INNOVATION & RESEARCH CAUCUS

UNPACKING INNOVATION ACTIVITIES IN RURAL FIRMS

Evidence from National Data Sets

IRC Report No: 059

REPORT PREPARED BY

Thao Nguyen*

Jeremy Phillipson*

Matthew Gorton*

Natalie Partridge*

Newcastle University, National Innovation Centre for Rural Enterprise

NICRE National Innovation Centre Rural Enterprise

Delivered with ESRC and Innovate UK

Authors
The core members of the research team for this project were as follows:

- Dr Thao Nguyen - Newcastle University
- Professor Jeremy Phillipson - Newcastle University
- Professor Matthew Gorton - Newcastle University
- Dr Natalie Partridge - Newcastle University

This document relates to IRC Project FFCoE008 Understanding and improving innovation amongst UK rural businesses

Acknowledgements
This work was supported by Economic and Social Research Council (ESRC) grant ES/X010759/1 to the Innovation and Research Caucus (IRC).

We are very grateful to the project sponsors at UK Research & Innovation (UKRI) for their input into this research. The interpretations and opinions within this report are those of the authors and may not reflect the policy positions of UKRI or its constituent councils. We would also like to acknowledge and appreciate the efforts of the IRC Project Administration Team for their support in preparing this report.

About the Innovation and Research Caucus
The Innovation and Research Caucus supports the use of robust evidence and insights in UKRI's strategies and investments, as well as undertaking a co-produced programme of research. Our members are leading academics from across the social sciences, other disciplines and sectors, who are engaged in different aspects of innovation and research systems. We connect academic experts, UKRI, IUK and the (ESRC), by providing research insights to inform policy and practice. Professor Tim Vorley and Professor Stephen Roper are Co-Directors. The IRC is funded by UKRI via the ESRC and IUK, grant number ES/X010759/1. The support of the funders is acknowledged. The views expressed in this piece are those of the authors and do not necessarily represent those of the funders.

Contact
You are also welcome to email us if you have any questions about this report or the work of the IRC generally: info@ircaucus.ac.uk

Cite as: Nguyen, T. et al. 2026. Unpacking Innovation Activities in Rural Firms. Evidence from National Data Sets, UK: Innovation and Research Caucus

CONTENTS

EXECUTIVE SUMMARY

This report provides a comprehensive analysis of innovation in rural firms, with a principal focus on firms with over 10 employees, drawing on linked UK Innovation Survey, Longitudinal Small Business Survey and Business Structure Database records. Rural businesses represent nearly a quarter of all firms in England and Wales, yet their innovation activities and challenges remain insufficiently understood within mainstream innovation policy debates.

Overall, rural firms in England are as likely to innovate as urban firms, with comparable rates of product, process and organisational innovation and similar levels of innovation investment. They are more likely than urban firms to be motivated to innovate in order to reduce their costs or environmental impacts. Moreover, a sustained, consistent engagement in innovation is strongly associated with higher turnover and productivity growth, with effects on these outcomes being significantly higher amongst rural compared with urban enterprises.

However, rural firms face greater difficulty converting innovation into commercial success, with notably lower rates of new-to-market innovation, weaker conversion of innovation into sales, and more limited use of formal innovation protection mechanisms.

Rural innovation varies significantly across rural areas. Firms in smaller rural settlements and hamlets and isolated dwellings frequently display stronger rates of innovation (including new-to-market innovation) and innovation investment, while rates are markedly lower in larger rural settlements that are more distant from major towns and cities. This strengthens the call for place-sensitive rather than rural/urban binary approaches.

The findings suggest that understanding and overcoming ecosystem and structural constraints, rather than firm-level deficits, is critical for improved outcomes from rural innovation. Rural innovators face challenges with accessing information and collaborating with partners. Notably, weaknesses in access to market information, finance, the cost of finance, lack of qualified personnel, and a less well developed external networks and institutional intermediaries appear to hinder innovation and the progression from “new-to-the-business” to “new-to-the-market” innovation.

Generally, universities have especially poor linkages with rural businesses (with poorer levels of engagement than for urban counterparts). In particular, rural firms located further away from major towns and cities are less likely to collaborate with universities, with this difference being statistically significant in larger rural areas.

The research challenges “urban = innovative, rural = laggard” dichotomies still implicit in much innovation policy and scholarship which, based on agglomeration theory, treats density as necessary precondition for innovation. Persistent innovation (innovating over more than one time period) is critical, and particularly so for rural firms, in realising turnover and productivity growth. The results also imply that ecosystem weaknesses are spatially uneven: larger rural settlements that are distant from major towns and cities

appear to be at particular risk of ecosystem failure, pointing to the importance of targeted intermediary capacity and brokerage between rural firms and universities, and national innovation programmes.

Supporting rural innovation requires reinforcing firms' capacity to sustain innovation over time, strengthening access to skills, finance, markets and networks, and improving the functioning of local innovation ecosystems, particularly in more remote rural areas. Addressing these systemic constraints will be essential if rural areas are to fulfil all of their potential to contribute to the UK's economic growth objectives.

1. Introduction

This report provides a holistic assessment of business innovation in rural England and Wales through a secondary analysis of key national data sets.

Rural areas account for 23% of businesses in England (Defra, 2026) and represent an important portion of the overall economy. Yet, with innovation systems typically built around urban and clustered geographies, rural economies are often assumed to lack innovation capability(Carlino & Kerr, 2014). Given their inherent dispersion of activities, and more limited access to resources, knowledge and associated agglomeration benefits, rural economies have traditionally been considered as inferior to cities as environments for innovation (Carlino & Kerr, 2014; Cooke, 2002; Florida & King, 2018).

However, evidence demonstrates innovation is not exclusive to urban and clustered areas (Eder, 2019), with studies suggesting that rural firms are as likely to be innovative as urban firms and also operate at the frontier of market and technological development (Fritsch & Wyrwich, 2021; Petrov, 2012; Tiwasing et al., 2023; Virkkala, 2007). Many forms of innovation are found in rural businesses, ranging from patented innovation, technology advancement as market leaders, to product and process innovation adoption, or organisational innovation.

In England, Tiwasing et al. (2023) found no difference in product or process innovation between rural and urban firms in the Northern Powerhouse and Midlands Engine regions. They found that rural firms in the Midland-Engine area were as likely as urban firms to have new-to-market (NTM) and new-to-business (NTB) innovation. In the Northern Powerhouse, rural businesses were more likely to report NTB innovation, but less likely to engage in NTM innovation. Keeble (1997) found that although firms in South East England reported more original innovations than their counterparts in peripheral regions, the latter had a better record of continuing innovation and higher R&D intensity. These findings suggest that innovation, including novel innovation, takes place in rural economies to a sizable extent.

Evidence concerning the impacts of a rural location on innovation processes and outcomes, remains mixed and incomplete. Some studies suggest that the location of businesses plays a minor role, and that firm-level factors are much more important (Johansson & Lööf, 2008). Likewise, Ozusaglam and Roper (2021) found innovation ambition to have a stronger effect on innovation effort than location. Yet, Copus et al. (2008) showed firm-level factors alone (e.g., size, age, owners' education, human capital) do not fully explain the innovation gap between regions, suggesting locational factors do play a meaningful role. Roper and Jibril (2023) found that greater remoteness or inaccessibility, measured as travel time, reduces new-to-the-world innovation (in terms of patents, trademarks and designs), although this was not necessarily the case in terms of a greater sparsity (reduced population density) of business setting. Importantly, recent evidence suggests that business innovation rates may be declining

across different geographies. For example, analysis of the UK Innovation Survey in Scotland by NICRE for OECD, suggests that the recent overall decline in self-reported innovation is apparent in both rural and urban areas, with both new-to-the-business and new-to-the-world innovation declining from 16% to 14% in rural and 18.5% to 17% in urban firms (OECD, 2023).

A key challenge in understanding innovation in rural areas is that regular releases of national innovation survey datasets do not routinely apply the official urban-rural classification of statistical geographies. Analysis of the rural geography of innovation is therefore reliant on often incomplete, bespoke, secondary analysis and *post-hoc* application of the classification.

In this research report we provide a comprehensive overview of rural innovation in England using official innovation and enterprise data sources. We extend the evidence base by including a wide range of drivers, measures and outcomes of innovation, with our research aiming to explore three main themes:

Firstly, we examine the types, and levels of innovation among rural firms. Some studies argue that firms in more peripheral areas tend to adopt existing innovations, rather than creating new to the world, breakthrough innovations (Berkes & Gaetani, 2021). We therefore investigate the levels and profile of innovation among rural businesses.

Secondly, we explore the factors that enable and hinder rural innovation. Rural economies have distinctive characteristics that are often seen as unfavourable for innovation (OECD, 2023; Partridge et al., 2026), such as lack of geographical proximity to urban centres, or a thin environment of resources and research institutes. We therefore consider factors, both at a firm-level (e.g., internal capability) and local-area-level (e.g., physical and soft infrastructures) affecting innovation levels.

Thirdly, we consider firm level outcomes of rural innovation. Specifically, we investigate the effects of innovation persistence (i.e., continuation in innovation adoption) on firm growth. This sustained engagement in innovation may reflect stronger organisational learning and innovation culture within firms, and could be especially significant to improved firm performance (Cefis & Marsili, 2006).

This report focuses on empirical analysis of UK national data sets. Accompanying IRC reports (Partridge et al., 2026) provide a state of the art review of the literature relating to rural innovation (Partridge et al., 2026), an assessment of stakeholder perspectives on the innovation support ecosystem for rural businesses (Phillipson et al., 2026), and a qualitative exploration of rural business innovation processes (Zarei et al., 2026).

The next section of this report introduces the research methodology with subsequent sections presenting the results of the analysis undertaken before discussing the findings and drawing conclusions.

2. Methodology

2.1 Data sources

In this study, we draw on three official data sources, namely the UK Innovation Survey 2013-2023 (UKIS), the UK Longitudinal Small Business Survey (LSBS) 2015-2022, and the Business Structure Database (BSD) 2013-2023. All three data sets are accessed from the ONS Secure Research Service (SRS).

The UKIS covers a wider range of innovation activities, including product, process, and organisational innovation as well as innovation investment. UKIS also surveys businesses about barriers, motivations, information sources, and cooperating partners for innovation. The UKIS, which runs every two years, focuses on businesses employing at least 10 employees, which means that a substantial part of the rural economy is not covered, particularly micro businesses and the self-employed (Defra, 2026). Each UKIS wave covers innovation activities over the timespan of the previous three years. For instance, UKIS wave 2023 covers activities over 2021-2023.

The BSD covers firms' turnover, employment, legal form, ownership and age. BSD is primarily derived from the Inter-Departmental Business Register, which includes firms registered for VAT or PAYE. As BSD covers most of the business population in the UK, it can be used to calculate economic indicators for an area, such as number of firms, % of firms achieving a high-growth episode, number of new business births etc.

By merging UKIS with BSD, additional information is obtained, including firms' longitudinal performance and economic indicators for the area in which they are located. As such this merged UKIS-BSD data set can capture the impacts of local economy drivers on innovation and the impacts of innovation on business performance. The merge also allows us to track firm performance over a longer horizon.

Meanwhile, LSBS provides information on product and process innovation and whether the product innovation is new to the market, as well as other business activities, including business ambition and investment plans. Crucially, LSBS covers self-employed business, micro and small and medium-sized businesses (MSMEs) but not large companies (having more than 250 employees). It also includes some businesses which are not registered for VAT.

Overall, analysing UKIS, LSBS and BSD allows us to capture a comprehensive picture of innovation activities in rural economies, in which UKIS and BSD offer insights into rural innovation in small, medium and large firms, and LSBS allows examination of rural innovation in microbusinesses. We also limit our analysis to England and Wales which use the same rural-urban classification (see below).

2.2 Data preparation and sample

UKIS data were merged with BSD using the firm identification number from both data sets. For each UKIS wave, data from BSD for the respective year when firms were interviewed was used in the merging process. For example, for UKIS wave 2013 which covered innovation activities over 2011-2013, we merged UKIS with BSD 2013 only. The merger resulted in around 72,000 observations in England and Wales. Breaking this down, there are about 12,500 observations in 2013 and 2015, 11,000 in 2017, 12,000 in 2019, 11,000 in 2021 and 12,000 in 2023. Rural firms account for about 19% of the total sample.

For parts of the analysis, we only consider microbusinesses (employing 1-9 people) from the LSBS. Here, there are around 24,000 observations for England and Wales over the period 2015-2022.

Throughout, the analysis applies the 'old' 2011 Rural:Urban classification to the data (ONS, 2013). In addition, we also apply the 'new' Rural:Urban classification 2021 (RUC21) for the analysis of the UKIS 2023 dataset, which allows for an improved understanding of the role of 'relative access' in impacting rural innovation (see box below).

In the **2011 Rural Urban Classification** Urban areas are settlements with populations of 10,000 or more and everywhere else is Rural (ONS, 2013). These categories are then broken down into a set of settlement types. For rural areas these include Hamlets and Isolated Dwellings; Village; and Town and Fringe. These are also classified as to whether they are set in a sparse setting reflecting where the wider area is remotely populated, based on dwelling density. Rural villages, hamlets and isolated dwellings are equivalent to smaller rural settlements in the 2021 classification and Rural town and fringe is equivalent to larger rural settlements.

The **2021 Rural Urban Classification** (ONS, 2026) "categorises Census Small Area statistical geographies … as Rural or Urban based on settlement characteristics in a continuation from the previous classifications. The …classification for each geography is either: 'Urban'- geographies dominated by dense settlements or Amalgamated Built Up Areas (ABUAs) with populations of over 10,000; 'Larger Rural Settlement' – geographies with settlements in a rural context, small towns and low-density fringes of conurbations, or dense ABUAs with populations of less than 10,000; or 'Smaller Rural Settlement'- indicative of geographies dominated by smaller villages, hamlets and isolated dwellings. These are then complemented by a sub-category based on Relative Access to a Major town or city (75,000 people) within 30 minutes travel by road. These are: 'Nearer to a Major town or city' – a majority of the population in a geography within 30 minutes of a major urban settlement; and 'Further from a Major town or city' – a majority of the population in a geography further than 30 minutes of a major urban settlement."

2.3 Definition of innovation variables

In this report, we refer to four types of innovation activities:

1. Product innovation: the introduction of new or improved goods or services.
2. New-to-market (NTM) product innovation: Product innovations not previously offered by competitors.
3. Innovation active: which includes businesses engaged in any of the following:
    - Product innovation;
    - Innovation in business processes used to produce or supply goods or services that the business has introduced. These innovations may be NTB or NTM;
    - New and significantly improved forms of organisation, business structures or practices, and marketing concepts or strategies;
    - Engagement in innovation projects not yet completed or abandoned
4. Broad innovation: comprising businesses which are innovation active (as above) and engaged in innovation investment.

2.4 Empirical framework

To examine factors that are hindering or encouraging firms' decision to engage with innovation, we employ a random effect dynamic probit model in which an innovation decision at time t is conditional on innovation decision at time t-1 as follows.

$$Prob(I_{it} = 1|I_{it-1}, \dots I_{i0,} X_{it}, c_i) = f(\alpha_1 I_{it-1} + \beta factor_{it} + \delta X_{it} + \theta Y_{jt} + c_i + \varepsilon_{it}) \quad (1)$$

In which, I_{it} refers to firm innovation activities. In the UKIS, I_{it} represents for 'innovation-broad', which equals to one if firm i engages in any innovation activities, namely product innovation, process and business organisation innovation, abandoned or not-yet-finished innovation, and innovation investment, and zero otherwise. We also distinguish 'NTM innovation' for I_{it}, which equals to one if firm i has NTM product innovation, and zero otherwise. For the LSBS, I_{it} represents 'innovation' which equals to one if firm *i* has a product or process innovation over the last three years, and 'NTM innovation' which equals to one if firm *i* has a NTM product innovation. $factor_{it}$ represents factors that may hinder or enable firms' innovation engagement, including barriers, motivation, information source, cooperation partners[1]. X represent for profile of firm *i*, including age, size in terms of employment and turnover, legal status, sector, export status. Y represents for profile of the lower-super-output-area j (LSOA) firm i located in, including number of businesses, number of businesses having a high-growth episode (meaning

[1] Since questions on motivation, information sources and cooperation partners are only asked for those who engaged in any type of innovation activities, variables representing these factors are only included in the regression on 'NTM innovation'.

having employment growth by at least 20% in the current year), number of new business births, Gross-Value-Added (GVA) of the area. Region and year dummies are also included.

Following Antonioli and Montresor (2021), a correction model (Wooldridge, 2002) is applied to account for initial condition of I_{it} as follows.

$$c_i = \theta_0 + \theta_1 I_{i0} + \theta_2 X_i + a_i \quad (2)$$

Inserting (2) in (1), yields:

$$Prob(I_{it} = 1 | I_{it-1}, \dots I_{i0,} X_{it}, c_i) = f(I_{it-1} + \beta factor_{it} + \delta X_{it} + \theta Y_{jt} + I_{i0} + a_i + \varepsilon_{it}) \quad (3)$$

To understand factors affecting the decision to start to innovate, conditional on a previous innovation decision, we insert interaction terms of I_{it-1} with $hinderer_{it}$ and $enabler_{it}$ into (3) as follows:

$$Prob(I_{it} = 1 | I_{it-1}, \dots I_{i0,} X_{it}, c_i) = f(I_{it-1} + \beta hinderer_{it} + \alpha I_{it-1} * hinderer_{it} + \delta X_{it} + \theta Y_{jt} + I_{i0} + a_i + \varepsilon_{it}) \quad (4)$$

Next, to examine the impacts of innovation on performance, we regress growth on innovation persistence as follows:

$$growth_{it} = IP_{it-1} + \delta X_{it} + \theta Y_{jt} + \varepsilon_{it} \quad (5)$$

in which, growth is natural logarithm value of turnover growth, employment growth, and labour productivity growth, IP is a categorical variable which equals to 1 if a firm was not innovation-active in successive UKIS survey periods ('persistent no-innovation'), 2 if a firm had innovation activities in a previous survey period but not the next (called 'intermittent innovation type1), 3 if a firm did not have innovation activities in a previous survey period but did so in the subsequent period; (called 'intermittent innovation type2), and 4 if a firm engaged in any innovation activity in successive survey periods ('persistent innovation').

3. Innovation Activities

3.1 Innovation Rates

Around a fifth of rural firms **employing at least 10 employees** engage in product innovation, the introduction of new or improved goods or services, which is a rate similar to urban firms (see Table 1). Firms in rural hamlets and isolated dwellings have the highest product innovation rate (23.7%). Some 7.9% of rural firms introduce product innovations that are NTM, which is 0.7% less than urban firms (with this difference being statistically significant). Yet, firms in rural hamlets, again, have the highest rate of NTM innovation.

The finding that business innovation rates in rural hamlets and isolated dwellings are higher than other rural localities, gives some support to arguments that resource constraints drive "innovation by necessity" (North & Smallbone, 1996), developing new processes or solutions to overcome limited access to suppliers, labour, and services (Hindle et al., 2010). At the same time, these businesses typically cannot rely on local demand and instead must orient their activities toward regional, national, or global markets (Gorton, 1999), which often encourages differentiation and innovation and novel business models (Kalantaridis, 2006).

Rural businesses are significantly less likely to convert their NTM innovation into improved turnover performance. Specifically, sales of new goods and services from NTM innovation accounted for 11% of total turnover of rural firms, compared to 13.5% in urban firms.

Approximately 44% of rural firms are innovation-active (a similar share to urban firms), with firms in rural hamlets and isolated dwellings having the highest levels overall (46.6%). Rural firms also demonstrate a similar average rate of innovation investment to urban firms, at about 37%, but with rural hamlets again demonstrating high rates on this measure. Overall, around 45% of rural firms are engaged in any kind of innovation (i.e., broad innovation), similar to urban firms, with firms in rural hamlets seeing a higher rate than other rural firms (48% compared to 44% in rural towns and 43% in rural villages).

Table 1: Innovation rates in rural and urban businesses 2011-2023 (UKIS, RUC 2011)

	Urban (U)	Rural (R)	U-R diff	Non-London urban	Rural town	Rural village	Rural hamlet	Town-Village diff	Hamlet-Village diff
Product innovation rate	21.1%	21.2%	-0.12%	21.3%	20.6%	19.5%	23.7%	1%	4.2%**
NTM product innovation	8.6%	7.9%	0.7%*	8.5%	8%	7%	8.8%	1.1%	1.8%**
Sales from NTM innovation	13.4%	11.0%	2.4%***	12.4%	9.9%	12.3%	11%	-2.4%	-1.3%
Innovation-active rate	44.7%	43.6%	1.1%	45.6%	43%	42%	46.6%	1%	4.7%**
Innovation-investment rate	37.4%	36.6%	0.9%	38.4%	35.4%	34.8%	40.2%	0.6%	5.4%***
Broad-innovation rate	45.9%	44.6%	1.3%	46.8%	43.9%	42.9%	47.8%	1%	4.8%**

Sales from NTM innovation refers to proportion of business total turnover in the year prior to the surveyed year from NTM innovation. Innovation-investment refers to firms that invested in one of the following activities: internal research & development (R&D), acquisition of R&D, acquisition of machinery and equipment, computer hardware and software for innovation, acquisition of existing knowledge, training for innovative activities, design activities, market introduction of innovations.

Innovation rates in larger rural settlements that are located further away from a major town or city are significantly lower than in other rural or urban contexts (see Table 2 applying RUC 2021). Businesses in these settlements have significantly lower rates of product innovation and innovation investment. Although they are not significantly less likely to have NTM product innovation, they are less able to convert their NTM innovations into sales than business in larger rural settlements located nearer to a major town or city. Whereas, converting NTM innovation into sales is more of a challenge in rural areas in general, businesses in more distant, smaller rural areas perform relatively well on this measure.

Table 2: Innovation rates in rural and urban businesses 2021-2023 (UKIS, RUC 2021)

	Urban (all)	Rural (all)	U-R diff	Rural large far	Rural large near	RLF-RLN diff	Rural small far	Rural small near	RSF-RSN diff	Urban far	Urban near
Product innovation rate	22%	22%	0%	14%	25%	-11% **	25%	23%	2%	20%	23%
NTM product innovation	10%	10%	0%	8%	10%	-2%	10%	10%	0%	11%	10%
Sales from NTM innovation	16.8	12.7	4.2**	7.34	12.71	-5.37 **	17.46	11.28	6.18	17.83	16.75
Innovation active rate	36%	36%	0%	25%	37%	-12% **	36%	39%	-3%	32%	38%
Innovation investment	25%	24%	1%	16%	27%	-11% ***	24%	25%	-1%	23%	25%
Broad Innovation rate	38%	37%	1%	25%	38%	-13% ***	38%	41%	-%	33%	38%

3.2 Innovation trends

Turning to trends in innovation among rural firms **employing at least 10 employees,** we see from Figure 1 an overall decline in the innovation rate over the period 2011-2023, and particularly for rural towns and villages. In 2011-2013, the innovation rate in firms in rural towns, villages, and hamlets and isolated dwellings had stood at around 40%. The following years saw innovation rates increase significantly, before a serious fall during the period 2017-2019 across all rural settings. This downward trend was reversed during the 2019-2021 period, which included the height of the Covid-19 pandemic, when innovation rates increased for firms across all rural settings, with firms in rural hamlets and isolated dwelling seeing the highest climb. However, in the final period 2021-2023, after the Covid-19 pandemic, innovation rates again decreased and reached their lowest levels for firms in rural towns (29%) and rural villages (35%). Between 2011 and 2023, firms in rural hamlets often displayed some of the highest, as well as the most fluctuating, innovation rates.

Relatively similar patterns are seen for innovation investment activities and broader innovation (Figure 2).

Product innovation rates display some similarities to, but also some notable differences, to the innovation rate, but with some variations too (Figure 3, left). Overall, the proportion of firms having product innovation increased slightly over the period 2011-2023 for firms across all three types of rural settings. The product innovation rates increased markedly initially but then decreased between 2017-2019. During the pandemic period 2019-2021, there was a sharp recovery in product innovation rates across all three rural settings. After the pandemic, there was a marked, continued increase in product innovation in rural hamlets and isolated dwellings, whereas rural towns and villages again saw only a level or declining innovation.

Rates of NTM innovation have fluctuated significantly, although there has been an overall increasing trend across all three rural settings (Figure 3, right). After an initial decline in rates for rural towns and hamlets and isolated dwellings, all three rural contexts saw an increase in NTM innovation, with rural towns showing the highest rate between 2015 and 2017. Again, we see a pre-pandemic dip, pandemic boost, and post-pandemic dip in the level of innovation, with the exception of rural hamlets and isolated dwellings which again showed continued strengthening in performance post-pandemic.

Turning to **innovation in micro businesses,** based on analysis of LSBS data between 2015 and 2022, we see in Figure 4 a general downward trend in process innovation rates and NTM product innovation among micro rural firms. At the outset of the pandemic these innovation levels drop significantly, and especially so in rural towns. Over the period, microbusinesses in rural hamlets and isolated dwellings often have the highest level of innovation. In 2021, rural microbusinesses saw a significant increase in NTM innovation. This increasing trend was continued into 2022 for microbusinesses in rural hamlets and isolated dwellings but not in other rural areas. Comparing Figures 3(right) and 4(right), we see that microbusinesses in rural towns appear more constrained than larger rural firms in terms of NTM innovation.

Figure 1: Innovation-active rates over time 2011-2023 (UKIS, RUC 2011)

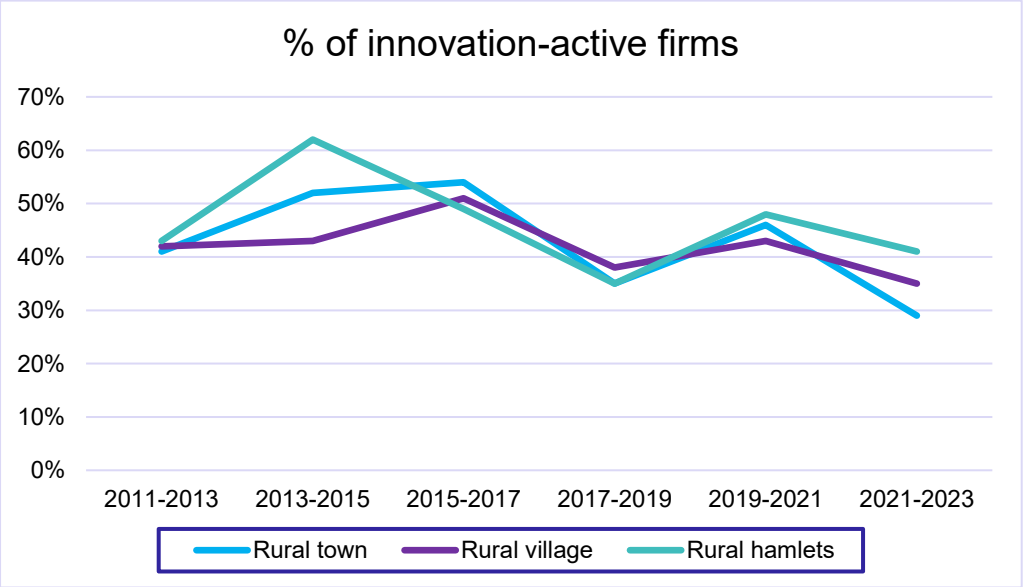


Figure 2: Broad-innovation rates and innovation investment rates 2011-2023 (UKIS, RUC 2011)

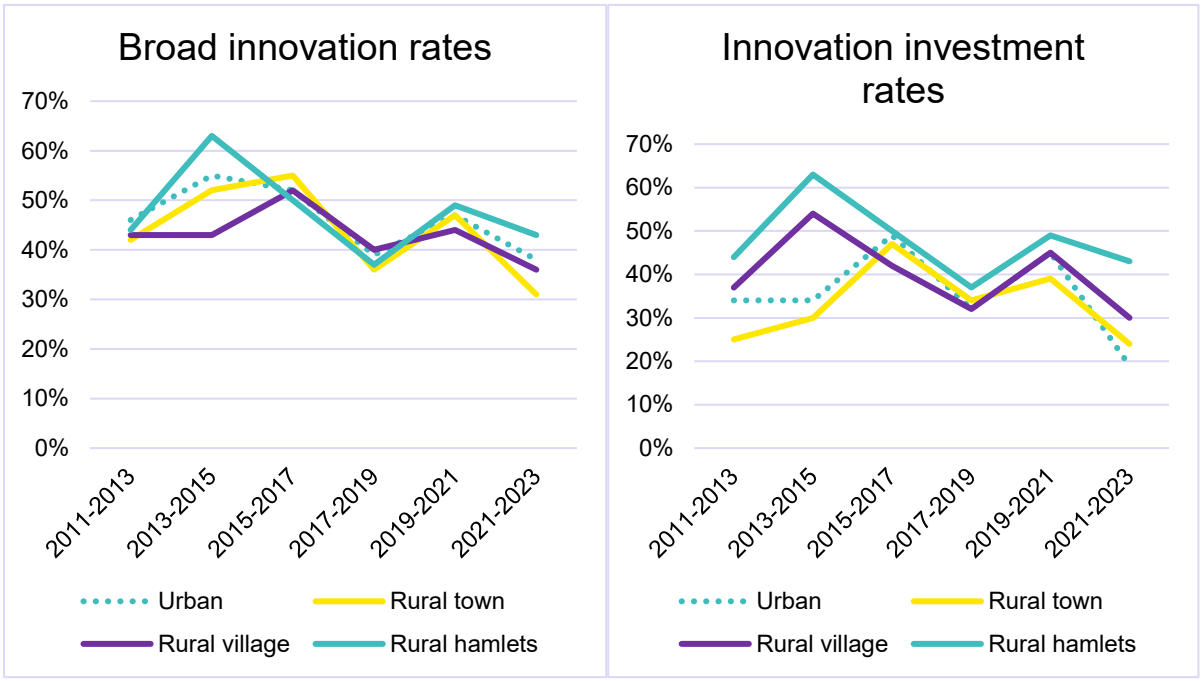


Figure 3: Product innovation and NTM innovation rates in rural firms 2011-2023 (UKIS, RUC 2011)

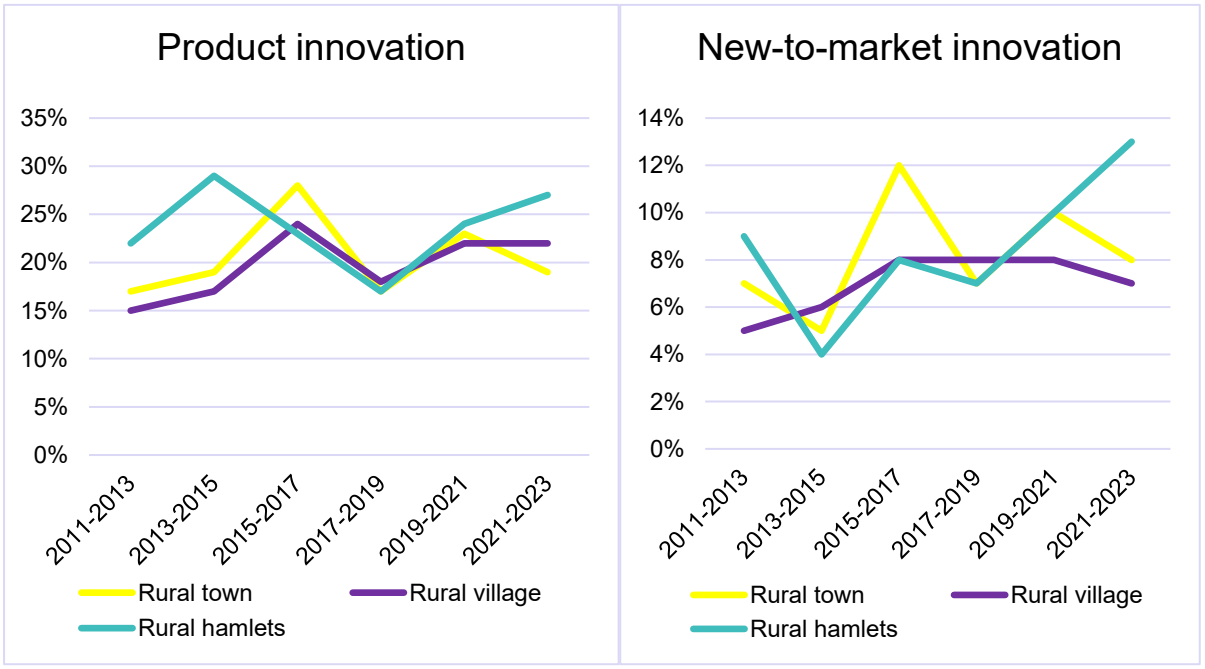
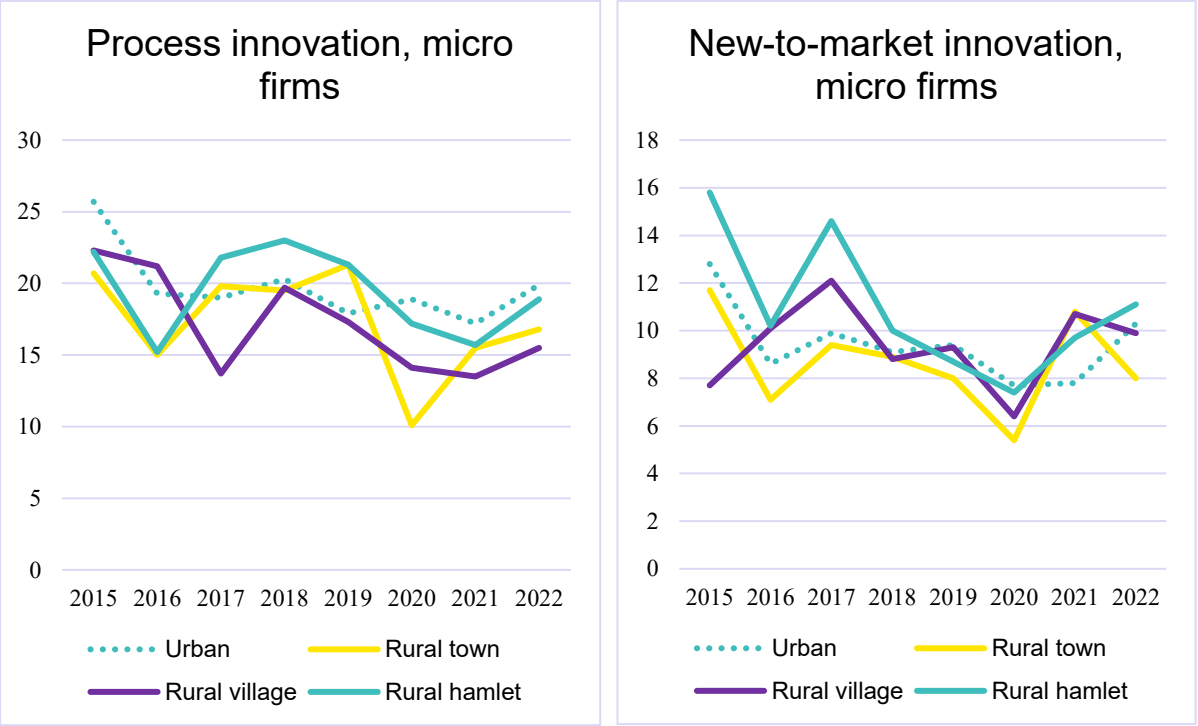


Figure 4: Innovation rates over time in micro firms, 2015-2022 (LSBS, RUC 2011)



3.3 Innovation in Processes and Business Organisation

Turning to innovation in processes and business organisation among enterprises **employing at least 10 employees**, we see that the most common forms of innovation in rural firms relate to the introduction of new business practices for organising procedures (18%), new methods for organising work responsibilities (16%), and new methods for information processing/communication (14%) (Table 3). These overall patterns and levels of business process innovation are similar for urban firms, with the exception of a lower propensity of rural firms being engaged in introducing new methods for information processing and communication. Overall, there is a general tendency for businesses in rural hamlets and isolated dwellings to be most likely, and rural villages the least likely, to introduce process innovation.

Table 3: Business process innovation, 2011-2023 (UKIS, RUC 2011)

	Urban (U)	Rural (R)	*U-R diff (a)*	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	*T-V diff*	*H-V diff*
New business practices for organising procedures	16.8%	17.7%	-0.9%	17.3%	17.7%	16.1%	19.6%	1.6%	3.5%**
New methods of organising work responsibilities and decision making	15.2%	15.7%	-0.5%	15.1%	15.4%	14.4%	17.5%	1.1%	3.1%*
New methods for information processing and communication	15.8%	14.1%	1.7%**	15.9%	13%	13.5%	16.1%	-0.5%	2.6%*
New methods for accounting and other administrative operations	11.1%	10.9%	0.1%	10.8%	10.8%	10.5%	11.6%	0.2%	1%
Implementation of changes to marketing concepts or strategies	10.5%	10.8%	-0.2%	10.6%	10.4%	10.3%	11.6%	0.1%	1.4%
New logistics, delivery or distribution methods	8%	7.9%	0.1%	8.1%	5.9%	7.8%	10.2%	-2%*	2.3%*
New methods of organising external relationships	7.3%	6.8%	0.5%	7.2%	6.8%	6.4%	7.4%	0.5%	1%

Column 'U-R diff' refers to the difference between urban and rural businesses; Column 'T-V diff' refers to the difference between businesses in rural towns and businesses in rural village; Column 'H-V diff' refers to the difference between businesses in rural hamlets & isolated dwellings and businesses in rural village.
, ** and * refer to significance at 10%, 5% and 1% significance level.*

3.4 Innovation investment and protection

The most common forms of innovation investment by rural firms **employing at least 10 employees** relate to acquisition of computer software (19%), internal R&D (18%), and computer hardware (18%) (Table 4). This pattern is similar for urban firms, with an exception being that rural firms are significantly more likely to invest in the acquisition of R&D and in advanced machinery and equipment for innovation. Firms in rural hamlets and isolated dwellings are the most likely to invest across the various innovation activities.

Table 4: Proportion of rural and urban firms investing in activities supporting innovation, 2011-2023 (UKIS, RUC 2011)

	Urban (U)	Rural (R)	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Acquisition of computer software	19.8%	18.9%	1%	20.4%	19.3%	17.1%	20.5%	2.2%*	3.4%*
Internal R&D	19.3%	18.2%	1%	19.7%	17.3%	17.6%	20.1%	-0.3%	2.5%
Acquisition of computer hardware	17.5%	17.6%	-0.1%	17.9%	17.7%	15%	20.3%	2.7%**	5.2%***
Training for innovative activities	13.1%	13.1%	-0.1%	13.4%	12.6%	11.2%	15.8%	1.4%	4.6%***
Acquisition of advanced machinery & equipment	11.9%	12.8%	-1%*	12.8%	12.1%	12.9%	13.8%	-0.8%	0.9%
All forms of design	12.1%	11.8%	0.3%	12.1%	10.7%	12.3%	12.7%	-1.5%	0.4%
Market introduction of innovations	11.6%	11.4%	0.2%	12%	10.9%	10.5%	12.8%	0.3%	2.2%
Acquisition of R&D	7.5%	8.6%	-1.1%**	7.8%	7.4%	8.2%	10.3%	-0.8%	2.2%*
Acquisition of existing knowledge	7.6%	7.5%	0.1%	8%	7.2%	7.7%	7.9%	-0.4%	0.2%

Rural innovators are less likely to protect their innovations than urban firms, through patents, design registration, copyright, trademarks etc (Table 5). Among rural firms, those in rural villages are more likely to use protection for their innovation activities through patents, design registration and lead time advantages.

When it comes to NTM innovation (Table 5), rural firms are as likely as urban firms to have innovation protection through patents, design registration, complexity of goods or services, and secrecy. However, they are less likely to use trademarks, copyrights and lead time advantages than urban firms. Differences in using innovation protection among rural firms becomes more significant when it comes to NTM innovation, with firms in rural villages again significantly more likely to use a wide range of innovation protection vehicles than those in rural hamlets & isolated dwellings and rural towns.

Table 5: Innovation protection 2011-2023 (UKIS, RUC 2011)

	Urban (all)	Rural (all)	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
Patents	14%	11%	2%***	11%	10%	15%	9%	-6%***	-6%***
Design registration	16%	13%	2%***	13%	12%	17%	12%	-5%**	-5%***
Copyright	19%	16%	3%***	16%	14%	19%	15%	-4%	-4%
Trademarks	21%	17%	4%***	17%	15%	20%	16%	-5%	-4%
Lead time advantages	12%	10%	2%**	10%	8%	11%	10%	-3%*	-1%
Complexity of goods or services	27%	24%	3%**	24%	22%	25%	26%	-3%	1%
Secrecy (include non-disclosure agreements)	25%	21%	4%***	21%	21%	23%	20%	-2%	-3%
NTM innovators									
Patents	28%	26%	2%	29%	21%	36%	23%	-14%***	-13%***
Design registration	30%	27%	3%	29%	23%	35%	25%	-12%**	-10%*
Copyright	35%	31%	5%*	33%	25%	36%	31%	-11%**	-5%
Trademarks	38%	32%	6%**	36%	25%	39%	35%	-14%***	-4%
Lead time advantages	26%	21%	5%**	25%	15%	26%	23%	-10%*	-3%
Complexity of goods or services	53%	50%	3%	52%	42%	49%	58%	-7%	-8%
Secrecy	48%	46%	2%	47%	46%	45%	47%	1%	2%

3.5 Constraints on innovation

Table 6 considers the constraints on innovation for businesses **employing at least 10 employees**, comparing firms engaged in 'broad innovation' (where firms engage in any type of innovative activities) and innovation inventors (referring only to businesses introducing product innovation that is NTM).

For rural innovators, financial constraints are the most pressing barrier, with 21% of firms highlighting the importance of challenges around availability of finance, 20% pointing to cost of finance, and 17% highlighting the high direct costs of innovation. Lack of skilled labour and UK regulation are the next two most pressing issues, highlighted by 16% and 14% of rural innovators. Market concentration is highlighted by 9.8% of rural innovators, compared to 10.8% of urban. Only about 4% of rural innovators highlight a lack of information on technology and on markets as barriers, which is significantly less than for urban innovators. The overall pattern of barriers is similar between rural and urban areas, and also between different rural settings (towns, villages, and hamlets and isolated dwellings). Some barriers, such as constraints around a lack of qualified personnel, feature slightly more for businesses in hamlets and isolated dwellings though the difference is not statistically significant.

Table 6 shows that NTM innovators ('inventors') are more likely than innovators in general to identify constraints on their innovation activity. Rural inventors are less likely to self-report constraints than urban inventors, and especially so in relation to availability of finance, the costs of innovation, challenges linked to the market being dominated by established businesses, and lack of information on technology. Nevertheless, substantial shares of rural inventors highlight important constraints on their innovation activities, relating to cost of finance (25.1%) and availability (22.4%), cost of innovation (21.4%), a lack of qualified personnel (19.7%) and UK regulation (19%). Importantly, there are also significant differences in barriers experienced among rural firms in different rural settings. A much higher share of firms (30%) in rural villages highlight a lack of finance and its cost. Moreover, a high proportion (27.2%) of inventor firms in rural hamlets and isolated dwellings face issues around accessing skilled employees.

Taking relative access into account, by applying the RUC 2021 for the period 2021-2023 (Table 7), a higher proportion of rural innovators that are more remote in both small and larger rural settings face barriers with the cost of finance and the availability of finance than rural firms closer to urban areas. Higher shares of firms in smaller rural settings that are less remote cited barriers linked to a lack of information on technology and markets as well as market concentration than those in similar settings that are more remote. Constraints linked to a lack of qualified personnel appear to be consistently experienced across geographies.

Table 6: Constraints affecting innovative firms and NTM innovation, 2011-2023 (UKIS, RUC 2011)

	Urban	Rural	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
Availability of finance	21%	20.8%	0.2%	19.9%	19%	21%	22.3%	-2%	1.2%
Cost of finance	19.5%	19.7%	-0.2%	18.8%	19.3%	20.4%	19.4%	-1%	-1%
High direct costs of innovation	18.8%	17.1%	1.7%	18.6%	16.6%	17.1%	17.6%	-0.5%	0.5%
Lack of qualified personnel	15.6%	15.8%	-0.2%	15.1%	14.9%	14.6%	17.7%	0.4%	3%
UK government regulation	13.4%	14.4%	-1%	12.9%	14%	12.6%	16.2%	1.5%	3.6%
Market dominated by established firms	11.8%	9.8%	2%*	11.3%	8.8%	9.8%	10.6%	-1%	0.8%
Lack of information on technology	6.2%	4.3%	1.9%***	5.8%	3.8%	5.3%	3.9%	-1.6%	-1.4%
Lack of information on markets	5.9%	4.2%	1.7%***	5.6%	4.2%	3.7%	4.4%	0.5%	0.7%
NTM innovators									
Cost of finance	23.9%	25.1%	-1.2%	22.4%	22.2%	28.5%	25.2%	-6.3%	-3.3%
Availability of finance	28.3%	22.4%	5.9%**	26.8%	20.1%	30.3%	18.4%	-10.2%**	-11.9%**
High direct costs of innovation	25.7%	21.4%	4.3%**	24.1%	20.6%	24.8%	19.4%	-4.1%	-5.4%
Lack of qualified personnel	22%	19.7%	2.3%	21.4%	14.6%	16.2%	27.2%	-1.6%	11%**
UK government regulation	18%	19%	-1%	18.4%	18.7%	16.7%	21.2%	2%	4.6%
Market dominated by established firms	13.4%	9.9%	3.5%**	13.2%	10.7%	7.3%	11.3%	3.4%	4%
Lack of information on markets	9%	7.6%	1.4%	8.9%	9.5%	6.1%	6.8%	3.4%	0.7%
Lack of information on technology	7.9%	5.3%	2.6%**	7.6%	4%	6.2%	6%	-2.2%	-0.2%

Table 7: Constraints affecting innovation, by relative access, 2021-2023 (UKIS, RUC 2021)

	Urban (all)	Rural (all)	U-R diff	Rural large far	Rural large near	RLF-RLN diff	Rural small far	Rural small near	RSF-RSN diff	U far	U near
Innovators											
Excessive economic risk	23%	21%	2%	21%	20%	1%	26%	23%	3%	18%	20%
High direct innovation costs	20%	16%	4%	20%	16%	4%	16%	18%	-2%	13%	22%
Cost of finance	23%	22%	1%	24%	13%	11%	26%	17%	9%	19%	19%
Availability of finance	24%	22%	2%	24%	18%	6%	23%	16%	7%	24%	21%
Lack of qualified personnel	23%	23%	0%	23%	24%	-1%	24%	27%	-3%	21%	21%
Lack of information on technology	8%	6%	2%	8%	5%	3%	6%	11%	-5%	3%	6%
Lack of information on markets	8%	9%	-1%	8%	8%	0%	8%	12%	-4%	7%	9%
Market concentration	13%	11%	2%	13%	12%	1%	10%	15%	-5%	6%	16%

Fewer rural than urban firms that are innovating have a degree in science or engineering subjects, with innovative firms in rural towns having lower proportions than other rural firms (Table 8). The share of employees with a science or engineering degree is higher in rural firms having NTM innovation than rural innovators in general (16%), but again, they have a lower share than urban firms (18%).

Table 8: Share of high-skill employees and exporting status (UKIS, RUC 2011)

	Urban	Rural	Urban-Rural diff	Non London Urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
% highskill_science	10%	8%	2%***	8.7%	7.2%	8.8%	8%	-1.6**	-0.8
NTM innovators									
% highskill_science	18%	15.7%	2.3%**	15.9%	11.3%	20%	16.6%	-8.6***	-3.3

3.6 Innovation motivation

The decision to innovate is influenced by a range of factors (Table 9). For innovator firms, market orientation as well as reducing costs and improving capacity are important push factors for innovation. Over a third of rural firms aimed to have new products or services, or to increase market shares or added value. A significantly higher proportion of rural than urban innovators choose to innovate in order to reduce costs (31%) or environmental impacts (24.8%).

Market-orientation and positioning are also the main innovation motive for both rural and urban inventors, and this is especially so for rural inventors, with 60% aiming to introduce new products or services, compared to 56% of urban firms. As with innovators in general, a significantly larger share of rural than urban inventors innovate for the purpose of reducing costs. Inventor firms in rural villages are also more likely to be aiming to improve capacity.

In terms of relative access, there are significant differences in innovation motivation among rural firms (Table 10). Firms in more remote rural areas are less likely to cite entering new markets and increasing market shares as the motivation for innovation than those in less remote rural areas, with the difference statistically significant for firms in larger rural areas. Meanwhile, firms in more remote rural areas are more likely to innovate for the purpose of reducing costs, improving capacity, and reducing environmental impacts, although the difference is not statistically significant. A lower level of relative access therefore appears to associate with innovation for purposes of cost-reduction, whereas market expansion is a more common motivation for firms closer to major towns and cities.

Table 9: Motivations of innovative firms and NTM innovators, 2011-2023 (UKIS, RUC 2011)

	Urban	Rural	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
New products/services	36.2%	37.8%	-0.5%	36.5%	35.7%	36.6%	37.7%	-1%	1%
Increasing market shares	36%	35.1%	0.9%	36.5%	32.2%	33.8%	38.7%	-1.7%	4.9%
Increase value added	36.6%	34.8%	1.8%	35.8%	32.2%	32.7%	38.7%	-0.5%	6.1%**
Reducing costs	27.2%	31.0%	-3.8%**	27.9%	29.0%	30.0%	33.3%	-1.4%	2.8%
Improving capacity	29.7%	27.8%	1.9%	29.8%	24.2%	28.7%	30.3%	-4.5%**	1.6%
Reducing environmental impacts	22.1%	24.8%	-2.7%**	22.3%	23.8%	24.4%	26.2%	-0.6%	1.8%
Entering new markets	21.1%	18.6%	2.5%***	20.7%	17.6%	19.6%	18.6%	-2%	-1%
NTM innovators									
New products/services	55.8%	60.1%	-4.3%*	56.7%	64%	57.1%	58.8%	6.9%	1.7%
Increasing market shares	50.5%	54.2%	-3.7%	50.7%	52.2%	54.3%	56.5%	-2.1%	2.2%
Increase value added	46.8%	44.9%	1.9%	45.7%	44.6%	45%	45.1%	-0.3%	0.2%
Entering new markets	39.8%	40.5%	-0.7%	39.6%	37.2%	44.2%	41.1%	-6.9%	-3.1%
Reducing costs	30.8%	34.6%	-3.8%*	31.9%	36.3%	38.1%	30.3%	-1.9%	-7.9%
Improving capacity	34.6%	34.4%	0.2%	34.3%	29.1%	41.5%	34%	-12.4%**	-7.5%
Reducing environmental impacts	27.5%	28.8%	-1.2%	28.5%	28.7%	32.9%	25.5%	-4.2%	-7.4%

Table 10: Motivations for innovation, by relative access, 2021-2023 (UKIS, RUC 2021)

	Urban (all)	Rural (all)	U-R diff	R large far	R large near	RLF-RLN diff	R small far	R small near	RSF-RSN diff	U far	U near
New products/ services	34%	33%	1%	28%	36%	-8%	37%	30%	7%	33%	34%
Entering new markets	22%	20%	2%	10%	21%	-11% *	15%	23%	-8%	17%	22%
Increasing market shares	32%	29%	3%	24%	29%	-5%	28%	30%	-2%	30%	32%
Reducing costs	26%	26%	0%	31%	24%	7%	31%	23%	8%	23%	26%
Improving capacity	32%	28%	4%	36%	30%	6%	36%	23%	13%	33%	32%
Increasing value added	41%	35%	6%**	34%	36%	-2%	42%	31%	11%	34%	41%
Reducing environmental impacts	26%	26%	0%	31%	24%	7%	31%	23%	8%	23%	26%

3.7 Sources of information and collaboration

Lower shares of rural than urban innovators (employing at least 10 employees) tend to seek external information to support their innovation (Table 11). Information generated from within the business or enterprise group is the most commonly accessed source, important to 43% of rural firms. Customers and suppliers are also important sources of innovation information, for a third and a quarter of rural innovator firms. Rural innovators are significantly less likely to seek information from universities or other higher education institutes, although numbers accessing these sources are very low overall (only 3.7% of rural innovators and 4.8% of urban innovators).

Inventors are generally more likely to access the range of information sources to support their innovation, with no significant differences between rural and urban firms in the importance placed on different sources. Only 8% of inventors see information from universities as being important to their innovation.

Firms located in more distant rural areas (small and large) are more likely to source information from within their business group or from competitors and businesses in their own industry than those located nearer to a major urban settlement, although the differences are not statistically significant (Table 12). In larger rural areas, firms located in more remote areas are more likely to get innovation information from their supply chains than those in less remote areas, but this is reversed for rural firms in smaller areas where firms located further away are less likely to get innovation information from their supply chains, although again the differences are statistically insignificant.

Table 11: Sources of information among innovative firms and NTM innovators, 2011-2023 (UKIS, RUC 2011)

	Urban	Rural	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
Within the business or enterprise group	45.7%	43.2%	2.5%*	45.1%	42.1%	44.8%	42.4%	-2.8%	-2.4%
Suppliers of equipment, materials, services or software	29.7%	27%	2.7%**	30.1%	26.6%	28.7%	26%	-2.1%	-2.6%
Clients or Customers from private sectors	35.2%	32.5%	2.7%**	34.6%	31.1%	33.6%	32.4%	-2.4%	-1.1%
Competitors/ other businesses in the industry	18.7%	17.1%	1.6%	17.9%	18.8%	17.3%	15.2%	1.5%	-2.1%
Universities or other higher education institutes	4.8%	3.7%	1%**	4.5%	3.5%	4.5%	3.4%	-1%	-1%
Government or public research institutes	4.4%	4.9%	-0.5%	4.1%	3.3%	5.3%	6.2%	-2%*	0.9%
NTM innovators									
Within the business or enterprise group	53.2%	53.5%	-0.3%	52%	53.4%	54.4%	52.3%	-1%	-2.1%
Suppliers of equipment, materials, services or software	31.4%	30.1%	1.3%	32.5%	30.7%	31.5%	28.6%	-0.7%	-2.9%
Clients or Customers from private sectors	47.3%	48.1%	-0.8%	47.1%	46.3%	49.6%	48.2%	-3.3%	-1.4%
Competitors/ other businesses in the industry	21%	21.2%	-0.1%	20.5%	24.2%	19.9%	19.4%	4.3%	-0.5%
Universities or other higher education institutes	7.5%	7.6%	-0.1%	7.1%	7.7%	9.2%	6.2%	-1.5%	-3.1%
Government or public research institutes	6.1%	7.5%	-1.4%	5.9%	5.3%	5.8%	10.8%	-0.5%	5%

Table 12: Sources of information among innovation-active firms, by relative access, 2021-2023 (UKIS, RUC 2021)

	Urban (all)	Rural (all)	U-R diff	R large far	R large near	RLF-RLN diff	R small far	R small near	RSF-RSN diff	U far	U near
Within business/ enterprise group	42%	37%	5%	45%	35%	10%	40%	33%	7%	41%	42%
Suppliers of equipment, materials, services or software	29%	25%	4%	26%	22%	4%	23%	27%	-4%	28%	29%
Clients or Customers from private sectors	35%	32%	3%	33%	32%	1%	29%	32%	-3%	32%	35%
Competitors/ other businesses in the industry	21%	16%	5%	22%	16%	6%	19%	13%	6%	22%	21%
Universities or other HEI	5%	4%	1%	--	6%	--	--	2%	--	6%	5%

When it comes to innovation cooperation, suppliers, customers, competitors and other businesses in the same business or enterprise group are the most common collaborators, and important for between a quarter and a third of rural innovators (Table 13). There are no significant differences in the importance of collaborating partners between rural firms, however rural firms are generally less likely than urban firms to cooperate for the purposes of innovation, across a wide range of partners, whether it be other businesses in their sector, clients and competitors, consultants, universities or government and public research institutes. In terms of the geography of collaboration partners, urban businesses are more likely than rural businesses to work with European and international partners.

For rural inventors, suppliers, customers, competitors, and other businesses in the same business or enterprise group are again the most important innovation collaborators. External collaboration is also more important for inventors as they are overall more likely to involve external collaborators in their innovation activities than the general population of innovators. Urban inventors are significantly more likely than rural inventors to cooperate with other businesses within their enterprise group (39.9% rural, 46.2% urban inventors), whereas a significantly lower share of rural inventors (20.9% of rural, 24% of urban) cooperate with universities or other higher education institutes. A smaller proportion of rural inventors collaborated with partners in the same region than urban firms, but there is no significant difference between rural and urban businesses when it comes to European partners.

When comparing rural firms in terms of their relative access (Table 14), we see that generally higher proportions of rural firms located nearer to a major urban settlement cooperated with other businesses in the same enterprise group, customers, suppliers and competitors. This contrast is particularly apparent for rural firms in smaller settlements. Rural firms located further away from major towns and cities are less likely

to collaborate with universities and other HEIs, with this difference being statistically significant in the case of larger rural settlements.

Table 13: Type and geography of collaboration partners among innovation-active firms and inventors, 2011-2023 (UKIS, RUC 2011)

	Urban	Rural	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Innovators									
Type of collaboration partners									
Other businesses within enterprise group	27.9%	23.7%	4.2%***	27%	22.7%	23.6%	24.9%	-0.9%	1.3%
Suppliers of equipment, materials, services or software	36%	34.6%	1.4%	36.2%	34%	35.5%	34.6%	-1.6%	1%
Clients or Customers from private sectors	34.5%	32.2%	2.3%**	34.4%	31.5%	32.5%	32.8%	-1%	-0.3%
Competitors/ other businesses in the industry	33.4%	31.3%	2.1%**	33.3%	30.8%	31.6%	31.6%	-0.8%	-0.01%
Consultants, commercial labs or private R&D institutes	18.5%	15.8%	2.6%***	17.8%	15.1%	15.9%	16.6%	-0.8%	0.7%
Universities or other higher education institutes	13.6%	11.1%	2.4%***	13.5%	10.1%	11.7%	11.8%	-1.6%	0.2%
Gov't or public research institutes	11.1%	9.2%	1.8%***	10.7%	8.8%	9%	10%	-0.2%	1.1%
Geography of collaboration partners									
Regional	26.1%	25.6%	0.5%	26.4%	26.7%	26%	24.4%	0.7%	-1.6%
UK	44.5%	42.2%	2.3%*	45%	42.1%	43.6%	41.4%	-1.4%	-2.2%
Europe	14.1%	11.9%	2.3%***	13%	10.8%	13.2%	11.8%	-2.4%*	-1.4%
International	12.1%	9%	3%***	10.5%	8.2%	9.4%	9.5%	-1.2%	0.1%
NTM innovators									
Geography of collaboration partners									
Other businesses within enterprise group	46.2%	39.9%	6.4%***	44.7%	35.5%	41.6%	42.5%	-6.1%	0.9%
Suppliers of equipment, materials, services or software	55.4%	52.6%	2.8%	56.2%	49.2%	53.3%	55.8%	-4.1%	2.5%
Clients or Customers from private sectors	57.9%	54.4%	3.5%	57.8%	51.8%	55.8%	55.7%	-4%	-0.03%
Competitors/ other businesses in the industry	54.9%	52%	2.9%	54.9%	49.5%	52.7%	54%	-3.2%	1.3%
Consultants, commercial labs or private R&D institutes	32.1%	28.9%	3.2%	31.3%	26.4%	31.5%	29.7%	-5.1%	-1.9%
Universities or other HEI	24%	20.9%	3.1%*	23.5%	18.7%	27.9%	17.8%	-9.1%**	-10.1%**

	Urban	Rural	U-R diff	Non-London urban	Rural town (T)	Rural village (V)	Rural hamlet (H)	T-V diff	H-V diff
Gov't or public research institutes	17.5%	15.2%	2.3%	16.9%	15.4%	17.4%	13.4%	-2%	-4%
Geography of collaboration partners									
Regional	39.8%	34.5%	5.3%**	38.8%	33.4%	39.3%	31.3%	-0.6%	-8%
UK	67.2%	62.9%	4.3%*	67.5%	60%	67%	62.4%	-7%	-4.5%
Europe	31.5%	29.7%	1.9%	30.5%	25.7%	30.3%	33.2%	-4.6%	2.9%
International	27.3%	23.8%	3.4%*	24.9%	21.5%	22.7%	27%	-1.2%	4.3%

Table 14: Collaboration partners among innovation-active firms, by relative access, 2021-2023 (UKIS, RUC 2021)

	Urban (all)	Rural (all)	U-R diff	R large far	R large near	RLF-RLN diff	R small far	R small near	RSF-RSN diff	U far	U near
Other businesses within enterprise group	32%	28%	4%	27%	28%	-1%	19%	33%	-14%	30%	32%
clients or Customers from private sectors	30%	26%	4%	24%	26%	-2%	15%	32%	-17%***	33%	30%
suppliers of equipment, materials, services or software	32%	28%	4%	21%	30%	-9%	19%	34%	-15%***	30%	32%
Competitors/ other businesses in the industry	30%	26%	4%	23%	26%	-3%	16%	32%	-16%***	33%	30%
Universities or other HEI	12%	8%	4%	4%	9%	-5%*	5%	9%	-4%	15%	12%
Consultants, commercial labs or private R&D institutes	18%	13%	5%	8%	15%	-7%*	11%	13%	-2%	16%	18%
Government or public research institutes	10%	7%	3%	6%	7%	-1%	6%	8%	-2%	11%	9%
UK partners	30%	34%	-4%	25%	30%	-5%	20%	36%	-16%***	37%	34%
European partners	11%	13%	-2%	8%	6%	2%	14%	14%	0%	10%	14%
International partners	11%	6%	5%	3%	5%	-2%	5%	8%	-3%	10%	11%

4. Factors affecting rural innovation

In this section of the report, we explore the combination of firm and local area level factors associated with an increase, or which reduce, the likelihood of firms (with at least 10 employees) being broadly engaged in innovation or NTM innovation (see Table 15).

After controlling for differences in firm profile and local area characteristics, rural innovators tend to experience constraints on their innovation arising from high direct innovation costs and lack of available finance as well as a lack of available qualified personnel.

Older rural firms are less likely than younger ones to engage in innovation. Innovating rural firms are typically larger, employ a higher proportion of employees with a degree in science, and are involved in exporting.

Several factors also appear to be associated with businesses that introduce NTM products (inventors). Rural inventors tend to experience constraints linked to a lack of information on markets. Rural inventors are also less likely to face barriers associated with market concentration.

The association of invention being driven by motivations to provide new products or to increase market share is more pronounced among rural inventors. Rural inventors tend to seek information from within their businesses or with other businesses in the same sectors. They also tend to engage in international cooperation and are involved in exporting.

Table 15: Firm and local factors associated with 'Innovator' and 'Inventor' firms' (probit analysis)

	Innovative firms				Inventing firms			
	Rural		Urban		Rural		Urban	
	b/se	me/se	b/se	me/se	b/se	me/se	b/se	me/se
Barrier- innovation cost	0.311***	0.100***	0.390***	0.127***	0.145	0.032	0.034	0.008
	(0.095)	(0.030)	(0.050)	(0.016)	(0.114)	(0.025)	(0.057)	(0.014)
Barrier- availability of finance	0.277***	0.089***	0.343***	0.111***	-0.173	-0.038	0.144***	0.036***
	(0.090)	(0.029)	(0.049)	(0.016)	(0.107)	(0.024)	(0.055)	(0.014)
Barrier- information on technology	-0.084	-0.027	0.013	0.004	-0.323*	-0.072*	-0.129	-0.032
	(0.182)	(0.058)	(0.079)	(0.026)	(0.194)	(0.043)	(0.091)	(0.023)
Barrier- information on market	0.064	0.020	0.056	0.018	0.320*	0.071*	0.175*	0.044*
	(0.181)	(0.058)	(0.089)	(0.029)	(0.194)	(0.043)	(0.095)	(0.024)
Barrier- market concentration	0.214	0.068	0.261***	0.085***	-0.343**	-0.076**	-0.147**	-0.037**
	(0.131)	(0.042)	(0.072)	(0.023)	(0.156)	(0.034)	(0.067)	(0.017)

	Innovative firms				Inventing firms			
	Rural		Urban		Rural		Urban	
Barrier- lack of qualified personnel	0.557***	0.178***	0.362***	0.118***	0.013	0.003	-0.003	-0.001
	(0.113)	(0.035)	(0.051)	(0.016)	(0.120)	(0.027)	(0.057)	(0.014)
Motivation- new products/services					0.493***	0.110***	0.385***	0.096***
					(0.094)	(0.021)	(0.050)	(0.012)
Motivation- new market					0.097	0.021	0.017	0.004
					(0.105)	(0.023)	(0.055)	(0.014)
Motivation - increasing market shares					0.353***	0.078***	0.180***	0.045***
					(0.098)	(0.022)	(0.053)	(0.013)
Motivation - improving capacity					0.002	0.000	-0.017	-0.004
					(0.092)	(0.021)	(0.051)	(0.013)
Information – within business group					0.253***	0.056***	0.203***	0.051***
					(0.091)	(0.020)	(0.046)	(0.011)
Information – suppliers					-0.235**	-0.052**	-0.072	-0.018
					(0.100)	(0.022)	(0.054)	(0.013)
Information – customers					0.104	0.023	0.145***	0.036***
					(0.099)	(0.022)	(0.048)	(0.012)
Information – sectors					0.200*	0.044*	-0.167***	-0.042***
					(0.108)	(0.024)	(0.060)	(0.015)
Information – universities					-0.142	-0.032	0.099	0.025
					(0.302)	(0.067)	(0.110)	(0.028)
Information – government					0.011	0.002	-0.135	-0.034
					(0.221)	(0.049)	(0.103)	(0.026)
Cooperation – within_group					-0.093	-0.021	0.018	0.005
					(0.109)	(0.024)	(0.055)	(0.014)
Cooperation – suppliers					0.118	0.026	0.030	0.008
					(0.125)	(0.028)	(0.060)	(0.015)
Cooperation – customers					0.251	0.056	0.326***	0.082***
					(0.246)	(0.055)	(0.118)	(0.029)
Cooperation – sectors					-0.049	-0.011	-0.159	-0.040
					(0.235)	(0.052)	(0.117)	(0.029)
Coop with university					-0.074	-0.016	0.041	0.010

	Innovative firms				Inventing firms			
	Rural		Urban		Rural		Urban	
					(0.112)	(0.025)	(0.055)	(0.014)
UK cooperation					0.008	0.002	0.084	0.021
					(0.138)	(0.031)	(0.074)	(0.018)
EU cooperation					0.054	0.012	0.152***	0.038***
					(0.110)	(0.025)	(0.058)	(0.014)
Intl. cooperation					0.326***	0.073***	0.127**	0.032**
					(0.123)	(0.027)	(0.058)	(0.015)
highskill_science	0.011***	0.004***	0.007***	0.002***	0.002	0.000	0.003***	0.001***
	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
Public support	1.159***	0.372***	1.280***	0.416***	0.304***	0.068***	0.313***	0.078***
	(0.120)	(0.037)	(0.066)	(0.021)	(0.096)	(0.021)	(0.049)	(0.012)
4-10 years	-0.056	-0.018	0.040	0.013	0.031	0.007	0.063	0.016
	(0.122)	(0.039)	(0.068)	(0.022)	(0.196)	(0.045)	(0.096)	(0.025)
11-20 years	-0.140	-0.045	0.021	0.007	-0.019	-0.004	-0.072	-0.018
	(0.141)	(0.045)	(0.067)	(0.022)	(0.193)	(0.044)	(0.095)	(0.024)
20+ years	-0.277**	-0.088**	-0.005	-0.002	-0.146	-0.032	-0.091	-0.023
	(0.133)	(0.042)	(0.067)	(0.022)	(0.195)	(0.044)	(0.096)	(0.025)
Ln(emp)	0.106**	0.034**	0.073***	0.024***	-0.057	-0.013	0.010	0.003
	(0.042)	(0.014)	(0.018)	(0.006)	(0.055)	(0.012)	(0.026)	(0.006)
Ln(sale)	0.025	0.008	0.007	0.002	0.041	0.009	-0.005	-0.001
	(0.028)	(0.009)	(0.014)	(0.005)	(0.038)	(0.009)	(0.020)	(0.005)
Sole proprietor	-0.352*	-0.112*	0.218	0.070	0.339	0.082	0.263	0.071
	(0.196)	(0.062)	(0.167)	(0.053)	(0.300)	(0.079)	(0.215)	(0.062)
Partnership	-0.009	-0.003	-0.240**	-0.078**	0.062	0.014	-0.215	-0.050
	(0.159)	(0.051)	(0.106)	(0.034)	(0.226)	(0.051)	(0.156)	(0.034)
Non-profit	-0.011	-0.003	0.236*	0.076*	0.305	0.073	-0.237	-0.055
	(0.315)	(0.101)	(0.129)	(0.041)	(0.337)	(0.087)	(0.174)	(0.037)
Export	0.401***	0.129***	0.385***	0.125***	0.529***	0.118***	0.348***	0.087***
	(0.074)	(0.023)	(0.033)	(0.011)	(0.097)	(0.021)	(0.049)	(0.012)
Ln(N of business)	0.070	0.022	0.015	0.005	0.059	0.013	0.027	0.007
	(0.076)	(0.024)	(0.030)	(0.010)	(0.104)	(0.023)	(0.043)	(0.011)
Ln(High-Growth Episode)	0.140	0.045	0.037	0.012	-0.069	-0.015	-0.025	-0.006
	(0.112)	(0.036)	(0.037)	(0.012)	(0.127)	(0.028)	(0.050)	(0.013)
Ln(business birth)	-0.047	-0.015	-0.111***	-0.036***	0.165	0.037	0.042	0.011
	(0.087)	(0.028)	(0.039)	(0.013)	(0.110)	(0.024)	(0.047)	(0.012)
Ln(GVA)	-0.058	-0.018	0.024	0.008	-0.024	-0.005	-0.039	-0.010
	(0.038)	(0.012)	(0.017)	(0.006)	(0.054)	(0.012)	(0.024)	(0.006)
Sector controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.183		0.127		-2.753***		-1.618***	

	Innovative firms				Inventing firms			
	Rural		Urban		Rural		Urban	
	(0.407)		(0.136)		(0.567)		(0.192)	
N	6234	6234	27179	27179	3317	3317	14759	14759

*Columns (1)-(4) present results for innovative firms with the first two columns for the rural sample and the second two columns for the urban sample. Columns (5)-(8) present results for 'NTM innovators'. Columns (1), (3), (5) and (7) present estimated coefficients and their standard errors and columns (2), (4), (6) and (8) present marginal effects and standard errors. For the age variable, the base category is firms up to 3 years old. For the legal status variable, the base is companies. Further description of variables is provided in Appendix A. *,** and *** denote 10%, 5% and 1% significance levels. For factors relating to motivation, information sources and innovation partners, these are not available for 'innovating firms' as these questions are not asked for these firms.*

5. Performance outcomes of innovation in rural firms

Next, we examine the effects of innovation persistence on business growth in rural and urban firms. We grouped firms into four groups: i) *persistent non-innovator*, which refers to those firms which were not innovation-active in two successive UKIS survey periods; ii) *intermittent innovator type 1* are those firms which had innovation activities in a previous survey period but not the next; iii) *intermittent innovator type 2* refers to those firms which did not have innovation activities in a previous survey period but did so in the subsequent period; and iv) *persistent innovator*, which refers to those firms that had innovation activities in two successive survey periods.

The results in Table 16 show that compared to persistent non-innovators, persistent innovators in rural areas are more likely to subsequently report turnover growth by 16.1% and productivity growth by 15.5%. For urban firms, innovation persistence has a modest impact on employment growth (2.7%), but no impact on turnover or productivity growth. The positive coefficients of intermittent-innovator-type-2 also show that moving into innovation increases productivity growth.

Table 16: Impacts of innovation persistence on business growth

	Turnover growth		Employment growth		Productivity growth	
	Rural	Urban	Rural	Urban	Rural	Urban
Intermittent innovator-type1$_{t-2}$	0.068	-0.013	0.028	0.002	0.042	-0.012
	(0.057)	(0.034)	(0.024)	(0.013)	(0.060)	(0.034)
Intermittent innovator-type2$_{t-2}$	0.103*	0.013	-0.019	0.022*	0.122**	-0.004
	(0.053)	(0.028)	(0.021)	(0.012)	(0.054)	(0.029)
Persistent innovator$_{t-2}$	0.161***	0.038	0.010	0.027**	0.155***	0.019
	(0.043)	(0.024)	(0.022)	(0.012)	(0.045)	(0.025)
11-20 years old	-0.127	-0.127***	-0.001	0.010	-0.128	-0.138***
	(0.081)	(0.044)	(0.044)	(0.025)	(0.089)	(0.048)
20+ years old	-0.122	-0.151***	-0.042	-0.021	-0.074	-0.120***
	(0.075)	(0.043)	(0.040)	(0.024)	(0.081)	(0.046)
Ln(employment)	0.042***	0.045***				
	(0.015)	(0.007)				
Ln(sale)			0.018***	0.011**		
			(0.006)	(0.005)		
Sole proprietor	0.078	0.144	0.009	-0.009	0.075	0.141
	(0.094)	(0.164)	(0.053)	(0.033)	(0.096)	(0.155)
Partnership	-0.058	-0.002	0.020	-0.018	-0.072	0.005
	(0.153)	(0.029)	(0.023)	(0.022)	(0.157)	(0.030)
Non-profit	-0.103	-0.126	0.009	0.016	-0.089	-0.142
	(0.121)	(0.140)	(0.035)	(0.021)	(0.123)	(0.136)
High-tech manufacturing	-0.044	-0.049	0.060	-0.007	-0.097	-0.040
	(0.080)	(0.039)	(0.060)	(0.020)	(0.093)	(0.035)
High-tech services	-0.032	0.192*	-0.025	-0.044	0.000	0.227**
	(0.137)	(0.103)	(0.055)	(0.028)	(0.139)	(0.098)
Mid-tech manufacturing	-0.188*	0.050	-0.057	0.031	-0.130	0.013
	(0.097)	(0.066)	(0.043)	(0.031)	(0.106)	(0.062)
Low-tech manufacturing	-0.016	0.012	-0.017	0.021	0.003	-0.011
	(0.135)	(0.071)	(0.047)	(0.035)	(0.140)	(0.069)
Export	-0.057	0.011	0.007	0.004	-0.064	0.007
	(0.040)	(0.021)	(0.020)	(0.009)	(0.039)	(0.021)
Ln(N of business)	0.047	-0.005	0.014	-0.009	0.036	-0.002
	(0.035)	(0.020)	(0.014)	(0.014)	(0.036)	(0.025)
Ln(HE firms)	0.027	-0.022	0.017	0.002	0.010	-0.025
	(0.050)	(0.021)	(0.038)	(0.014)	(0.057)	(0.021)
Ln(business birth)	0.063	-0.016	0.006	-0.002	0.057	-0.013
	(0.051)	(0.020)	(0.023)	(0.012)	(0.049)	(0.020)
Ln(GVA)	-0.035*	0.012	-0.014	0.002	-0.022	0.015
	(0.019)	(0.012)	(0.010)	(0.008)	(0.020)	(0.014)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.254	0.065	-0.137	-0.082	-0.135	0.220**
	(0.178)	(0.104)	(0.111)	(0.055)	(0.187)	(0.101)
N	1712	7586	1713	7596	1712	7586

*The table above presents results from weighted probit regressions of performance on firm and area control variables, including innovation persistence (base: persistent non-innovator, with intermittent innovator-type 1 is defined as those firms who had innovation activities in the previous wave but not this wave, and intermittent innovator-type 2 refers to those who did not have innovation activities in the previous wave but have this wave), firm age (base: firms up to 10 years), firm size, turnover, legal status (base: company), sector (base: Other sectors rather than high-, mid-, low-tech manufacturing and high-tech services), exporting status, local areas' business population, number of firms with more than 20% growth in employment/sales, number of new business birth, gross-value-added (GVA) , and sector, region and time dummies. Columns (1), (3) and (5) present estimated coefficients and standard errors for the estimation of turnover growth, employment growth and productivity growth for the rural sample respectively, and Columns (2), (4) and (6) report results for the urban sample. *,** and *** denote significance at 10%, 5% and 1% levels.*

6. Conclusions

Regardless of geography, an overarching issue highlighted from the research is that product innovation rates in England and Wales are low, and notwithstanding Covid-19 pandemic induced changes, are declining over time. Specifically, only just over 1 in 5 businesses with more than 10 employees witnessed product innovation and less than 10 percent had NTM innovation. The absence of innovation curtails productivity improvements, and in part the country's productivity crisis is an innovation problem.

Rural firms are typically as innovative as their urban counterparts when innovation is measured broadly, rather than solely through R&D or patenting indicators, and they invest in innovation at broadly comparable rates. Specifically, across datasets (UKIS, LSBS, BSD), rural firms engage in product, process and organisational innovation at rates comparable to urban firms, echoing earlier UK and international evidence (Keeble & Walker, 1994; North & Smallbone, 2000; Phillipson et al., 2019; Tiwasing et al., 2023). Rural firms are more likely than urban firms to be motivated to innovate in order to reduce their costs or environmental impacts. The analysis also highlights that innovation persistence is strongly associated with higher turnover and productivity growth for rural firms.

At the same time, rural firms face greater challenges in translating innovation effort into commercial success, notably lower rates of NTM innovation, weaker conversion of innovation into sales, and more limited use of formal innovation protection mechanisms. Rural firms appear to find it more difficult to realise innovation investments into NTM sales. Specifically, while rural firms make innovation related investments at similar rates to urban firms, and in some cases more intensively such as for advanced machinery and applied R&D, they are significantly less likely to convert NTM innovations into sales. In addition, rates of innovation protection are also lower in rural firms than urban firms, despite the similarity in their innovation rates. In other words, rural firms find it more difficult to convert *i*nnovation effort into NTM innovation realisation.

However, rural innovation varies significantly across settlement type and according to accessibility (ONS, 2026). Firms in hamlets and isolated dwellings frequently display stronger rates of innovation (including NTM) and innovation investment, while rates are markedly lower in larger rural settlements that are more distant from major towns and cities. Micro-businesses in rural towns appear more held back in terms of NTM. This strengthens the call for place-sensitive rather than rural/urban binary approaches, aligning with recent work emphasising the importance of accessibility over sparsity *per se* in shaping innovation outcomes (Roper & Jibril, 2023).

The findings suggest that understanding and overcoming ecosystem and structural constraints, rather than firm-level deficits, is critical for improved outcomes from rural innovation. The results also imply rural innovators face challenges with accessing information and collaborating with partners, with collaboration barriers also extending to NTM innovators. Notably, weaknesses in access to market information, finance, the cost of finance, lack of qualified personnel, and less well-developed external networks and

institutional intermediaries appear to hinder innovation and the progression from “new-to-the-business” to “new-to-the-market” innovation.

These constraints are experienced to differing extents across rural areas. For example, NTM innovators in hamlets and isolated dwellings often encounter skills gaps. Remoter rural firms are much more likely to highlight challenges linked to the cost of finance and its availability.

The results have important lessons for universities. Generally, universities have especially poor linkages with rural businesses (with poorer levels of engagement than for urban counterparts), albeit engagement is weak across all geographies. Moreover, rural firms located further away from major towns and cities are less likely to collaborate with universities, with this difference being statistically significant in larger rural areas.

Regarding wider implications for innovation policy, the analysis provides robust empirical evidence that challenges “urban = innovative, rural = laggard” dichotomies still implicit in much innovation policy and scholarship (Carlino & Kerr, 2014), which, based on agglomeration theory, treats density as necessary precondition for innovation. Moreover, the results imply that ecosystem weaknesses are spatially uneven: larger rural settlements that are distant from major towns and cities appear to be at particular risk of ecosystem failure, pointing to the importance of targeted intermediary capacity and brokerage between rural firms and universities, and national innovation programmes.

Taken together, the findings underline the need for place-sensitive innovation policy that moves beyond a simple urban–rural dichotomy. Supporting rural innovation requires reinforcing firms’ capacity to sustain innovation over time, strengthening access to skills, finance, markets and networks, and improving the functioning of local innovation ecosystems, particularly in more remote rural areas. Addressing these systemic constraints will be essential if rural areas are to fulfil all of their potential to contribute to the UK’s economic growth objectives.

References

Antonioli, D., & Montresor, S. (2021). Innovation persistence in times of crisis: an analysis of Italian firms. *Small Business Economics*, *56*(4), 1739-1764. https://doi.org/10.1007/s11187-019-00231-z

Berkes, E., & Gaetani, R. (2021). The Geography of Unconventional Innovation. *The Economic Journal*, *131*(636), 1466-1514. https://doi.org/10.1093/ej/ueaa111

Carlino, G., & Kerr, W. R. (2014). *Agglomeration and Innovation*. https://www.nber.org/system/files/working_papers/w20367/w20367.pdf

Cefis, E., & Marsili, O. (2006). Survivor: The role of innovation in firms' survival. *Research Policy*, *35*(5), 626-641. https://doi.org/https://doi.org/10.1016/j.respol.2006.02.006

Cooke, P. (2002). *Knowledge economies: Clusters, learning and cooperative advantage*. Routledge.

Copus, A., Skuras, D., & Tsegenidi, K. (2008). Innovation and peripherality: An empirical comparative study of SMEs in six European Union member countries. *Economic Geography*, *84*(1), 51-82. https://doi.org/10.1111/j.1944-8287.2008.tb00391.x

Defra. (2026). *Rural Economic Bulletin - Economics Statistics for Rural England - February 2026*. https://www.gov.uk/government/statistics/quarterly-rural-economic-bulletin

Eder, J. (2019). Innovation in the periphery: A critical survey and research agenda. *International Regional Science Review*, *42*(2), 119-146.

Florida, R., & King, K. M. (2018). Urban Start-up Districts: Mapping Venture Capital and Start-up Activity Across ZIP Codes. *Economic Development Quarterly*, *32*(2), 99-118. https://doi.org/10.1177/0891242418763731

Fritsch, M., & Wyrwich, M. (2021). Does successful innovation require large urban areas? Germany as a counterexample. *Economic Geography*, *97*(3), 284-308.

Gorton, M. (1999). Spatial variations in markets served by UK-based small and medium-sized enterprises (SMEs). *Entrepreneurship & Regional Development*, *11*(1), 39-55. https://doi.org/10.1080/089856299283281

Hindle, R., Huggins, R., & Wilkinson, C. (2010). *Opportunities and Barriers to Business Innovation in Rural Areas: theory, evidence and implications*.

Johansson, B., & Lööf, H. (2008). Innovation activities explained by firm attributes and location *Economics of Innovation and New Technology*, *17*(6), 533-552. https://doi.org/10.1080/10438590701407349

Kalantaridis, C. (2006). A study into the localization of rural businesses in five European countries. *European Planning Studies*, *14*(1), 61-78. https://doi.org/10.1080/09654310500339133

Keeble, D. (1997). Small firms, innovation and regional development in Britain in the 1990s. *Regional Studies*, *31*(3), 281-293. https://doi.org/Doi 10.1080/00343409750134692

Keeble, D., & Walker, S. (1994). New Firms, Small Firms and Dead Firms - Spatial Patterns and Determinants in the United-Kingdom. *Regional Studies*, *28*(4), 411-427. https://doi.org/10.1080/00343409412331348366

North, D., & Smallbone, D. (1996). Small business development in remote rural areas: The example of mature manufacturing firms in northern England. *Journal of Rural Studies*, *12*(2), 151-167. https://doi.org/10.1016/0743-0167(96)00009-5

North, D., & Smallbone, D. (2000). Innovative activity in SMEs and rural economic development: Some evidence from England. *European Planning Studies*, *8*(1), 87-106. https://doi.org/Doi 10.1080/096543100110947

OECD. (2023). *Enhancing Rural Innovation in Scotland, United Kingdom*. https://doi.org/doi:https://doi.org/10.1787/33b8c803-en

ONS. (2013). *2011 Rural Urban Classification* http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/index.html

ONS. (2026). *2021 Rural Urban Classification*. https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2021ruralurbanclassification

Ozusaglam, S., & Roper, S. (2021). *It's not just where you are, it's where you want to go: ambition, innovation and digital innovation in urban and rural micro-businesses*. https://www.ncl.ac.uk/mediav8/nicre/files/NICRE%20Research%20Report%20No%202%20May%202021%20It%C3%A2%C2%80%C2%99s%20not%20where%20you%20are,%20it%C3%A2%C2%80%C2%99s%20where%20you%20want%20to%20go.pdf

Partridge, N., Phillipson, J., Gorton, M., Cunningham, J., & White, J. (2026). *Catalysing Rural Innovation: Part 1: State of the Art Review*

Petrov, A. N. (2012). Beyond spillovers: Interrogating innovation and creativity in the peripheries. In H. Bathelt, M. P. Feldman, & D. F. Kogler (Eds.), *Beyond Territory: Dynamic geographies of innovation and knowledge creation* (pp. 168-190). Routledge.

Phillipson, J., Partridge, N., Gorton, M., & Nguyen, T. (2026). *Catalysing Rural Innovation: Part 2: Perspectives on the Innovation Ecosystem and Recommendations*

Phillipson, J., Tiwasing, P., Gorton, M., Maioli, S., Newbery, R., & Turner, R. (2019). Shining a spotlight on small rural businesses: How does their performance compare with urban? *Journal of Rural Studies*, *68*, 230-239. https://doi.org/10.1016/j.jrurstud.2018.09.017

Roper, S., & Jibril, H. (2023). Understanding the geographical distribution of innovation in England: density, accessibility and spillover effects. *Regional Studies*, *58*(6), 1320-1338. https://doi.org/10.1080/00343404.2023.2252900

Tiwasing, P., Gorton, M., Phillipson, J., & Maioli, S. (2023). Rural businesses and levelling up: A rural-urban analysis of business innovation and exporting in England?s north and midlands. *Journal of Rural Studies*, *100*, 103007. https://doi.org/ARTN 10300710.1016/j.jrurstud.2023.103007

Virkkala, S. (2007). Innovation and networking in peripheral areas—a case study of emergence and change in rural manufacturing. *European Planning Studies*, *15*(4), 511-529.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data MIT press*. MIT Press.

Zarei, C., Gorton, M., Phillipson, J., Partridge, N., & Nguyen, T. (2026). *Rural Businesses' Understandings of Innovation: Drivers, Barriers and Collaboration*.

Appendix 1: Variables description

Variable name	Variable description
barrier_innocost	=1 if firm cited '*high direct innovation cost*' as a highly important constraint; =0 otherwise
barrier_finavai	=1 if firm cited' *availability of finance*' as a highly important constraint; =0 otherwise
barrier_infotech	=1 if firm cited '*lack of information on technology*' as a highly important constraint; =0 otherwise
barrier_infomar	=1 if firm cited '*lack of information on market*' as a highly important constraint; =0 otherwise
barrier_concentr	=1 if firm cited '*market concentration*' as a highly important constraint; =0 otherwise
barrier_skill	=1 if firm cited '*lack of qualified personnel*' as a highly important constraint; =0 otherwise
motive_newproduct	=1 if firm cited '*increasing range of goods or services'* as a highly important factor affecting innovation; =0 otherwise
motive_newmarket	=1 if firm cited '*entering new markets*' as a highly important factor affecting innovation; =0 otherwise
motive_increasing market	=1 if firm cited '*increasing market share*' as a highly important factor affecting innovation; =0 otherwise
motive_increasing capacity	=1 if firm cited '*increasing capacity for producing goods or services*' as a highly important factor affecting innovation; =0 otherwise
info_group	=1 if firm cited '*within your business or enterprise group*' as a highly important source for information for innovation activities; =0 otherwise
info_supplier	=1 if firm cited '*suppliers of equipment, materials, services or software*' as a highly important source for information for innovation activities; =0 otherwise
info_customer	=1 if firm cited '*clients or customers from the private sectors*' as a highly important source for information for innovation activities; =0 otherwise
info_sector	=1 if firm cited '*competitors or other businesses in your industry*' as a highly important source for information for innovation activities; =0 otherwise
info_uni	=1 if firm cited '*universities or other higher education institutes*' as a highly important source for information for innovation activities; =0 otherwise
info_gov	=1 if firm cited '*government or public research institutes*' as a highly important source for information for innovation activities; =0 otherwise
Coop within_group	=1 if firm cited '*other businesses within your enterprise group*' as a collaborator for innovation cooperation; =0 otherwise
Coop with suppliers	=1 if firm cited '*suppliers of equipment, materials, services or software*' as a collaborator for innovation cooperation; =0 otherwise
Coop with customers	=1 if firm cited '*clients or customers from the private sectors*' as a collaborator for innovation cooperation; =0 otherwise
Coop with sectors	=1 if firm cited '*competitors or other businesses in your industry*' as a collaborator for innovation cooperation; =0 otherwise
Coop with university	=1 if firm cited '*universities or other higher education institutes*' as a collaborator for innovation cooperation; =0 otherwise
UK cooperation	=1 if firm cited UK organisation as a collaborator for innovation cooperation; =0 otherwise
EU cooperation	=1 if firm cited EU or EFTA organisation as a collaborator for innovation cooperation; =0 otherwise
Intl. cooperation	=1 if firm cited organisation outside UK, EU/EFTA as a collaborator for innovation cooperation; =0 otherwise
highskill_science	= shares of employees with a degree in science or engineering subjects
Public support	= 1 if firm received public support for innovation activities; =0 otherwise
0-3 years	if firm aged up to 3 years old
4-10 years	if firm aged 4-10 years old
11-20 years	if firm aged 11-20 years old
20+ years	if firm aged more than 20 years old

Variable name	Variable description
Ln(emp)	=ln(employment)
Ln(sale)	=ln(turnover)
Company	If firm's legal status is company
Sole proprietor	If firm's legal status is sole proprietorship
Partnership	If firm's legal status is partnership
Non-profit	If firm's legal status is a non-profit organisation
export	If firm is a exporter
Ln(N of business)	= natural log (number of business) of the lower-super-output-area firm located in
Ln(HGE)	= natural log (number of business achieved a high-growth episode) of the lower-super-output-area firm located in
Ln(business birth)	= natural log (number of new business birth) of the lower-super-output-area firm located in
Ln(GVA)	= natural log (gross-value-added) of the lower-super-output-area firm located in

www.ircaucus.ac.uk

Email info@ircauscus.co.uk Twitter @IRCaucus