



Implications of the digital divide on rural SME resilience

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ABSTRACT

This paper examines the implications of the ‘digital divide’ on the capabilities for Small and Medium Sized enterprises (SMEs) to operate in the face of challenging economic times, such as the Coronavirus pandemic. Previous research has shown that rural businesses, especially SMEs, are more impacted by lower levels of digital connectivity than those in urban areas, with this digital divide affecting business’ entrepreneurial activity. Using data from a survey of 110 businesses in Wales, the paper investigates the barriers and opportunities associated with the accessibility of high-speed broadband services and its impact on business decisions. Findings show that digital connectivity across rural areas of Wales has improved due to infrastructure investments; however, many businesses were still without reliable digital connections. Logistic regression findings show that location and distance to urban areas are significant variables relating to satisfactory levels of digital connectivity, with the impact of these more evident in rural areas. The implications of which are reduced opportunities for businesses to pursue diversified activities, limiting the ability of these businesses to develop resilience in economically challenging times. Furthermore, the paper considers how the Coronavirus pandemic has driven many business activities online, therefore businesses with less reliable access to digital connectivity and lacking an online presence are likely to be more constrained in their ability to be resilient.

1. Introduction

Recent decades have seen increasing debates surrounding the digital divide, the gap between levels of digital connectivity in urban and rural areas. Despite attempts by governments in many countries to advance connectivity access (Cambini and Jiang, 2009; Holt and Galligan, 2013), debates surrounding the digital divide remain where rural communities have faced difficulties in keeping up with digital connectivity developments (Malecki, 2003; Strover, 2003; Velaga et al., 2012). Indeed, the lesser provision of digital connectivity in rural areas is considered ‘the rural penalty’ (Hite, 1997; Malecki, 2003) with rural inhabitants paying the price for living in rural areas. This corresponds with debates regarding the challenges of rural economies and rural development (Marsden, 2016; Marsden and Sonnino, 2008; Wilson, 2008; Winter and Lobley, 2009). McManus et al. (2012) recognise the rural decline and the dependence of rural communities on the agricultural sector. Despite this, the positive aspects of the digital broadband rollout in rural areas are documented in relation to optimised farming operations (Tyler et al., 2016), increased productivity and sustainability through smart farming (Griffith et al., 2013), and social inclusion in rural areas (Ye and Yang,

2020).

Currently research on the digital divide is limited. A systematic literature review by Salemink et al. (2017) identified 157 papers since the mid-1990s, covering a range of issues from connectivity (cf. Malecki, 2010; Townsend et al., 2013), business development (cf. Bosworth, 2010; Cumming and Johan, 2010; Malecki, 2003; Roberts and Townsend, 2016; Tranos, 2012), and policy and regulations (cf. Gómez-Barroso and Feijóo, 2012; Holt and Galligan, 2013). Previous research has been conducted in a variety of research settings, including the UK (Townsend et al., 2013), the Netherlands (Markantoni et al., 2014), Australia (Griffith et al., 2013; Tyler et al., 2016), China (Ye and Yang, 2020), and the USA (Mahasuweerachai et al., 2010). Given the changing nature of digital connectivity, such as the emergence of ultrafast broadband and 5G mobile technology, there is a need for up to date research to account for such developments. This paper follows recommendations of Salemink et al. (2017) for research on specific places in understanding issues on a community level.

Wales was chosen as the research setting as a place where the rural economy is important, as approximately 83% of Wales is rural, and 35% of the population live in rural areas (Statistics for Wales, 2008).

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Furthermore, the natural landscape of Wales with high mountains and deep narrow valleys provide constraints on traditional connectivity. Consequently, it is a setting that has seen previous research on the issue of the digital divide, notably [Henderson et al. \(2018\)](#), who identified business clusters according to their level of digital maturity, and [Bowen and Morris \(2019\)](#), who evaluated the impact of digital connectivity levels on agrifood businesses. Both studies focus on SMEs, as businesses that face greater challenges due to limited resources, particularly rural SMEs, which are considered most disadvantaged by issues of the digital divide.

This paper builds on previous research by further understanding how the digital divide has impacted on rural-based SMEs. Specifically, it expands on work by [Henderson et al. \(2018\)](#) in evaluating whether policies in developing digital connectivity have reduced the existence of the digital divide, and how digital connectivity impacts on small business activities. In so doing the research specifically focusses on answering three key research questions:

- What is the effect of location on the access to and quality of digital connectivity?
- How do SMEs utilise technology?
- How would enhanced digital connections change business operations?

Additionally, this research considers how digital connectivity could provide rural-based SMEs with opportunities to overcome challenging economic periods, such as Brexit or the Coronavirus pandemic, as outlined by [Bowen and Morris \(2019\)](#), whilst also providing an understanding of the potential and barriers of the 4th Industrial Revolution into digital and Smart technologies within rural locations ([Cowie et al., 2020](#)).

Hereafter, the structure of the paper firstly reviews the literature on digital connectivity, particularly in relation to rural areas, and provides a contextual background to digital divide issues in Wales, as the research setting for this paper. The methodology section outlines the rationale for the quantitative methods adopted within this study, as well as the methods of analysis. The subsequent section documents descriptive findings, a logistic regression and cross tabulations analysis leading to a discussion and conclusions aimed at stimulating appropriate policy recommendations in overcoming digital divide issues.

2. Literature review

The issue of the digital divide has seen a range of research emerge since the mid-1990s. This research is largely documented in a systematic literature review by [Salemink et al. \(2017\)](#) who account for the varied issues of digital divide research that have evolved yet persisted in recent decades. General findings from the review point to the need for digital connectivity for all, echoing claims of [Townsend et al. \(2013\)](#) that digital connections, both broadband and mobile, should be accessible by all, however they acknowledge that rural communities have been disadvantaged by digital connectivity issues, which impact on the rural economy and the ability for rural areas to be competitive. These issues were observed at the beginning of the millennium ([Malecki, 2003](#); [Strover, 2003](#)), but more recent research indicates that the problem persists ([Henderson et al., 2020](#); [Wavehill, 2020](#)).

Rural businesses are often disadvantaged due to remoteness from their suppliers or markets ([Townsend et al., 2013](#)). Research has shown that adoption of information and communication technology (ICT) can address many of these issues ([Salemink et al., 2017](#)). A lack of ICT access can disadvantage and reduce potential growth opportunities for many businesses as they fail to respond to international competition from businesses who are quicker to adopt the latest ICT tools. Therefore, digital supply and demand failures are apparent in reducing the uptake of ICT in rural areas. Supply failures include the lack of a high quality, reliable fast broadband and the demand failures relate to the poor

uptake of new technology due to a lack of knowledge or skills to adopt new technologies ([BEIS, 2019](#)).

Considering Resource-based View theory ([Barney, 1991](#); [Wernerfelt, 1984](#)), businesses are able to leverage competitive advantage through specific resources available to them. [Barney \(1991\)](#) classifies resources into physical, human and organisational capital resources. Technology and location are notable physical resources, which include digital connectivity. [Morone \(1989\)](#) proposes that successful enterprises have better management of technology. Knowledge is a notable human capital resource, with knowledge resources associated with the entrepreneurial mindset of entrepreneurs and can be a useful source of competitive advantage ([Alvarez and Busenitz, 2001](#)). As rural-based businesses are considered to have less access to resources, including technology, such as digital connectivity, this leaves them at a disadvantage compared to equivalent businesses in urban areas, where such resources may be more readily available. This questions the ability of businesses in rural areas to be resilient in the face of economic challenges, such as the Coronavirus pandemic, as they would be less likely to leverage relevant resources, and display less entrepreneurial capabilities. However, access to digital connectivity resources could enable rural businesses to build on valuable, rare, inimitable or non-substitutable resources ([Barney, 1991](#)) to leverage competitive advantage in more globalised marketplaces. This is dependent on the reliability of local digital connectivity, and the effectiveness of government policy in ensuring access to reliable coverage. Hence, the objectives of this study focus on understanding the impact of the digital divide on rural-based SMEs.

2.1. Business development

[Salemink et al. \(2017\)](#) point to rural development as a significant theme within digital divide literature underlining the contribution of advanced telecommunication technologies to GDP growth due to investment in infrastructure and improved productivity ([Capello et al., 2011](#); [Ford and Koutsky, 2005](#); [Forman et al., 2012](#); [Greenstein and McDevitt, 2011](#); [Kolko, 2012](#); [Prieger, 2013](#); [Van Gaasbeck, 2008](#)). However, [Tranos \(2012\)](#) posits that digital connectivity is essential for improved infrastructure, but is not enough on its own to lead to economic development. Furthermore, research shows that such growth in GDP is unevenly distributed between urban and rural areas ([Kirschner, 2005](#); [Tu and Sui, 2011](#)). Entrepreneurial activity in rural regions is seen to be positively impacted by digital connectivity ([Ford and Koutsky, 2005](#)), however [Cumming and Johan \(2010\)](#) warn of the disadvantages of digital connectivity on rural entrepreneurs by exposing them to internet-based competition, such as through e-retail. Despite this, they state that more innovative entrepreneurs can respond positively to this competition, and strengthen the rural economy. [Roberts and Townsend \(2016\)](#) claim that improved digital connectivity can attract human capital into rural areas. Indeed, they note advantages of improved digital technology in rural areas provides resources for creative practitioners to use in cultural activities within the community. Aligning with resource-based theory, they argue that digital connectivity is important for the creative economy in rural areas, as well as the influence of local actors in rural resilience. Actors such as local businesses are considered to contribute to community resilience ([Besser, 2013](#); [Farmer et al., 2012](#)), and creative practitioners contribute to rural diversification ([Franklin et al., 2011](#); [Sherrieb et al., 2010](#)). In the rural context, improved digital connectivity can bring advantages through smart farming, such as in Australia ([Griffith et al., 2013](#)), in which technology and big data can be used to develop more productive methods and improve sustainable agricultural operations. Further benefits are seen to improvements in social inclusion within rural communities, such as in China ([Ye and Yang, 2020](#)).

2.2. Diversification

Diversification is considered an important opportunity for rural business to expand on their business activities, particularly for rural businesses that often possess limited resources (Morris and Bowen, 2020). This includes business growth or internationalisation, for companies who may be suited to, or interested in, achieving international growth. Indeed, internationalisation offers SMEs the opportunity to spread the risk across several markets (Spowart and Wickramasekera, 2012). Diversification and entrepreneurial strategies rely heavily on the adoption of innovation and technology as ways to exploit market opportunities made available by location and digital connectivity (Bowen and Morris, 2019). The ability of farmers to show entrepreneurial skills by diversifying or deploying resources to increase or replace current business activity, might be critical in the future of agriculture and futures of contemporary family run farms (McFadden, 2016), whilst also addressing issue of a rural decline (McManus et al., 2012). Rural companies that export depend on a reliable digital infrastructure to sell to overseas markets. Indeed, Bowen and Morris (2019) recognized that digital connectivity was an important resource in facilitating international growth among SMEs in the food and drink industry. Small and medium sized enterprises have been able to expand internationally as a faster rate and there has been a rise in businesses born global, these are businesses which internationalise from the beginning or shortly after (Madsen and Servais, 1997).

Many industries already embrace technological advancements but the agricultural sector, a significant sector in the rural economy, is perceived to be a laggard to change (Diederer et al., 2003; Hennessy et al., 2016; Morris et al., 2017). It is feared that the digital revolution is bypassing the agricultural sector, especially upland farming systems (Bowen and Morris, 2019). In fact the uptake of smart technologies within traditional livestock systems is pedestrian at best (Cowie et al., 2020). To overcome agricultural challenges including Brexit uncertainty, the industry is required to develop, promote and adopt new technologies, skills and knowledge to help businesses compete and grow locally, nationally and internationally. Advancements of digital infrastructure and technology can create new employment opportunities in rural areas for educated young individuals, thus reducing effects of 'brain drain' and keeping farms run as family businesses (Donnelly, 2014). Yet, whilst the uptake of technology will depend on a stable connection for the tools to be effective and valuable to the user, uptake also depends on the factors such as farm size and farmer characteristics areas, which rural development and agricultural policy must address (Diederer et al., 2003; Hennessy et al., 2016; Morris et al., 2017). Adopters of ICT can be categorized by their speed of adoption, and research has shown that Wales is lagging behind on the uptake of ICT compared to other countries (Morris et al., 2017). This can be attributed to a combination of gaps in provision and quality of digital infrastructure and lower skill levels of end users (Salemink et al., 2017). As Wales is a predominantly rural area, the connectivity issues are particularly significant especially for agriculture and tourism (Wavehill, 2020).

Some businesses seek to build a competitive advantage through increased efficiency and/or through diversification with the use of technology. The most successful businesses are the ones who effectively manage technology advancements (Morone, 1989). Morris and James (2017) find that there are many benefits and drawbacks for business through social media. Benefits include the ability for businesses to engage with stakeholders and develop business opportunities for strategic growth through smaller budgets. Drawbacks include sharing misleading information, an increasing volume of messages, and trolling. However, digital marketing and skills development are drivers for further entrepreneurial activity with business owners in this sector and uptake of social media provides farmers and producers a voice and provides new networking opportunities (Morris and James, 2017).

2.3. Digital connectivity in Wales

Wales is chosen as the setting for this research as it predominantly consists of rural areas with connectivity levels amongst the worst in the UK (Philip et al., 2017). Indeed, several studies have identified a digital divide between rural and urban areas in Wales, which places a number of challenges on rural SMEs (Bowen and Morris, 2019; Henderson et al., 2018, 2020; Wavehill, 2020). Despite investment in broadband connections in Wales over recent years, coverage of superfast broadband still lags. An Ofcom (2020) report highlights that 6% of Welsh residential premises do not have access to reliable broadband services. The report further highlights the digital divide with 98% coverage in urban areas as opposed to 78% in rural locations. Broadband over a fixed connection is available to almost all homes and businesses in Wales, where only 3% of premises are unable to receive broadband from a fixed line, however this equates to only 1% in urban locations and increases to 13% in rural locations. The rural counties of Ceredigion and Powys have the worst availability of broadband from either 4G, Fixed connection or WISP, with 3% of premises in Ceredigion and 4% in Powys unable to access these services. Additionally, research by the National Assembly for Wales (2017) highlights Wales as lagging behind the rest of the UK regarding the availability of mobile connections, with the lowest levels of coverage by 2G, 3G and 4G connections across the UK. Specifically, 4G coverage in Wales is 43.9% compared to a UK level of 71.3%.

Whilst it is recognized that a reliable fast broadband connection should be available to all, businesses in rural regions are the most dependant on broadband to overcome issues such as isolation and distance from their markets (Bowen and Morris, 2019). Where some locations have accessibility to the latest technological advancements, other areas may be left behind which will put pressures on the businesses in those locations. Indeed, Philip and Williams (2019) highlight that vulnerable home-based micro-businesses in rural areas of the UK are being left behind in the fast-changing national and global digital economy. Regions with low accessibility to superfast broadband are more likely to experience movement of individual talent and businesses to better connected areas, subjecting rural areas to a brain drain of skills (Townsend et al., 2017). Rural economies fail to grow as business and jobs move away.

Research specific to digital divide issues in Wales underlines challenges that rural SMEs face due to insufficient levels of connectivity. Henderson et al. (2018) found that SMEs engaged in a range of essential activities digitally, such as emailing, accounting and electronic payments. They identified four clusters, defining businesses according to their digital maturity. These range from the digitally disengaged, businesses with a lower level of digital engagement; passive exploiters, who make use of basic applications; active exploiters, who engage in a wider range of digital platforms and technologies, to the digitally embedded, businesses with high digital engagement. Similarly, findings from Bowen and Morris (2019) showed that rural agribusinesses displayed tendencies of being more reactive than proactive to entrepreneurial activity, and less likely to pursue business growth, underlining lower levels of entrepreneurial capabilities, placing SMEs at a competitive disadvantage. A review of the literature underlines the existence of a digital divide between urban and rural areas, with rural areas often considered disadvantaged due to lower levels of connectivity and entrepreneurial capability, as apparent in Wales, which impacts on businesses ability to develop competitive advantage or resilience.

3. Methodology

With the aim of investigating impacts of digital connectivity levels on the activities of SMEs in rural and urban areas, this paper adopts a quantitative research approach. This is based on a pragmatist worldview of the authors, and an epistemology of applying the most appropriate method to reach suitable outcomes on this issue. Following the 'what works' principle of Creswell and Plano Clark (2011), a questionnaire

was adopted as the research method, allowing for the investigation of a range of issues relating to digital connectivity, as well as reaching a larger sample of SMEs. While many previous studies favour qualitative research (such as Williams et al., 2016; Philip and Williams, 2019), this quantitative method is consistent with Bowen and Morris (2019), who used an online questionnaire as part of their research on digital connectivity. The use of questionnaires is designed to gather information from SMEs in understanding the specific issues that they experience in relation to digital connectivity, with the aim of outlining ways in which businesses can overcome these connectivity issues. Additionally, the use of online questionnaires was a suitable method due to Covid-19 restrictions.

Wales was chosen as the research setting for this study as it is a predominantly rural space, where approximately 83% of the land is rural, but 65% of the population live in urban places, defined as living in settlements of more than 10,000 people (Statistics for Wales, 2008). Indeed, previous research has investigated issues of the digital divide on rural businesses in Wales, particularly on agrifood businesses (Bowen and Morris, 2019; Morris et al., 2017). This study aims to build on previous research in understanding how the digital divide impacts on a wider range of rural SMEs, not exclusive to food and farming, and the possible impacts of digital connectivity levels on the activities of rural SMEs. Furthermore, the research findings provide insights for rural locations across the globe.

Data was gathered from an online self-complete questionnaire comprised of questions relating to the company Director’s profile, the company’s perceived satisfaction with the level of digital connectivity, the activities of the company that relate to digital connectivity, and the company profile. Respondents were selected through purposive sampling with the aim of achieving a sample of businesses across a range of industry sectors, as well as capturing a balanced representation of urban and rural-located SMEs from different parts of Wales. The questionnaire was distributed in English and Welsh to 200 SMEs in January 2020, leading to 110 useable responses, a response rate of 55%. Responses were edited and stored in SPSS 26 with analysis conducted through descriptive statistics, a logistic regression and cross tabulations, as presented in the following section.

4. Findings

Quantitative data was obtained through the completion of 110 online questionnaires by company directors distributed to 200 small and medium-sized businesses across Wales, a response rate of 55%. This compares favourably with previous studies in this area, such as Bowen and Morris (2019) whose samples of farmers and food producers received response rates of 9.84% and 23.7% respectively. This section presents the findings from the questionnaires, outlining descriptive findings, a logistic regression and cross tabulation analysis.

4.1. Respondents’ profile

The majority of respondents were located in South West Wales (59.8%), a predominantly rural region. The rural areas of North West

Wales (15%) and mid Wales (15.9%) also saw higher levels of respondents compared to the more urban areas of North East Wales (5.6%) and South East Wales (3.7%). Despite the higher number of respondents situated in South West Wales, Fig. 1 highlights a range of respondents in relation to their distance from an urban area, based on the Office for National Statistics (ONS) definition of an urban area as a settlement of over 10,000 people (ONS, 2016), often used in research in a UK context. Companies situated within 5 miles of an urban area represent 54.5% of respondents, with 4.55% of respondents situated more than 25 miles from an urban area. Given the geographic and topographic characteristics of Wales, even locations relatively close to urban areas could face connectivity challenges, and are often characterised as rural.

The majority of company respondents were microenterprises (45.5%) of less than 10 employees, with 21.8% representing small businesses (11–50 employees) and 32.7% medium-sized businesses (51–250 employees). Respondents represented a variety of business types, as seen in Fig. 2, including farms (17.3%), service providers (11.8%), tourism (8.2%) and several others.

4.2. Descriptive findings

Descriptive statistics from the surveys outline the importance of digital connectivity to the businesses. Table 1 documents a mean value of 4.4182 for business’ satisfaction with the reliability of their digital connection, based on a 1–7 Likert scale. This implies that the respondents were largely satisfied with their connectivity, although the mean value is closer to the median than the maximum value. The table also points to the importance of high speed connectivity for both the use of technology in the business (5.5273) and for marketing the business through the website and social media (5.4182).

Findings in Fig. 3 outline the main activities for which the respondents use broadband connectivity. The highest frequency being marketing (59 respondents), with storage and data sharing (41) and accounting (38) also prominent activities. This highlights the varied activities to which businesses depend on reliable broadband connectivity, ranging from industry-specific activities, to general business administration or communication.

4.3. Logistic regression

Having identified the nature of business activities for which digital connectivity is required, a logistic regression was conducted with the aim of analysing the various influences of the different variables observed in the survey against the company’s perceived satisfaction with their broadband connection. A logistic regression was chosen as it is suitable in evaluating the associations between the issues explored in the questionnaire (independent variables), based on scale questions, and perceived satisfaction of the broadband connection (dependent variable) (Pallant, 2016). The use of regression in this research is consistent with similar studies on rural digital divide research (Ford and Koutsky, 2005; Kolko, 2012; Prieger, 2013; Reddick et al., 2020). Here, the logistic regression is used to investigate whether relationships exist between the main variables identified from the literature, set out in three

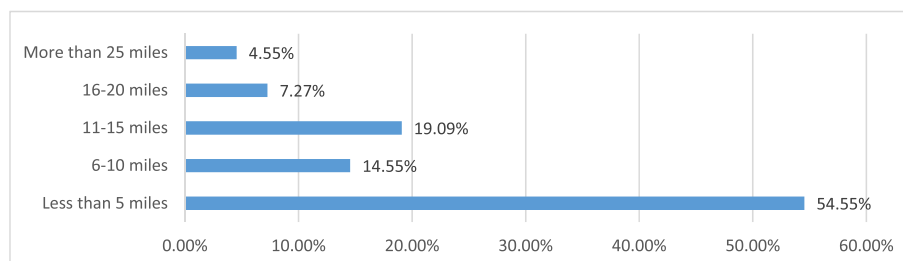


Fig. 1. Respondents according to their distance from an urban area.

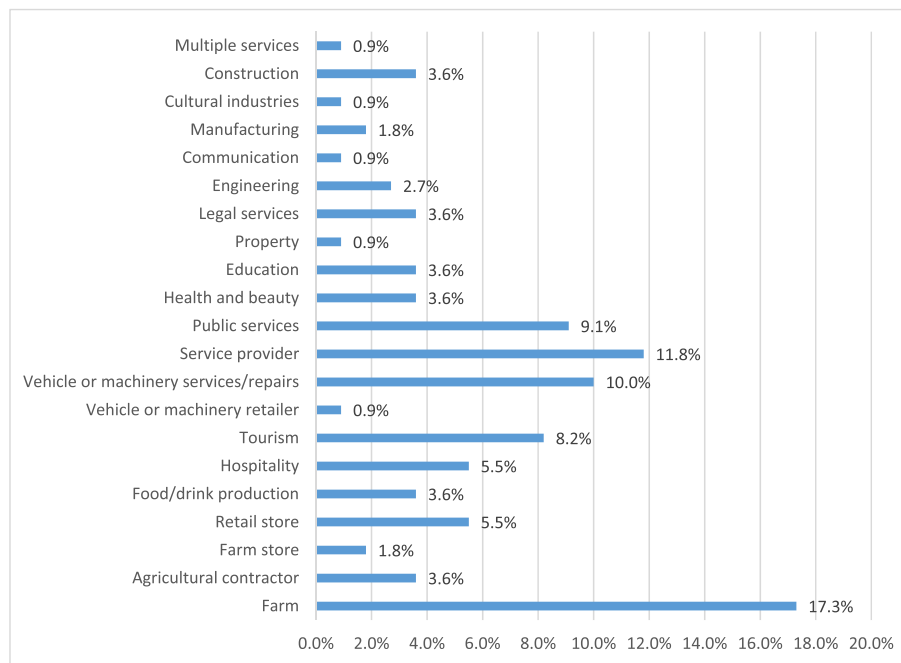


Fig. 2. Respondents business types.

Table 1
Importance of digital connectivity to the business.

Variable	N	Min.	Max.	Mean	Std. Dev.
Satisfaction with reliability of digital connection	110	1.0000	7.0000	4.4182	1.98333
High speed connection is important for technology use	110	1.0000	7.0000	5.5273	1.76463
High speed connection is important for marketing	110	1.0000	7.0000	5.4182	1.73142

constructs, against the perceived satisfaction of broadband connection, measured as a categorical variable. Table 2 evaluates this in relation to the constructs of company Director’s profile, the company’s activities, and the company’s profile. Four statistically significant variables are identified from the logistic regression analysis conducted in SPSS. For the company Director, age as the only statistically significant variable. This implies that the age of the business director influences their

perceived satisfaction of their broadband connectivity. Among the company activities, quality control is the only variable that has a relationship with the perceived satisfaction of digital connectivity, which implies that this is an important activity that could be impacted by the company’s level of digital connectivity. Two statistically significant variables are shown in Table 2 relating to company profile variables. Both the company location and its distance to an urban area influence the company’s perceived satisfaction with its digital connectivity. This implies that different locations across Wales experience differing levels of digital connectivity. This merits further investigation.

4.4. Cross tabulations

To further investigate the statistical significance of the location and distance to urban area variables from the logistic regression, a cross tabulation was conducted between these two variables and the dependent variable of satisfaction with digital connectivity. The aim of this was to evaluate differences within these variables to consider whether certain locations across Wales saw differences in their responses relating

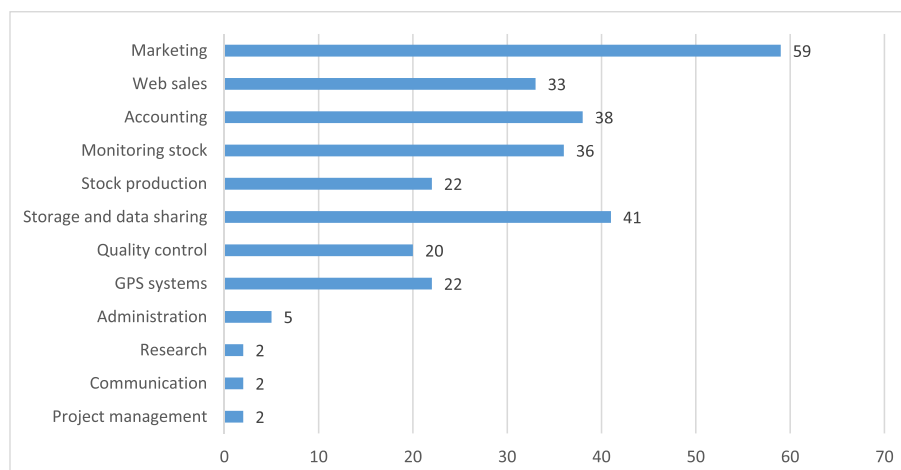


Fig. 3. Respondents’ activities using digital connectivity.

Table 2
Logistic regression findings.

Variable	B	S.E.	Sig.
Company Director profile			
Gender	−0.649	0.437	0.138
Age	−0.518	0.247	0.036 ^a
Education	0.015	0.237	0.951
Role in the business	−0.220	0.128	0.087
Time in the business	0.011	0.209	0.958
Constant	5.513	1.558	0.000
Chi-square	11.204		0.047 ^a
Cox and Snell R square	0.097		
Nagelkerke R Square	0.168		
Percentage correct predictions	87.30%		
Company activities			
Marketing	1.261	0.726	0.082
Web sales	−0.057	0.812	0.944
Accounting	0.244	0.713	0.732
Monitoring stock	0.217	0.661	0.742
Stock production	0.473	0.831	0.569
Storage	0.751	0.647	0.246
Quality control	−1.441	0.720	0.045 ^a
GPS	−0.597	0.686	0.384
Other	0.952	1.159	0.411
Constant	1.062	0.515	0.039
Chi-square	10.417		0.318
Cox and Snell R square	0.090		
Nagelkerke R Square	0.157		
Percentage correct predictions	83.60%		
Company profile			
Business type	−0.125	0.104	0.231
Staff	−0.417	0.455	0.360
Turnover	0.121	0.100	0.222
Location	−1.094	0.460	0.017 ^a
Distance to urban area	−0.689	0.262	0.008 ^a
Constant	8.860	2.539	0.000
Chi-square	21.321		0.001 ^a
Cox and Snell R square	0.176		
Nagelkerke R Square	0.305		
Percentage correct predictions	85.50%		

^a Statistically significant at 0.05 level.

to digital connectivity satisfaction. Findings presented in Table 3 show a mixed picture across the different regions. In terms of location, positivity towards connectivity was observed for most parts of Wales, with only South West Wales, a predominantly rural area, experiencing notable levels of dissatisfaction. In this case, 14 of the 63 respondents (22%) in this location expressed dissatisfaction in their level of connectivity. The highest levels of satisfaction were observed in North East Wales (100%) and South East Wales (88.9%), the two areas of Wales with the highest levels of urban population. Similarly, cross tabulation findings relating to the distance to urban area variable saw respondents situated more closely to urban areas experiencing higher levels of satisfaction. Those situated within 5 miles of an urban area saw an 86.7% level of satisfaction, compared to 80% dissatisfaction among those situated more

Table 3
Cross tabulations findings.

		Connectivity		Total
		Bad	Good	
Location	North East Wales	0	6	6
	North West Wales	1	14	15
	Mid Wales	1	16	17
	South East Wales	1	8	9
	South West Wales	14	49	63
Total		17	93	110
Distance to urban area	Less than 5 miles	8	52	60
	6-10 miles	3	13	16
	11-15 miles	2	19	21
	16-20 miles	0	8	8
	More than 25 miles	4	1	5
Total		17	93	110

than 25 miles from an urban area. This would imply that evidence for a digital divide still exists between urban and rural areas in Wales.

5. Discussion

Findings from this research provide evidence that the digital divide still exists. This is apparent from the logistic regression, with location and distance to urban area variables showing statistical significance. Further investigation through cross tabulations pointed to higher levels of satisfaction in the quality of digital connectivity in more urban parts of Wales, these being the North East and South East of Wales, with higher levels of dissatisfaction observed in rural South West Wales. The overall level of satisfaction was shown in Table 1, with a mean value of 4.4182, denoting that it was mostly positive, although the mean value was closer to the median rather than the maximum value (7.0000). These findings are echoed in observations relating to the distance of businesses from urban areas, underlining inconsistent levels of satisfaction between urban and rural areas. This goes against the principle of reliable levels of connectivity for all, as noted by Townsend et al. (2013), however this is consistent with observations of digital connectivity levels in Wales (Bowen and Morris, 2019; Henderson et al., 2020; Wavehill, 2020). The findings support claims that rural communities are disadvantaged through digital connectivity issues (Kirschner, 2005; Townsend et al., 2013; Tu and Sui, 2011). In the context of Wales, connectivity levels remain lower than other parts of the UK (Ofcom, 2020), despite an increase in levels compared to a previous Ofcom (2013) report.

The lower levels of connectivity observed in Wales imply that policies in ensuring coverage all over Wales have not achieved their intended aims. Indeed, findings from this research underline that high levels of dissatisfaction remain in rural areas in relation to their digital connectivity. This would imply that further investment in digital infrastructure is necessary, which, as research has shown, can contribute to GDP growth and improved levels of productivity (Capello et al., 2011; Ford and Koutsky, 2005; Forman et al., 2012; Greenstein and McDevitt, 2011; Kolko, 2012; Prieger, 2013; Van Gaasbeck, 2008). As advancements in digital connectivity technology progress quickly, such as the development of ultra-fast broadband or 5G mobile connectivity, there is a need for places, particularly rural places, to keep up with new technology. This requires consistent investment on the part of governments and can be considered more important than ever due to changing habits influenced by the Coronavirus pandemic. As many countries worldwide followed a lockdown policy, where people were encouraged to stay at home and work from home, businesses and individuals became highly dependent on reliable access to digital connectivity, with the majority of business activities being conducted online, including emailing, video meetings and e-retail. With differing levels of connectivity between urban and rural areas, this placed rural businesses at a competitive disadvantage to urban-based companies in their efforts to be resilient in the face of the changed situation caused by the pandemic. This is comparable to forewarnings of Bowen and Morris (2019) that rural-based businesses are greater impacted by changes caused by Brexit, due to lower levels of digital connectivity providing rural businesses with less digital resources to compete in the marketplace.

This research underlines that implications of the digital divide are substantial, especially at a time when businesses are more reliant on digital connectivity. Findings in Table 1 show that digital connectivity is important for respondents in enabling businesses to carry out significant daily activities. The main uses of digital connectivity observed in this research (Fig. 3) include marketing, data storage, accounting, stock monitoring, and web sales. However, logistic regression findings only pointed to quality control as being statistically significant. These represent rudimentary activities for any business, therefore insufficient levels of connectivity would impact on the ability of the business to operate effectively. These activities are consistent with research by Henderson et al. (2018), who observed similar activities among Welsh

SMEs in relation to their use of digital technology. With businesses becoming increasingly reliant on digital connectivity as a result of the Coronavirus pandemic, the ability to perform these core activities is dependent on businesses having sufficient access to digital connectivity. Additionally, digital technology is an important resource for businesses seeking to develop greater resilience in the face of the challenging economic period, through business growth or diversification.

Diversification represents an opportunity for businesses to become more competitive, particularly in a globalised marketplace, such as internationalisation, which is seen to spread the business risk across multiple markets (Spowart and Wickramasekera, 2012). The ability to diversify and develop more entrepreneurial activities is heavily dependent on digital connectivity (Bowen and Morris, 2019). Findings from this research imply that the lower levels of connectivity observed in Wales could impact on the ability of a business to engage in diversified activities, particularly in South West Wales, where levels of satisfaction to connectivity are considerably lower than in the more urban areas of North East and South East Wales. The rural economy is often comprised of small businesses who operate in industries such as agriculture, food production, cultural industries, or public services, where specific rural factors are evident. Respondents from this research span a range of settings (Fig. 2), with 17.3% of respondents in farming, 11.8% in service provision, and 10.0% in vehicle servicing. Farming is a sector where challenges are acknowledged, and it is seen as critical for farmers to show more entrepreneurial skills in diversifying the range of farm activities through deploying resources to maximise the business potential of the farm (McFadden, 2016). Benefits of digital connectivity can also be seen in more efficient farming practice, such as through big data (Tyler et al., 2016), or smart farming (Griffith et al., 2013). Indeed, in the context of Wales, the natural resources that exist on many farms could provide opportunities to diversify into renewable energy, to supplement farm income (Morris and Bowen, 2020). However, the agricultural sector is often considered a laggard to change, often due to the elderly age of farmers, and less likely to embrace technological advancements (Morris et al., 2017). Indeed, SMEs in the agriculture and food sectors were seen to be more reactive to business growth opportunities in rural areas, due to digital divide issues, despite opportunities that exist in diversification in farming, and international growth for food producing SMEs (Bowen and Morris, 2019). Internationalisation opportunities are more evident through digital connectivity, which enables SMEs to be 'born global' and engage in international activities from their inception (Madsen and Servais, 1997). For businesses with lower levels of digital connectivity, such as in South West Wales, this becomes more challenging.

Considering resource-based view theory, findings underline that limited resources observed in rural areas through limited access to digital connectivity and fewer human capital resources lead to limitations in leveraging competitive advantage. This is linked with lower levels of entrepreneurial activity, as businesses are more passive towards development opportunities, thus impacting the potential for rural businesses to be more resilient. Limited resources in rural areas can often lead to a 'brain drain', the loss of educated, often young, individuals who move from peripheral rural areas to core urban areas in search of work. This is often evident in farming areas, however, advancements in digital infrastructure can create more opportunities for younger people to stay in rural areas and reduce the effects of the 'brain drain' (Donnelly, 2014). Indeed, improved levels of digital connectivity can attract human capital to rural areas, particularly for creative practitioners who can make use of natural resources and engage with the community (Roberts and Townsend, 2016). As a small country, rural residents in Wales are often located within close proximity to urban centres, as findings in Table 3 point to greater satisfaction in levels of digital connectivity among respondents closer to urban areas, with greater dissatisfaction among those located 25 miles or more away from urban areas. However, creative practitioners could contribute to rural diversification activities (Franklin et al., 2011; Sherrieb et al., 2010) and contribute to resilience

within rural communities along with other small businesses (Besser, 2013; Farmer et al., 2012). With rural businesses located in relatively close proximity to urban areas, there are opportunities for closer engagement between rural and urban businesses, especially SMEs who could benefit from sharing resources and knowledge. Geographic spillovers from urban to rural areas can have an impact on rural growth or poverty, supported by integrated networks (Argent, 2016). This could be facilitated through local government actions, or more recent policies of developing city and regional growth deals. Growth deals depend on connecting individuals and businesses within the specific region, therefore reliable digital connectivity is an important resource is facilitating these local networks.

6. Conclusion

Digital connectivity is essential for businesses of all sizes to conduct rudimentary daily tasks, as well as seeking business growth. This is essential at a time of economic difficulty, such as the Coronavirus pandemic, as businesses have suffered from a decrease in business activity, and a need to adapt to working more remotely. The range of businesses included in this research (Fig. 2) engage with digital connectivity in different ways, depending on their business activity. However, the use of digital connectivity for core business activities, as well as facilitating a more diversified business model, means that access to reliable connectivity is more important for businesses and individuals than ever. This has been compounded by the Coronavirus pandemic, which forced many businesses to adapt almost overnight and develop an online presence.

This research contributes to discussions of the digital divide, which have grown in prominence in recent years. Drawing upon previous studies within the same research setting of Wales (Bowen and Morris, 2019; Henderson et al., 2018), the aims of this research focus on understanding contemporary issues of the digital divide on rural-based SMEs. Firstly, evidence implies that the digital divide still exists, despite attempts to ensure the rollout of superfast broadband and mobile coverage across all parts of Wales. Additionally, evidence from Ofcom (2020) shows that Wales remains the region of the UK with the lowest levels of connectivity. Consequently, further attempts would be recommended to ensure that rural places are not left behind, and that levels of connectivity can be enhanced, with the aim of keeping up with advances in digital connectivity, notably ultrafast broadband and 5G mobile connectivity. While the research is focussed on Wales, the findings could apply to places with similar geographical characteristics, as well as similar levels of a digital divide between urban and rural areas.

Secondly, the implications of the digital divide are observed on rural-based SMEs, both on their day-to-day business activities, such as marketing, accounting, or data storage; and their opportunities to explore diversified activities. Considering theoretical groundings of the resource-based view (Barney, 1991; Wernerfelt, 1984), rural SMEs can be seen to be disadvantaged competitively against urban SMEs, where there is a greater likelihood of resource availability. The digital divide compounds this disadvantage as rural-based SMEs face lower levels of digital connectivity, which could inhibit the ability for such businesses to perform routine activities, or pursue diversification activities. The disadvantages observed in rural areas often lead to a 'brain drain' of skilled individuals from rural to urban areas due to a perceived lack of opportunities. Diversified business activities are considered an opportunity for businesses to overcome the challenges of periods of difficulty, such as the Coronavirus pandemic. Access to digital connectivity presents businesses with opportunities to diversify their activities, such as internationalisation, therefore the lower levels of digital connectivity experienced in rural areas can be seen to inhibit the opportunities for rural SMEs to explore growth or diversified activities, putting them at a disadvantage in their efforts to increase business resilience in the face of the Coronavirus pandemic.

In summary, location matters when it comes to access to reliable

digital connectivity, as such, despite investment, rural and more remote locations are disadvantaged. Opportunities for SMEs to utilise technology are vast, from daily operations and decision support tools to online marketing and engagement with buyers and suppliers. Therefore, to support all businesses and ensure a level playing field the infrastructure and supporting education systems and drivers must be in place. Digital connectivity can reinvigorate the rural economy, providing further opportunities for entrepreneurial activities whilst protecting and enhancing employment opportunities away from urban locations. Opportunities can be created for well-paid and high skilled workers whilst also increasing the financial resilience of existing businesses. Concerns remain that the 4th Industrial revolution is bypassing rural economies.

Implications of this research span beyond the context of the research setting of the study, as recent research on this issue has identified evidence of a digital divide in various research settings. As such, many places face the challenges of ensuring widespread digital connectivity, however, the greater dependency that has been placed on reliable connectivity during the pandemic should serve as a notice to policymakers that a redressing of digital divide issues should be sought to ensure that rural-based SMEs are not placed at a disadvantage. Indeed, rural-based SMEs should receive appropriate support in overcoming periods of difficulty and in ensuring that they can reach their potential.

Limitations in the research are acknowledged in the sample of the survey, with variations in the number of responses obtained from different regions of Wales, despite efforts to ensure that all regions are represented evenly. Despite this, findings are based on a rigorous research process, and suitable comparisons can be drawn on the varying levels of connectivity across Wales. Indeed, this represents a contribution of the paper in understanding the implications of digital connectivity challenges across various regions, both urban and rural.

Given the continuous developments in digital connectivity technology, such as the emergence of ultrafast broadband and 5G mobile connectivity, there is a need to continue to revisit the situation of the digital divide. Future research should continue to investigate the impact of the digital divide on rural areas in different research settings, particularly in emerging economies, which have seen little research on this issue. Further research is also desirable on the impact of economic downturns, such as the Coronavirus pandemic, on rural places, particularly on rural development, and how rural businesses can develop greater resilience to overcome the challenges of these periods.

Author statement

All authors contributed equally to all aspects of this paper, from the beginning of the research to the writing of the paper.

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