9 The impact of Brexit on the digitisation of rural areas in the UK

Paolo Gerli and Jason Whalley

Introduction

Digital technologies have become an essential input for the rural economy and society. Access to broadband and the use of digital services has proved to be a major determinant of rural SMEs' growth and internationalisation (Bowen and Morris, 2019). Furthermore, being online is nowadays fundamental to accessing (most) public services and actively participating in society (see Lyon *et al.*'s chapter in this volume). Even foundational sectors such as agriculture, healthcare and education are increasingly shifting towards digitally enabled modes of delivery (Cullinan *et al.*, 2021; Rijswijk *et al.*, 2020).

These transformations have been emphasised and accelerated by the Covid-19 pandemic, when digital platforms allowed business operations and the delivery of public services to continue throughout lockdowns and despite social restrictions (Phillipson *et al.*, 2020). It is expected that some of these digital innovations will remain in use after the end of the pandemic, with the boosting of the diffusion of digital technologies being commonly recognised as a key cornerstone of the post-Covid-19 recovery (Baig *et al.*, 2020).

However, the pandemic has further exposed the digital divides afflicting rural areas. For example, recent research has highlighted that the shift to online education posed significant challenges for students based in rural locations, where broadband access is of poor quality or completely lacking (Cullinan *et al.*, 2021). Similarly, it has been observed how the elderly have struggled to benefit from eHealth applications due to their limited level of digital literacy (Litchfield *et al.*, 2021).

Bridging the rural-urban digital divide has long been a priority for both national and local governments across the UK (Gerli *et al.*, 2020). Previous interventions were designed and enacted in compliance with the policy frameworks adopted by the European Union (EU) (Falch and Henten, 2018). After Brexit, though, the UK is no longer required to abide by these rules and this opens up a range of possibilities as well as a number of challenges.

This chapter outlines and discusses the implications Brexit has for the digitisation of the rural economy and society in the UK, highlighting both the challenges and the possibilities that leaving the EU opens up. With this in mind, the chapter

is structured as follows: The first section outlines the state of rural broadband in the UK. It is followed by a summary of the EU regulatory framework for broadband and digital markets, detailing how this has been applied so far in the UK. Next implications of Brexit are explored, with a focus on broadband state aid, universal service obligations, mobile connectivity and new regulatory issues related to data-driven applications and smart technologies. Finally, conclusions are presented along with a summary of recommendations for researchers and policymakers.

Rural broadband in the UK

A significant urban–rural divide is evident across the UK with regard to broadband access[1] (Table 9.1). Looking across the four nations, a consistent pattern emerges: the provision of "decent" broadband is considerably better in urban than in rural areas. This is also true for the UK as a whole. A similar picture is observed when it comes to "superfast" broadband, though it is noticeable that the gap between urban and rural coverage varies across the four nations. In each of the four nations, the coverage of ultrafast broadband is noticeably lower than

Table 9.1 Coverage of fixed broadband in the UK, December 2020

	England		Northern Ireland		Scotland		Wales		UK	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Decent – 10 Mbit/s download, 1 Mbit/s upload	93	99	81	99	83	99	87	99	90	99
Superfast – download speeds between 30 Mbit/s and 300 Mbit/s	84	98	66	99	72	98	78	98	81	98
Ultrafast – download speeds between 300 Mbit/s and 1 Gbit/s	21	66	17	82	15	60	20	41	20	65
Gigabit – download speeds of 1 Gbit/s and greater	18	26	17	71	13	47	19	19	17	29

Source: Compiled by the authors based on Ofcom (2020a, 2020b).

it is for superfast; broadly speaking, ultrafast coverage is around a quarter of the superfast levels in all four nations. Finally, when it comes to gigabit coverage, the previously demonstrated advantage of urban vs rural coverage is observable. Having said that, it is worth noting that gigabit coverage in Northern Ireland is substantially higher than elsewhere in the UK.

Similarly, the availability of mobile broadband is uneven across rural and urban areas. Ofcom (2020a) estimated that the outdoor 4G data coverage from all operators is available to 87 percent of the rural premises (compared to 99 percent in urban areas). Indoor coverage is even lower, with only 46 percent of rural premises being covered by all operators, as opposed to 86 percent in urban areas. The indoor coverage of rural premises of single operators spans from 68 percent to 80 percent, while in the urban areas is between 93 percent and 98 percent.

Although still significant, the rural–urban digital divide has considerably reduced over the past ten years. Since the early 2010s, new commercial and community-based providers have been deploying fibre networks in rural areas (Gerli *et al.*, 2017). Meanwhile, a plurality of public programmes has been launched to support the supply and demand of rural broadband. Figure 9.1 summarises the major events in the UK superfast broadband market, taking place since the late 2000s.

To date, all the public interventions put in place to sustain broadband supply and demand across the UK have been designed and implemented in compliance with the EU regulatory framework. That framework is outlined in the following section which focuses on the state aid guidelines for broadband diffusion and the regulation of Universal Service Obligation (USO).

The EU regulatory framework for broadband and digital markets

Since the late 1980s, the European Commission and the European Parliament have adopted several measures to regulate the development of electronic communications across its Member States[2]. Initially, the EU institutions primarily focused on promoting competition and safeguarding consumer rights (Falch and Henten, 2018). In 2002 the European Parliament introduced a set of rules obliging the former monopolists to make their networks available to new entrants. Another directive, also adopted in 2002, normed the universal service obligations for telecommunications providers. These were revised in 2009 to include access to Internet (Batura, 2016).

The increasing relevance of digital technologies for economic growth and social development pushed the EU policymakers to follow a more interventionist approach in broadband markets (Falch and Henten, 2018). In 2010, the EU Commission adopted the Digital Agenda for Europe, which committed the Member States to reach 100 percent superfast broadband coverage by 2020. An additional target was set in 2016 to ensure that all EU citizens have access to at least 100 Mbit/s by 2025 (European Commission, 2016).

Given that commercial supply is unlikely to reach these levels of coverage,[3] specific guidelines were designed by the EU Commission to permit state aid in
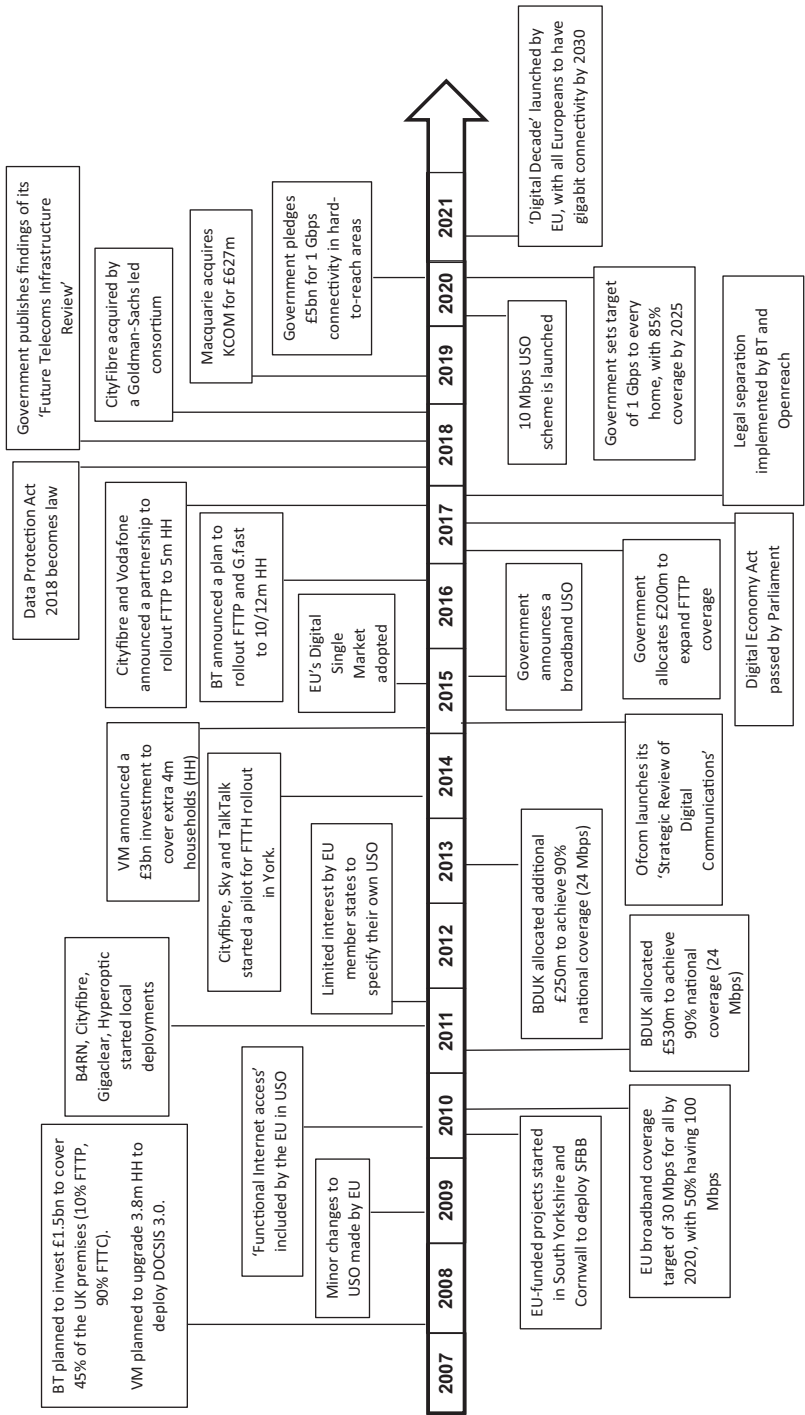
Figure 9.1 Timeline of relevant developments.
Source: Derived from Gerli and Whalley (2021).

broadband markets (Koenig and Bache, 2012). Public intervention is admissible only in those areas where the market fails to provide broadband access. Such areas are identified through public consultations, periodically run to ascertain where commercial suppliers intend to invest within a period of three years. This is meant to minimise the risks of market distortions and prevent public interventions from discouraging private investment. The state aid guidelines also mandate that public funding is allocated on a competitive basis (European Commission, 2013).

The EU framework has been enforced in the UK by the Office of Communications (Ofcom), set up in 2003 to both promote competition and safeguard consumer rights in the national telecommunications market. In 2011, the UK government also established Building Digital UK (once known as Broadband Delivery UK (BDUK)), an agency of the Department for Media, Culture and Sport (DCMS) in charge of allocating and managing state aid for rural broadband (NAO, 2013).

Over the past ten years, BDUK has designed a variety of programmes to support both the supply and the demand of rural broadband. Under its supervision, the devolved nations and county councils have invested more than £2.5 billion to subsidise the rollout of superfast broadband in rural areas (BDUK, 2021). BDUK has also funded the deployment of mobile networks in remote locations and encouraged the adoption of full-fibre broadband through direct subsidies or vouchers to end-users.

These initiatives have reduced but not eradicated the rural–urban digital divide, as it remains uneconomic to provide the hardest-to-reach areas with superfast broadband, even with the support of state aid (Gerli *et al.*, 2020). As a result, a divide within rural areas has emerged between those rural communities provided with superfast or even ultrafast broadband and those still unable to access high-speed connectivity (Gerli and Whalley, 2021). Acknowledging the difficulties that had been encountered and the continued unsatisfactory nature of broadband access for some, the government launched a broadband USO in late 2015 that would provide everyone with connectivity (Stocker and Whalley, 2019).

Although the notion of USO was well established in the EU regulatory framework,[4] when it came to broadband the 2009 revision stipulated only that "functional access to the Internet" should be provided (Davies, 2016). As debates continued regarding the inclusion of broadband into the directive, Member States were left to themselves to develop their own national initiatives. By 2011, only three – Finland, Malta and Spain – had used national legislation to specify minimum broadband speeds (Davies, 2016). Both Finland and Spain set a minimum speed of 1 Mbps.

The UK, in contrast, suggested 2 Mbps. If the property could not be connected through a commercial scheme, subsidies of up to £350 would be provided to install satellite-based connections (Jackson, 2015; UK Government, 2015b). Thus, the UK was arguably at the forefront of developments, and the gap with other Member States was further widened with the broadband USO which was set at 10 Mbps (UK Government, 2015a), a figure supposedly sufficient for several members of a family to be simultaneously online (Ofcom, 2015).

Subsequent to the government's announcement of the broadband USO in November 2015, a series of consultations was undertaken by both the government and Ofcom (Stocker and Whalley, 2019). In effect, these consultations provided the detail lacking in the initial announcement. The download speed of the broadband USO was confirmed at 10 Mbps, and eligibility criteria were outlined, determining the number of properties that could receive support and on what terms (see Hutton (2020) for more details). Significantly, these criteria also included who would provide the USO, with BT and KCOM (in Hull) being designated the providers in June 2019 (Ofcom, 2019).

The EU regulation has not been limited to broadband markets. EU institutions have increasingly shifted their attention to the markets of digital services and data-driven applications to mitigate competitive distortions and safeguard the rights of digital users. One of the most well-known pieces of EU regulation in this context is the General Data Protection Regulation (GDPR), adopted in 2016, which has been taken as a reference by many non-EU countries (Goddard, 2017). More recently the European Parliament has been discussing new legislations regarding digital media and emerging technologies such as artificial intelligence (AI). Given the complexity of these markets, the relevant regulatory frameworks are still developing. Meanwhile, the European Commission has opened numerous investigations into the alleged anticompetitive behaviours undertaken by companies with a dominant position in digital markets such as Google and Apple (UNCTAD, 2021).

The regulatory framework for broadband and digital markets after Brexit

The regulatory regime that emerged in the UK from the enforcement of the EU framework is complex and dynamic (House of Lords Select Committee on the Constitution, 2004; Sutherland, 2013). While telecommunications is a reserved matter, with responsibility resting with Westminster, the developed administrations in Northern Ireland, Scotland and Wales have developed their own broadband projects,[5] albeit to different degrees and in different ways. Interestingly, the Scottish Government noted the role of BDUK before going on to argue, in essence, that it wished to be more ambitious (Scottish Government, 2017).

With Brexit, the UK can diverge from the EU regulatory framework. So far, this does not appear to have occurred. That the regulatory framework has not yet diverged may simply reflect the relatively short period of time that has passed. It may also be due to the lack of institutional capacity within the UK, which limits the ability of the government to develop innovative policies to tackle the specific challenges faced. Sutherland (2017) suggests the need to narrow the remit of the relevant ministers and enhance co-ordination across the UK, while the relatively low number of civil servants within DCMS noted by Stewart (2016) alludes to its limited capacity to develop policies, especially when the Department's broad scope is taken into account.[6] Focused ministers and more civil servants may result in greater policy innovativeness, reversing the decline that is arguably evident in Cave (2017).

State aid regulation after Brexit

After leaving the EU, the UK is no longer bound to comply with the extant regulation on state aid. Nevertheless, the UK government has not communicated any plan or intention to revise the current framework, which remains in force. Consistently, recent initiatives launched to subsidise full-fibre networks are still designed according to the criteria included in the EU state guidelines.

It must be recalled that several commentators in the UK have highlighted a number of shortcomings in the implementation of broadband state aid (Gerli *et al.*, 2020; Hutton, 2021; NAO, 2013). Particular concerns have been raised with regard to the limited competition for public subsidies observed in the implementation of BDUK-funded initiatives (NAO, 2015). As the majority of the contracts awarded by BDUK were won by BT, the former state-owned operator, the latter was able to de facto determine the intensity and allocation of state aid (Gerli *et al.*, 2020). As a result, public subsidies were also utilised in areas already served by community networks or small-scale providers, that, in contrast, rarely benefitted from state aid (Gerli *et al.*, 2017).

As documented in Gerli and Whalley (2021), these distortions directly reflect shortcomings in the EU regulation for state aid. The regulatory framework gives commercial providers too much power in the definition of intervention areas and does not include specific safeguards to favour the participation of small-scale providers (such as rural internet service providers or community networks). For example, intervention areas are defined according to the results of public consultations where all commercial suppliers can specify where they intend to invest. Due to their limited resources, small-scale providers have struggled to take part in these consultations. As a result, state aid has in the past been used to deploy broadband in areas that were already connected by these providers. Not only did this harm competition, but it also led to an inefficient allocation of public funding.

Following Brexit, the UK government has the power to define new regulations for broadband state aid that could effectively support small-scale providers, and community networks in particular, whose contribution has been crucial to reduce the rural–urban digital divide (Gerli and Whalley, 2021). Making the process for state aid allocation more transparent and open would enhance the participation of alternative providers, promote competition, and reduce the level of public support needed to deploy rural broadband.

The latter is even more desirable if it is considered that, after Brexit, the UK will no longer have access to the EU funding for regional development that has often been used to support the digitisation of rural communities and businesses. Around half of the projects led by BDUK have received EU funding (Gerli *et al.*, 2020), which was used to support new technology pilots and demand-side initiatives such as digital skills trainings for SMEs.

Such interventions have been inconsistent across the country because of their dependence on funding made available from the EU (Gerli and Whalley, 2022). Leaving the EU implies that rural regions will be unable to fund similar initiatives unless the UK government introduces a new scheme to replace the EU regional

development fund. Given the shortage of digital skills in the UK and their importance for economic growth (EDGE Foundation, 2019), the lack of public interventions in this area could further compromise the ability of rural communities and businesses to participate in the digital economy and society, thereby exacerbating existing digital divides.

USO after Brexit

Brexit appears to have minimal, if any, impact on USO. With the designation of BT as the provider of USO, progress has been made on providing connections to eligible properties. In October 2020, BT announced that two-thirds of the 610,000 properties identified in 2019 as being eligible had been provided with 4G-based connectivity (BT, 2020). As illustrated by Table 9.2, a significant number of the USO requests were deemed to be ineligible, with the consequence that relatively modest numbers of properties have been connected through the scheme.

While the number of connections is modest, it is worth remembering that they will be transformational in nature, with the connection enabling individuals or businesses to access the Internet and all it entails. Having said this, the speed provided through USO is only a fraction of that enjoyed by others; in March 2021, the median average download speed across the UK was 50.4 Mbit/s (Ofcom, 2021). This highlights the "safety net" nature of the connections provided by the USO, limiting what the properties connected can undertake online.

Although there was some discussion of faster connection when the relevant legislation was progressing through the House of Lords (Jackson, 2017), with 30 Mbit/s being suggested, this came to nothing. It is, however, possible to review the USO (Jackson, 2020b), with the legalisation stipulating that this should occur once at least 75% of premises receive broadband connections with download speeds of at least 30 Mbit/s. Given current take-up rates, the review is unlikely to happen in the foreseeable future.

Moreover, when the review is undertaken, it will need to address a series of tensions. As the gap with average speeds widens, the "safety net" nature of USO

Table 9.2 Universal Service Obligation requests and confirmed orders

	2020								2021		
	May	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*
Number of requests received	835	1,279	1,526	2,200	2,084	1,412	1,067	962	1,826	1,673	913
Ineligible requests	536	731	781	1,157	1,098	1,006	905	716	1,163	1,137	666
Confirmed orders	11	35	194	151	105	202	84	44	47	46	35

Source: Compiled by the authors from BT (2020, 2021).

will be highlighted. If the USO is to continue playing this role, then it will need to be increased to reflect the range of activities undertaken online, in the same way that the 10 Mbit/s reflected Ofcom's previous assessment of what a family would need (Ofcom, 2015). Setting aside the difficulties of identifying what a family undertakes online, through virtue of being a "safety net" whatever speed is determined will be less, probably considerably so, than that available elsewhere in the country. As a consequence, USO will simultaneously narrow and perpetuate the digital divides that exist.

Secondly, should a range of technologies be used to provide USO? As noted above, two-thirds of the eligible properties identified in 2019 have been connected through 4G. While a 4G connection is better than no connection, wireless speeds are less than those utilising fibre. 5G, which is being rolled out across the UK, is considerably faster than 4G (Curwen and Whalley, 2021) but it will take several years before it is widely available and, even when it is, it will take many years for the remote parts of the country to be covered. In March 2020, the four mobile operators (EE, O2, Three and Vodafone) entered into an agreement with the government to expand 4G coverage in those areas with partial or no signal (UK Government, 2020b). Through their own investment and with financial support from the government, just over £1 billion will be invested to expand their joint 4G coverage to 95 percent of the population by the end of 2025 (UK Government, 2020b). If the roll out of 5G follows a similar pattern to that of 4G, then it will be a decade or so before it is widely available across the UK, with the final push requiring government encouragement.

Satellite broadband could play a role. In November 2020, the UK government completed its purchase of a stake in OneWeb (UK Government, 2020c). Whether the government would have acquired a stake if the UK had remained in the EU is moot, as is the viability of broadband via Low Earth Orbit satellites given that, as Alok Sharma, the Business Secretary, stated at the time of the purchase that the satellites had "the potential to connect people worldwide, providing fast UK-backed broadband from the Shetlands to the Sahara and from Pole to Pole" (UK Government, 2020c). In other words, from the government's perspective, there is a role for satellite-provided broadband. Having said this, it is worth noting that while satellites are able to improve broadband speeds (Beckett, 2021), sometimes significantly, monthly subscription charges are not cheap when compared to the broadband packages offered by Virgin Media in urban or B4RN in rural areas. Improved connectivity will, therefore, come at a cost for users.

Improving mobile coverage

Given the challenges associated with providing fixed broadband connectivity in rural areas, expanding and improving mobile coverage is arguably an attractive alternative. In early 2020, details emerged of an initiative to expand rural mobile coverage. The "Shared Rural Network" would see the country's four mobile network operators invest in their networks to expand their collective 4G geographical coverage so that it will be available in 95 percent of the country by the end of

2025 (UK Government, 2020b).[7] Although the agreement between the mobile operators and the government specified collective UK targets, it also outlined specific objectives for each operator across each of the four UK nations (Jackson, 2020a). For example, to achieve the interim objective of 88 percent geographical coverage by 30 June 2024 (Jackson, 2020a), the specific targets for Scotland were set at 75 percent for EE and O2, 72 percent for 3 UK and 76 percent for Vodafone (Jackson, 2020a).

To expand their coverage of "good quality data and voice coverage" (Jackson, 2020a),[8] the mobile operators agreed to collectively invest £532 million. Another £500 million would be provided by the government. As a result, mobile coverage has begun to expand, with EE, for example, revealing that it would improve its coverage in 579 locations across the UK over the course of 2021 (EE, 2021; Jackson, 2021). While the Shared Rural Network will improve 4G geographical coverage across the country, three areas are expected to benefit the most: Highlands & Islands, Mid and West Wales and the north-east of England (UK Government, 2021b).

5G is the latest generation of mobile technology, with its improved technical performance over previous generations expected to support a diverse array of economic activities (Curwen & Whalley, 2021). The licenses were auctioned in April 2018, with the subsequent roll-out of coverage unsurprisingly favouring urban areas (Curwen & Whalley, 2021). As part of its promotion of 5G, the government announced, in February 2020, that £65 million would be made available to support a number of trials (UK Government, 2020a). £30 million were earmarked to support seven projects identified through the Rural Connected Communities competition.[9]

While these trials may illustrate the benefits of 5G, they did not accelerate its rollout in rural areas. With this in mind, the government announced, in April 2021, changes to planning regulations (UK Government, 2021e). The changes, the government argued, would encourage mobile operators to improve their existing infrastructure in rural areas. This would, in turn, speed up the rollout of 5G (UK Government, 2021b).

Emerging issues: regulating technologies and services for rural users

While a strong argument can be made that the regulatory regime post-Brexit has not changed, it is possible to identify several emerging issues that are likely to impact on rural users in the near future. The first of these sought to improve the functioning of digital markets. Acknowledging the widespread unease at how digital markets operate, the government commissioned a report in 2018 to explore how the challenges these markets pose could be addressed. This report, published in March 2019, recommended that a dedicated unit should be created to support the development of a more pro-competitive approach (Furman, 2019). Complementing and building on this report was another, from the Competition & Markets Authority (2020), which outlined a pro-competitive regulatory regime

with three pillars and recommended the establishment of the Digital Markets Unit. The unit was established in April 2021 (UK Government, 2021a). However, the necessary legislation to implement the new regulatory approach has yet to be enacted. Consultations on the proposals closed in October 2021 (UK Government, 2021c).

The second emerging issue is the apparent willingness of the UK to diverge from the EU's approach to data[10]. While being part of the EU, the UK had, of course, adopted the relevant directives with GDPR coming into force in 2018 (Sandle, 2021). In March 2021, it was announced that the government was considering amending the regulatory regime for data primarily to facilitate economic growth (Sandle, 2021). Interestingly, it was suggested that a "sweet spot" existed between maintaining the protective elements of GDPR on the one hand and the economic benefits of freer-flowing data on the other. In August 2021, further insights into the government's position emerged: the regulatory framework would be changed, to cut costs but also to enable the UK to sign data agreements with countries outside the EU (Scammel, 2021).

But how will these two issues impact rural areas? Digital technologies are increasingly applied in several economic activities, including agriculture and healthcare, where data-driven applications and smart technologies are becoming increasingly popular. Precision farming and other smart farming technologies are expected to significantly boost the productivity and environmental sustainability of the farming sector (Rijswijk *et al.*, 2020). Likewise, eHealth applications and telemedicine promise to improve the accessibility and cost-effectiveness of healthcare for rural communities (Peck *et al.*, 2015).

The markets for these technologies and services are still developing, but an increasing number of stakeholders are calling for regulatory interventions to prevent market distortions and abusive behaviours that could undermine the positive effects of these digital innovations (Atik and Bensen, 2021; Svendsen *et al.*, 2021). In particular, given the economies of scale associated with the development of smart technologies and online platforms, one likely scenario is that the various markets that emerge will be dominated by a small number of large companies (Birner *et al.*, 2021; Gerli *et al.*, 2021). This dominance could result in the limited choice for end-users, restricting their ability to move from one supplier to another. This would also result in technology and service providers gaining significant control over sensitive data which may be either personal or commercial in nature (Atik and Bensen, 2021; Senbekov *et al.*, 2020).

Although digital markets have attracted considerable attention in recent years, the Digital Markets Unit is still being set up. Having said this, if progress could be made in areas such as data portability or non-personal data protection, the rural economy and society would undoubtedly benefit from data-driven applications and smart technologies. On the other hand, Brexit also exposes the rural UK to another challenge. The limited size of the national market, especially when compared with that of the EU, may result in the UK becoming just a recipient of digital technologies developed elsewhere. This will, in turn, limit the ability of the UK to influence market developments – for example, in terms of the

digital technologies that are adopted or the approaches to data sharing that are developed.

With regard to smart agriculture, the consequence of this may be that rural users will struggle to find equipment and services that are closely aligned with their needs, assuming that farmers will actually be able to afford to purchase smart technologies and services. Losing access to CAP funding will likely undermine the capability of smaller farmers to keep up with the pace of technological change. Furthermore, smaller farmers are unlikely to possess the necessary financial and human resources to incorporate and then manage digital technologies within their operations, especially if appropriate digital skills training will no longer be available to rural businesses due to the lack of ERDF funding (as highlighted in Section "The EU Regulatory Framework for Broadband and Digital Markets").

In the context of healthcare, the new measures on data protection announced in August 2021 are expected to boost the development of AI-enabled diagnostics and other telemedicine services (UK Government, 2021d). However, some have raised concerns that the new international data partnerships may result in the transfer of sensitive and personal data to countries where the data protection regime is less stringent (Molloy, 2021). This could have important implications for the acceptance and adoption of eHealth applications in the rural UK. A recent study focusing on Canada found that the satisfaction and willingness to use tele-medicine is normally lower among rural households with limited access to and familiarity with digital services (Rush *et al.*, 2021). Concerns regarding the privacy of eHealth may further undermine their trust in these services and their willing-ness to use them (Gerli *et al.*, 2021).

Some of the emerging issues discussed in this section are already being addressed at the EU level. For example, industry stakeholders have adopted a code of con-duct for agricultural data sharing (Copa-Cogeca, 2018) and DG-Health (2021) "has been reviewing the Member States" rules on health data. Although policy measures have yet to be defined, it is likely that Brussels will increasingly inter-vene to regulate digital markets consistent with its aim of supporting the digital economy while safeguarding competition. The UK government is also taking action in this regard, but a clear regulatory framework is still missing. Further-more, being out of the EU will likely reduce its ability to counteract the market power of large technology providers with the risk that market distortions may offset the contribution of smart technologies for the sustainable development of rural communities.

Conclusion

Digital technologies are expected to have a transformative impact on rural com-munities and businesses in the UK. These impacts are multi-faceted; digital technologies allow individuals in rural communities to access services such as healthcare and online education that may not currently be available in rural areas and create commercial opportunities for rurally located businesses. Broadband is at the heart of these changes, being increasingly viewed as essential for accessing

services and engaging in commerce. However, the availability of "fast" broadband across the UK is uneven. This clearly disadvantages rural areas where coverage lags behind that of urban areas. Not only does this limit the ability of individuals to access services, it also restricts the commercial opportunities available to businesses.

Over the years, EU institutions have played an active role in encouraging the provision of rural broadband as well as regulating various aspects of the digital economy. After Brexit, the UK is now able to decide for itself how to address the digital transformation of the rural economy and society. This could be seen as an opportunity to review some or all of the existing regulations to make them "rural-proof". In particular, the current state aid rules for broadband diffusion could be revised to better support community broadband networks and other small providers who, so far, have struggled to benefit from public subsidies despite their proven contribution to reducing the rural-urban digital divide in the UK.

On the other hand, leaving the EU could expose the rural economy and society in the UK to new risks and challenges, especially if no regulatory interventions are put in place to mitigate market distortions in the development and provision of digital technologies. To date, the position of the UK government on this matter remains unclear. Such a lack of clarity risks stalling the digital transformation in rural areas and thus undermining its potential socio-economic benefits.

Furthermore, due to Brexit, the UK will no longer have to comply with targets set by the EU or coordinate its initiatives with the other Member States. As a result, the promotion of the digital economy and society is left to the enthusiasm of domestic political parties. Having removed the EU as a source of pressure and promotion, it is crucial that governments at various levels across the UK are held to account by other stakeholders, such as Ofcom or the National Audit Office (NAO) whose powers and resources will need to be expanded to ensure their independence and rigour. Similarly, it is of paramount importance to intensify interdisciplinary research efforts.

These efforts should study the effects of smart technologies on rural businesses and communities, in order to detect distortions potentially emerging from the use of digital technologies in agriculture, healthcare and other foundational sectors of the rural economy. The research should also seek to explore the societal aspects of digital technologies, in terms of their use, the associated skills and whether some benefit more than others. Such research would help inform policy and regulatory developments, thereby preventing the risks and maximising the benefits of data-driven applications and other digitally enabled services and devices in a rural context.

Notes

1 Ofcom (2020a) identifies four different types of broadband connection based on the speeds, with the slowest being described as 'decent' and the fastest as 'gigabit'.
2 For an assessment of the initial liberalisation agenda see, for example, Ungerer (2013).
3 Commercial providers have little incentive to deploy broadband networks in scarcely populated and remote areas, due to the cost structure of these infrastructures. This

explains the existence of rural-urban divide, as documented above, and justifies public interventions in broadband markets.

4 For an overview of USO and its development within the EU see, among others, Batura (2016).

5 The Scottish Government, for example, has provided over £500 million to support the provision of 'superfast' broadband through the R100 programme.

6 According to the government's website, the Department "helps to drive growth, enrich lives and promote Britain abroad. We protect and promote our cultural and artistic heritage and help businesses and communities to grow by investing in innovation and highlighting Britain as a fantastic place to visit."

7 Geographical coverage means the proportion of the country where mobile services are available. Given higher population densities in urban compared to rural areas, using geographical rather than population as the criteria for coverage results in service being available over more of the country than would otherwise be the case.

8 The government's press release mentions 4G without specifying the quality of the service that is provided (UK Government, 2020b), but it does note in the definition of coverage used by Ofcom which states that coverage is "based on the minimum signal strength required to deliver a 95% probability of making a 90-second telephone call successfully completed, and a 95% chance of getting a download speed of at least 2Mbit/s" (UK Government, 2020b).

9 Five of these projects were in England, and one each in Wales and Scotland (UK Government, 2020a).

10 This is just one illustration of what appears to be the much broader desire of the UK government to diverge from, or perhaps remove altogether, EU law (Foster, 2021).

References

Atik, C. and Martens, B. (2021) 'Competition problems and governance of non-personal agricultural machine data: Comparing voluntary initiatives in the US and EU', *Journal of Intellectual Property, Information Technology and E-Commerce Law, 12,* 370–396.

Baig, A., Hall, B., Jenkins, P., Lamarre, E., and McCarthy, E. (2020) *The COVID-19 recovery will be digital: A plan for the first 90 days.* Available at https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-covid-19-recovery-will-be-digital-a-plan-for-the-first-90-days (Accessed: 20 February 2021)

Batura, O. (2016) *Universal Service in WTO and EU Law.* The Hague: Asser Press.

BDUK (2021) *Table of local broadband projects.* Available at https://www.gov.uk/guidance/building-digital-uk (Accessed: 03 September 2021).

Beckett, M. (2021) *What is starlink? Elon musk's SpaceX internet project, explained.* Available at www.uswitch.com Link needs to be to specific article (Accessed:).

BEREC (2019) *BEREC Report on Member States' best practices to support the defining of adequate broadband internet access service, BoR (19) 2060.* Available at https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/9289-berec-report-on-member-states-best-practices-to-support-the-defining-of-adequate-broadband-internet-access-service-ias

Birner, R., Daum, T., and Pray, C. (2021) Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges. *Applied Economics Perspectives and Policy, 43*(4), 1–26

Bowen, R. and Morris, W. (2019) The digital divide: Implications for agribusiness and entrepreneurship. Lessons from wales. *Journal of Rural Studies, 72,* 75–84.

BT (2020) *BT report on progress against the broadband USO*, 30 October. Available at https://www.bt.com/about/bt/policy-and-regulation/keeping-the-uk-connected/a-universal-service-obligation

BT (2021) *BT report on progress against the broadband USO*, 30 April. Available at https://www.bt.com/about/bt/policy-and-regulation/keeping-the-uk-connected/a-universal-service-obligation

Cave, M. (2017) 40 years on: An account of innovation in the regulation of UK telecommunications, in 3½ chapters, *Telecommunications Policy*, *41* (10), 904–915.

Competition & Markets Authority (2020) *A new pro-competition regime for digital markets. Advice of the digital markets taskforce*, December. Available at https://www.gov.uk/government/consultations/a-new-pro-competition-regime-for-digital-markets

Copa-Cogeca (2018) *EU code of conduct on agricultural data sharing by contractual agreement*, Brussels, Belgium. Available at http://fefac.eu/wp-content/uploads/2020/07/EU_COD1.pdf

Cullinan, J., Flannery, D., Harold, J, Lyons, S., and Palcic, D. (2021) The disconnected: COVID-19 and disparities in access to quality broadband for higher education students. *International Journal of Educational Technology in Higher Education*, *18*, 26.

Curwen, P. and Whalley, J. (2021) *Understanding 5G mobile networks – a multidisciplinary primer.* Emerald: Bradford, UK.

Davies, R. (2016) *Briefing – Broadband as a universal service*, April, *European parliamentary research service*, PE 581977. Available at https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/581977/EPRS_BRI(2016)581977_EN.pdf

DG Health (2021) *Assessment of the EU member states rules on health data in the light of GDPR.* Brussels, Belgium. Available at https://ec.europa.eu/health/system/files/2021-02/ms_rules_health-data_en_0.pdf

EDGE Foundation (2019) *Skills shortages in the UK economy.* London: EDGE Foundation.

EE (2021) *EE to expand 4G coverage in more than 500 area in 2021 to boost rural connectivity*, 24 February. Available at https://newsroom.ee.co.uk/ee-to-extend-4g-coverage-in-more-than-500-areas-in-2021-to-boost-rural-connectivity/ (Accessed 11 March 2022).

European Commission (2013) *Communication from the commission — EU guidelines for the application of state aid rules in relation to the rapid deployment of broadband networks.* Brussels, Belgium. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013XC0126%2801%29

European Commission (2016) *European gigabit society*. Brussels, Belgium. Available at https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52016DC0587

Falch, M. and Henten, A. (2018) Dimensions of broadband policies and developments. *Telecommunications Policy*, *42* (9), 715–725.

Foster, P. (2021) *The risks of doing away with EU law – Financial Times*, 23 September. Available at https://www.ft.com/content/9c862bff-5351-4293-8dfc-df121c727709

Furman, J. (2019) *Unlocking digital competition – report of the digital competition expert panel*, March. Available at https://www.gov.uk/government/publications/unlocking-digital-competition-report-of-the-digital-competition-expert-panel (Accessed 9 December 2021).

Gerli, P., Arakpogun, E. O., Elsahn, Z., Olan, F., and Prime, K. S. (2021) Beyond contact-tracing: The public value of eHealth application in a pandemic. *Government Information Quarterly*, *38* (3), 101581.

Gerli, P., Matteucci, N., and Whalley, J. (2020) Infrastructure provision on the margins: An assessment of broadband delivery UK, *International Journal of Public Administration*, *43* (6), 540–551.

Gerli, P., Wainwright, D., and Whalley, J. (2017) Infrastructure investment on the margins of the market: The role of niche infrastructure providers in the UK, *Telecommunications Policy*, *41* (9), 743–756

Gerli, P. and Whalley, J. (2021) Fibre to the countryside: A comparison of public and community initiatives tacking the rural digital divide in the UK, *Telecommunications Policy*, forthcoming.

Gerli, P. and Whalley, J. (2022) Digital entrepreneurship in a rural context: The implications of the rural-urban digital divide, in Keyhani, M., Sorgner, A., Kollmann, T., Hull, C., and Ashjari, A. (eds.). *The Handbook of Digital Entrepreneurship*. Edward Elgar: Cheltenham.

Goddard, M. (2017) The EU general data protection regulation (GDPR): European regulation that has a global impact, *International Journal of Market Research*, 59 (6), 703–705.

House of Lords Select Committee on the Constitution (2004) *The regulatory state: Ensuring its accountability*, 31 March, 6th Report of Session 2003–04. Available at https://publications.parliament.uk/pa/ld200304/ldselect/ldconst/68/68.pdf

Hutton, G. (2020) *The Universal Service Obligation (USO) for broadband*, Briefing paper CBP 8146, House of Commons Library, 2 October. Available at https://researchbriefings.files.parliament.uk/documents/CBP-8146/CBP-8146.pdf

Hutton, G. (2021) *Gigabit-broadband in the UK: Government targets and policy*, Briefing paper CBP 8392, 30 April. Available at https://researchbriefings.files.parliament.uk/documents/CBP-8392/CBP-8392.pdf

Jackson, M. (2015) Broadband satellite subsidy to help 300000 rural UK premises, *ISP Review*, 6 December. Available at https://www.ispreview.co.uk/index.php/2015/12/broadband-satellite-subsidy-expanded-to-300000-rural-uk-premises.html (Accessed 8 September 2021).

Jackson, M. (2017) UK House of Lords vote for 30 Mbps broadband USO with 6 Mbps upload, *ISP Review*, 22 February. Available at https://www.ispreview.co.uk/index.php/2017/02/uk-house-lords-vote-30mbps-broadband-uso-6mbps-uploads.html (8 September 2021).

Jackson, M. (2020a) Ofcom's plan to measure the 4G UK mobile coverage obligation, *ISP Review*, 18 March. Available at https://www.ispreview.co.uk/index.php/2020/03/ofcoms-plan-to-measure-the-4g-uk-mobile-coverage-obligation.html (Accessed 8 September 2021).

Jackson, M. (2020b) 10Mbps UK broadband universal service obligation to go live Update 3, *ISP Review*, 19 March. Available at https://www.ispreview.co.uk/index.php/2020/03/10mbps-uk-broadband-universal-service-obligation-to-go-live.html (Accessed 8 September 2021).

Jackson, M. (2021) Gov updates on 4G shared rural network rollout progress, *ISP Review*, 29 June. Available at https://www.ispreview.co.uk/index.php/2021/06/gov-updates-on-uk-4g-shared-rural-network-rollout-progress.html (Accessed 8 September 2021).

Koenig, C. and Bache, V. (2012). The guidelines for the application of state aid rules in relation to rapid deployment of broadband networks—Remedy for a market failure? *Journal of European Competition Law & Practice*, 3 (3), 261–263.

Molloy, C. (2021) *What the tories want to do with our health data, and why we need to stop them*. Available at https://www.opendemocracy.net/en/ournhs/what-the-tories-want-to-do-with-our-health-data-and-why-we-need-to-stop-them/ (Accessed 21 February 2022).

NAO (2013) *The rural broadband programme*. London. Available at https://www.nao.org.uk/report/the-rural-broadband-programme-3/

NAO (2015) *The superfast (rural) broadband programme: Update*. London. Available at https://www.nao.org.uk/report/superfast-rural-broadband-programme-update/

Ofcom (2015) *Connected nations*, 1 December. Available at https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research

Ofcom (2019) *Delivering broadband universal service. Statement: Designating universal service providers and setting conditions*, 6 June. Available at https://www.ofcom.org.uk/consultations-and-statements/category-1/delivering-broadband-universal-service (Accessed 8 September 2021).

Ofcom (2020a) *Connected nations 2020*, 17 December. Available at https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research

Ofcom (2020b) *Connected nations 2020 – Scotland report*, 17 December. Available at https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research

Ofcom (2021) *Connected nations update – Summer 2021*, 9 September. Available at https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research

Peck, F., Jackson, K., and Marshall, A. (2015) *Digital health and social care activities in Cumbria: An overview and digital health and its application in rural areas: A review of international experience*. Academic Health Science Network.

Phillipson, J., Gorton, M., Turner, R., Shucksmith, M., Aitken-McDermott, K., Areal, F., Cowie, P., Hubbard, C., Maioli, S., McAreavey, R., Souza-Monteiro, D., Newbery, R., Panzone, L., Rowe, F., and Shortall, S. (2020) The COVID-19 pandemic and its implications for rural economies. *Sustainability*, *12* (10), 3973.

Rijswijk, K., Bulten, E., Klerkx, S., Dessein, J., Debruyne, L., Brunori, B., Scotti, I., Bacco, M., Currie, M., Bartolini, F., Van Der Velden, D., Rolandi, S., and Metta, M. (2020) *Digital Transformation of Agriculture, Forestry and Rural Areas*. Pisa.

Rush, K. L., Seaton, C., Li, E., Oelke, N. D., and Pesut, B. (2021) Rural use of health service and telemedicine during COVID-19: The role of access and eHealth literacy, *Health Informatics Journal*, *27*(2), 1–15. https://doi.org/10.1177/14604582211020064

Sandle, P. (2021) UK aims to diverge from EU data rules to drive growth, minster says, *Reuters*, 11 March. Available at https://www.reuters.com/article/us-britain-data-idUSKBN2B3009

Scammell, R. (2021) UK looks beyond EU in data law overhaul that aims to cut business costs, *Verdict*, 26 August. Available at https://www.verdict.co.uk/uk-data-law-overhaul/

Scottish Government (2017) *Digital scotland – Reaching 100 % programme*, June. Available at https://www.gov.scot/publications/digital-scotland-reaching-100-programme-public-consultation-report-revised/

Senbekov, M., Saliev, T., Bukeyeva, Z., Almabayeva, A., Zhanaliyeva, M., Aitenova, N., Toishibekov, Y., and Fakhradiyev, I. (2020) The recent progress and applications of digital technologies in healthcare: A review. *International Journal of Telemedicine and Applications*, 2020, 8830200.

Stewart, D. (2016) *The UK telecoms sector post Brexit*, Broadband Stakeholders Group, 16 November. Available at http://www.broadbanduk.org/2016/11/16/3553/ (Accessed 8 September 2021).

Stocker, V. and Whalley, J. (2019) Who replies to consultations and what do they say? The case of broadband universal service in the UK, *Telecommunications Policy*, *43* (8), 101823.

Sutherland, E. (2013) Independence and the regulatory state – telecommunications in Scotland and the rest of the United Kingdom, *Telecommunications Policy*, *37* (11), 1046–1059.

Sutherland, E. (2017) The implications of Brexit for the governance of telecommunication markets in the United Kingdom, *Digital Policy, Regulation & Governance*, *19* (1), 2–20.

Svendsen, M. T., Tiedemann, S. N., and Andersen, K. E. (2021) Pros and cons of eHealth: A systematic review of the literature and observations in Denmark. *SAGE Open Medicine*. https://doi.org/10.1177/20503121211016179

UK Government (2015a) *Government plan to make sure no-one is left behind on broadband access*, 7 November. Available at https://www.gov.uk/government/news/government-plans-to-make-sure-no-one-is-left-behind-on-broadband-access

UK Government (2015b) *Satellite dishes to boost broadband speeds in most remote areas of UK*, 7 December. Available at https://www.gov.uk/government/news/satellite-dishes-to-boost-broadband-speeds-in-most-remote-areas-of-uk

UK Government (2020a) *New £65 million package for 5G trials*, 20 February. Available at https://www.gov.uk/government/news/new-65-million-package-for-5g-trials

UK Government (2020b) *Shared rural network*, 9 March. Available at https://www.gov.uk/government/news/shared-rural-network

UK Government (2020c) *UK government secures satellite network oneweb*, 20 November. Available at https://www.gov.uk/government/news/uk-government-to-acquire-cutting-edge-satellite-network

UK Government (2021a) *Digital markets unit*, 7 April. Available at https://www.gov.uk/government/collections/digital-markets-unit

UK Government (2021b) *New laws to wipe out rural mobile 'not spots' and speed up rollout of next-generation 5G technology*, 20 April. Available at https://www.gov.uk/government/news/new-laws-to-wipe-out-rural-mobile-not-spots-and-speed-up-rollout-of-next-generation-5g-technology

UK Government (2021c) *Government unveils proposals to increase competition in UK digital economy*, 20 July. Available at https://www.businessleader.co.uk/government-unveils-proposals-to-increase-competition-in-uk-digital-economy/

UK Government (2021d) *UK unveils post-Brexit global data plans to boost growth, increase trade and improve healthcare*, 26 August. Available at www.gov.uk

UNCTAD (2021). *Competition law, policy and regulation in the digital era*, April 2021. Available at https://unctad.org/system/files/official-document/ciclpd57_en.pdf

Ungerer, H. (2013) Back to the roots: The 1987 telecom green paper 25 years after – Has European telecom liberalisation fulfilled its promise for Europe in the internet age? *Info*, 16 (2), 14–24.