digital transactions, the dominant companies generate very substantial revenues and, in most cases, group profits (CEPS, 2019). It is claimed that digital platforms pay substantially less than they should in the countries in which they operate (Freuler, 2020) and the international taxation regime is depicted as unfairly enabling tax avoidance and facilitating a path towards inequality.

In response to arguments favoring adjustment to this regime to better sustain government support for public services, investment in infrastructure and to avert social disorder resulting from rising socio-economic inequalities in the mid 1990s, a 'bit tax' was proposed to collect revenues from the transmission of information by electronic means (HLEG, 1997; Soete & Kamp, 1996). Criticized at the time for the potential impact of such a tax on the rate of innovation in digital technology and services, in 1998 the World Trade Organization imposed a moratorium on taxing services provided using the internet. The expected benefits of digitally-driven innovation for economic growth received a privileged position as compared to arguments about the need to sustain public welfare. With human populations facing health, unemployment and environmental crises, the urgency of a response to the rise of 'big tech' platforms and the need to ensure that countries have a sustainable tax base is increasing. There is movement as well towards taxes specifically targeting the large digital platform companies with a view to sustaining public interest journalism and media as they have become dependent on platform services to distribute their content. Ambivalence about which values should receive priority has created institutional rigidity and it has not so far been politically feasible to agree guiding principles for international taxation in the digital era.

In the pre-internet era, the existing international taxation principles were regarded as common sense.[16] Taxes are levied against revenues (e.g. value added tax) or profits (e.g. corporate profit taxes) in the country where a company is legally established. However, digital services offered online do not necessarily require a physical presence and the billing for these services or the international allocation of costs of

[13] The Court found that, 'unless there is a valid Commission adequacy decision, … competent supervisory authorities are required to suspend or prohibit a transfer of personal data to a third country where they take the view, in the light of all the circumstances of that transfer, that the standard data protection clauses are not or cannot be complied with in that country' (EU, 2020a: np, 2020b).

[14] GAIA-X was established in mid-2020 as a not-for-profit company with an initial annual budget of €1.5m.

[15] The purpose of this section is not to detail the complex stipulations under existing international, national or within country, tax law. Despite a United States government commitment to a permanent moratorium on taxes on internet access and on internet-only services under the US Trade Facilitation and Trade Enforcement Act of 2015 (incorporating the Internet Tax Freedom Act, 1998, (US, 1998, 2016), more than half the American states levy some form of tax on digital products (mostly downloads) at a rate of 1 to 7 percent.

[16] One key area nevertheless of ambiguity was international transfer pricing which enabled companies to reap profits in the jurisdiction of their choice.

producing them may be arranged to reduce these taxes. The OECD and G20 countries have been seeking to change the international tax rules to enable countries to tax revenues or profits where value creation occurs using a new concept, 'significant economic presence'. For example, a platform with a local warehouse and employees supporting the sale of goods online could provide a basis for taxation if the tax regime were to be changed (OECD, 2015, 2019b, 2019c). As the G7 says, these countries are working 'to enable our economies and communities to *adjust* to the pace of change today, so that the global economy works for everyone' (emphasis added) (G7, 2017, p. 2). The G7 and OECD proposals met resistance during the Trump Administration. At this writing in early 2021 there is renewed momentum towards a shift in the priorities and values underpinning the international tax rules to create a fairer regime. It is also argued, however, that a change in taxation is unnecessary because economic value is created by platform companies, not by their users and it is unfair to target large (foreign) companies (Kennedy, 2019). Thus, it is not clear whether a global agreement will be achieved.

Regionally and nationally, nevertheless, there have been signs of change. The European Commission has recognized that:

> 'digital business have different characteristics than traditional ones in terms of how value is created, due to their ability to conduct activities remotely, the contribution of end-users in their value creation, the importance of intangible assets, as well as a tendency towards winner-takes-most market structures rooted in the strong presence of network effects and the value of big data' (EC, 2018, p. 2).

The Commission proposed that tax be collected where a human user of large digital platforms is involved (not machine-to-machine communication) and when data collection is for monetization purposes. In the absence of agreement on the Commission's proposals, member states have been unilaterally introducing digital taxes, generally on revenues, not profits. France, Germany, Italy, Spain and the United Kingdom are among those introducing national digital taxes, with France observing that 'economic efficiency is at stake, as well as tax fairness and sovereignty' (Le Maire *et al.*, 2017, p. np). Even if a tax (2 percent on revenues in the United Kingdom) is passed on by charging an additional fee to the digital platforms' advertising clients or to those who sell their products using a platform, the intention is to enhance the fairness of taxation, albeit currently raising relatively small amounts of revenue for the tax base.[17] The United States government has responded to these moves by insisting that the imposition of national digital taxes is a nontariff trade barrier and that the digital platform companies might reduce or withdraw their services or pass the costs onto users. The United States has introduced retaliatory measures in the form of trade sanctions against countries implementing a digital services tax based on the results of US Trade Representative investigations under section 301 of the US Trade Act (1974) (Fleming *et al.*, 2020; US, 1974; VAT Update, 2020). Confronted with the Covid-19 pandemic, the G20 countries postponed their efforts to reach agreement on new international tax principles and the United States has not implemented its trade sanctions during the pandemic crisis but may do so if ongoing negotiations fail.

Before the pandemic, there also were concerns about whether developments within the ICT paradigm are leading to automation-induced unemployment without the creation of compensating jobs for workers and about the precarious working conditions in the face of flexible contracting in the 'gig' economy. A change in taxation principles cannot be expected to address this and other harms associated with the ICT paradigm directly. It might, however, provide a potentially stronger buffer for those disadvantaged by the social costs of adjustment to changes in the paradigm as is implied by Sennett's (2019, p. np) observation that in today's technology-enabled world, 'a specter of uselessness hangs over people – a sense of bareness'. Freeman took the view that we should not look to ICTs (even if universally available) to stabilize economies and societies when they are facing destabilizing technological change (Freeman, 2001a). A consideration of the need for politically-inspired interventions to address the social costs of adjustments to new digital technologies and assure that public values are upheld was certainly a prominent feature in in his work.

4. Conclusion

Digital technology innovation – a major part of the 4th Industrial Revolution – involving advances in AI and data analytics and ever 'smarter' networks, is often depicted as the pathway for averting or mitigating economic and social crises, albeit with policy or regulatory adjustments (Schwab, 2017; United Nations, 2019). In welcoming evidenced-based debate on the contemporary path of innovation, Freeman also would likely have cautioned against a narrow focus on technology and the digital market. While many scholars working in the critical traditions of the social sciences (e.g. science and technologies studies, critical approaches in communication studies and other disciplines) have long heeded this advice, there is still within the neoclassical economics and the economics of technological innovation fields, a prominent overemphasis on research focusing primarily on market dynamics – the monetization of data – with the expectation that technology-induced change will lead to an optimization of market outcomes with benefits for all. While Freeman regarded capitalism and its institutions as the 'most effective in human history in stimulating a flow of technical and organizational innovations and diffusing them through the production system' (Freeman, 1992c, p. 216), he also argued that there may be circumstances in which certain technical innovations should not be deployed. Further, that when they are deployed, there must be an effort to 'humanize' technology as distinct from focusing principally on profit and economic growth (Freeman, 1994, p. 11).

The three themes – ambiguity, guiding principles and politics – are among many that might have been selected from Freeman's work on paradigmatic techno-economic change to inform the discussion in the preceding section. These themes are helpful, however, because they encourage a researcher to distinguish between taken-for-granted principles and practices and potential alternatives that could yield outcomes that are fairer and more equitable. Alternative standards that better secure privacy in 5G networks, privacy enhancing legislation for the deployment of AIaaS, and revised choices about tax rules and the distribution of public revenues are examples of such potential alternatives.

Freeman ventured considerably beyond the limiting assumptions of neoclassical economic theory. For him, ambiguous outcomes – benefits and harms – of the innovation process were empirical problems for investigation. His recognition of the need for political interventions in the market is evident in his observations about the need for government funding of redistribution policies and the 'need for a strong ethos of solidarity' (Freeman & Soete, 2005, p. 350). He was concerned about concentrations of political and economic power (Freeman, 1992c), commenting that their consequences in the form of 'extreme disparities of wealth and income not only jeopardize civil liberty and inhibit technological choice, they also endanger industrial and national security and are offensive to common decency' (Freeman, 1992c, p. 226).

There is no indication that Freeman expected the dominance of large firms to be eroded by advances in digital technology (Freeman, 2007). For instance, he signaled that upholding the right to freedom of speech would be crucial to limit abuses of power by dominant companies (and states), commenting that when this right is not upheld 'talk of freedom of choice is often empty air' (Freeman, 1992c, p. 223). Freeman's work was prescient. In a period of dominant digital platforms and advancing commercial datafication, which until quite recently was widely treated as an exemplary pattern of techno-economic change - broadly consistent with beneficial outcomes for society, his work serves as an important

[17] The amounts of tax revenue are tiny compared to billions in state expenditure associated with national Covid-19 responses.

guide for investigations of the harmful consequences of these developments. These include the massive scaling up of platforms leading to entrenched corporate control structures, hyperactive financial capital delinked from the 'real' economy and the invisible nudging of human behavior (Mansell & Steinmueller, 2020; Zuboff, 2019).

Steps are being taken in countries in the West, the East and the global South to regulate dominant digital platforms and their practices. These include measures to achieve data privacy protection, to strengthen competition policy and introduce accountability for the content hosted by these companies, plus changes in taxation rules. These are likely to moderate some features of digital companies' business strategies that are inconsistent with public values but struggles to uphold these values by adopting commonsense principles that enable, rather than disable, individual and collective wellbeing are ongoing. Freeman's emphasis on reimagining the future and on resisting technological innovation pathways that perpetuate power asymmetries and produce social and economic inequalities is salutary. It continues to inspire scholarly research on techno-economic and socio-technical change which insists that monetizing digital information for commercial gain is not the only way to design and operate digital technologies in support of individuals and their societies.

Like many researchers who undertake critical scholarship on the complex determinants of our digitized future (Couldry & Mejias, 2019; van D Dijck et al., 2018; Mansell, 2021 In Press; Zuboff, 2019), Freeman, no doubt would have championed research aimed at evidencing the multiple causes and consequences of contemporary digital technology designs and data ownership and control arrangements. His insistence on a 'economics of hope' might have oriented him, not only to explaining and resisting harmful and exploitative outcomes, but to actively engaging with policy making to help shape expectations and to mobilize the features of changes in the techno-economic ICT paradigm 'for good'. In line with Freeman's insights, proposals for alternative innovation choices are essential, with pathways evaluated not solely by the narrow metrics of economic analysis, but by using a broader analytical framing encompassing the political, the social and the cultural.

Credit Author Statement

This paper is entirely the author's own work.

Declaration of Competing Interest

The author has no conflicts of interest to declare.

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