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Networks and Rural-Urban Linkages for Rural Innovation

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Networks and Rural-Urban Linkages for Rural Innovation

Michelle Marshalian, Philip Chan and Marc Bournisien de Valmont

This working paper examines the role of networks and rural-urban linkages to absorb and enhance innovation in rural regions, placing a special focus on the distinctive characteristics of rural areas that drive the different ways they adopt and diffuse innovation. After a review of the literature on innovation and innovation adoption through networks and linkages for rural areas, three enablers of innovation absorption and diffusion through networks and linkages are discussed: **place**-based networks focusing on digital infrastructure; linkages between **people** via migration flows; and **firm**-based networks including university-industry linkages, international trade and foreign ownership, and clusters. It also provides some policy-takeaways.

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Key messages

While larger scale and more densely connected networks in urban areas can bring local advantages for innovation, such as through higher access to skills and technological assets, rural areas can also be important sources of innovation, including through innovation absorption despite their lower density and greater distance to markets. Indeed, in some cases, very high levels of density (and competition) may inhibit innovation, including through deterring new entrants.

Adoption and diffusion of innovation is critical for rural areas. While it is important for both urban and rural settings, adoption and diffusion of innovation in rural areas can help overcome the relatively larger challenges in accessing business networks, labour markets and public services that exist in rural areas. Rural entrepreneurs' access to business networks and suppliers, are critical components of adoption and diffusion, in particular, in tradeable activities, which can be enhanced by:

- **Ensuring access to quality digital infrastructure** for innovation that goes beyond policies for encouraging competition and investment in communications infrastructure, to considering how to reduce geographical inequalities while ensuring equality in the quality-of-service provision, such as through "last-mile" services to rural areas.
- **Encouraging interregional mobility** to improve access to innovative individuals (including through remote working) and the integration of these considerations into regional planning.
- **Building linkages between firms and innovation partners** such as through:
  - University-linkages that i.) provide education services to train workers and/or ii.) create collaborations on applied research and development.
  - Trade and global value chain facilitation or supporting rural access to pre-existing trade support agencies or government programmes.
  - Supporting the potential of cluster development and smart specialisation policies to build eco-systems for innovations tailored to local contexts.

1 Facilitating rural innovation through networks and rural-urban linkages

Entrepreneurs and individuals located in rural areas compete in the same regional and global market as their urban counterparts. However, they often face competitive disadvantages characterised by longer distances, higher transportation costs to markets and more limited business-to-business networking opportunities. At the same time, however, rural firms also have comparative advantages based on their local economies, with more niche products, including origin-protected and artisanal, products and access to natural resources. In many activities, in particular, those that can leverage the digital transformation, networks that promote linkages can help overcome some of the disadvantages related to physical and operational distance between places, including through facilitating innovation absorption and diffusion.

Building on previous reports on understanding the nature of innovation in rural regions (OECD, 2022[1]), this report i.) *reviews the literature* on innovation adoption and diffusion fit for rural regions; ii.) outlines *enablers of adoption and diffusion* focusing on connecting **places** through digital infrastructure, **people** through migration and remote work, and **firms** through university-firm and firm-to-firm linkages; and iii.) *outlines some policy takeaways* on enabling linkages and networks for innovation through these 3 dimensions.

Innovation fit for rural regions

Different forms of innovation are likely to occur in rural regions than in urban areas (OECD, 2022[1]). Most innovations emerging from rural or remote regions are typically of a form that is incremental, tied to local comparative advantages, or long incubation periods. Many of them also take place outside of the market pressure that is more intensely felt in urban regions. The following summarises 2 distinct types of innovations more likely to occur in rural regions:

- **Slow innovation:** Innovation that is more easily developed in peripheral areas with less rush to market, non-market sourced information, and more difficult to capture in a comparative way (Mayer, 2020[2]; Shearmur and Doloreux, 2016[3]; Rodríguez-Pose and Fitjar, 2013[4]; Goetz and Han, 2020[5]).
- **Reverse innovation** : Innovations in the periphery of the global business environment, that target the production of new goods and services to the demands of local markets in rural regions. In some cases, these substitute higher production costs with lower cost local alternatives from local value chains, while keeping most of the functionality (Govindarajan and Euchner, 2012[6]; Taglioni and Winkler, 2016[7]).

Box 1. Defining Innovation from the 4th revision of the Oslo Manual (2018)

Innovation is a multi-faceted phenomenon. Innovation, as defined in the Oslo Manual, is a consequence of a combination of pre-existing ideas adopted in new ways, or the extensions derived through incremental advances.

What is the Oslo Manual?

The Oslo manual provides the internationally accepted definition and standards to measure and report statistics on innovation.

Defining Innovation

The 4th edition of the Oslo Manual distinguishes between innovation as an outcome (an innovation) and the activities by which innovations come about (innovation activities). It defines an innovation as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)."

Source: https://www.oecd.org/sti/inno/oslo-manual-2018-info.pdf ; http://www.oecd.org/sti/oslo-manual-2018-9789264304604-en.htm

The path for innovation in urban regions often involves agglomeration, however rural regions, by definition, have less agglomeration, with more accessible areas benefiting from resources in urban areas. Smaller cities can "borrow" agglomeration from neighbouring cities. OECD (2015[8]), found that doubling a population living in urban agglomerations within a 300-kilometre radius around a city, increases productivity of the city in the centre by 1-1.5% reflecting higher flows of, and exchanges in, workers and ideas and access to talent to undertake innovative activities. With populations projected to decline in rural regions in European countries (OECD, 2020[9]), the imperative for rural regions to find ways to achieve growth without relying on agglomeration are even stronger, especially for remote areas. On the other hand, rural places that are close to cities can borrow agglomeration effects through their stronger linkages in transportation networks, commuting flows, spatial planning etc.

In rural areas, adoption and diffusion of innovation are critical. The higher potential from network effects in urban areas means that in practice innovation-related improvements in rural areas at the technological frontier are generally rarer than those in urban areas. As such, innovations which are new to the firm rather than to the market typically account for a greater share of innovation in rural areas (Mahroum et al., 2007[10]).

But not all forms of innovation are easily adopted in rural areas. In many cases, innovations made for cities depend on infrastructure and services specific to cities, and need to be reverse engineered to meet the needs of rural places. For example, innovations in private transportation or ride-hailing services such as Uber and Lyft, are less viable in places where long distances and low density are a typical characteristic. A report by Pew Research Center (2019[11]) found that in the United States, 45% of urban and 40% of suburban residents had used a ride-hailing app, like Uber or Lyft. However, only 19% of rural residents reported using such a service. Furthermore, the study found that innovation adoption is even wider between wealthier and poorer Americans in rural areas.

Rural regions may hold an advantage in some highly specialised R&D and innovations. Not all innovations necessarily benefit from agglomeration effects of spillovers. For many significant R&D-related investments for example, the risks associated with unintended knowledge outflows due to proximity can be more significant than any potential benefits of agglomeration (Iammarino and McCann, 2013[12]; Iammarino and McCann, 2006[13]). In these cases, distance from large population centres may help

preserve secrecy and security. However, at the same time, they are less likely to benefit from shared non-traded inputs and small labour markets.

Adoption and diffusion in rural areas

The ability for rural people and businesses to successfully adopt innovations depends on their connectivity to other regions. Of particular importance is proximity to access knowledge networks in, and knowledge spill-overs from, urban areas. However, there is some variation in the role of linkages and networks within OECD countries. In the case of Europe, differences in territorial scale do not appear to play quite the same productivity-enhancing role that they do in the US. While size is important in both the context of innovation for both Europe and the United States, European cities tend to rely relatively more on what is often termed as 'borrowed size' (Garcilazo and Oliveira Martins, 2020[14]), in which urban-rural linkages play a crucial productivity-enhancing role. This does not appear to have a parallel in the US. Rather than focusing simply on urban scale, opportunities for enhancing rural and small-town innovation are more widespread when spatial networks are more developed than where growth is overwhelmingly urban-dominated. For remote rural areas, dependence on digital networks and supply chain linkages (where possible through infrastructure), are increasingly important.

Innovation adoption and diffusion through rural-urban linkages

The depth and reach of linkages between rural and urban areas is an important factor for facilitating the transfer of knowledge between places. These linkages can be facilitated through institutional partnerships. For example, national, regional and local government authorities can create opportunities to deepen networks and bring in new players through networking events within functional areas, facilitating access to national programmes for sub-national stakeholders and entrepreneurs, or building networks of entrepreneurs to learn from challenges and opportunities from different regions. Other forms of deepening linkages include facilitating access to research partners such as universities, the private sector and civil society organisations.

Innovation adoption and diffusion occurs in networks, but not much is known about the role of rural-urban networks for innovation adoption and diffusion. Fast-growing economies tend to have a more rapid diffusion of relatively new innovations and technologies (Bassanini, 2002[15]; Hall, 2004[16]). Yet little is understood about barriers to diffusion of innovation within countries in places that are growing at different speeds. In addition, entrepreneurs in rural areas (whether in federal or unitary governments) often face challenges in physical (and digital) access to services and resources, such as skilled labour, that facilitate innovation adoption and diffusion. This includes factors such as supply chain networks, (specialised) labour markets, international finance networks, and regional or international markets that are more difficult to access for rural entrepreneurs than urban entrepreneurs.

Understanding drivers of innovation adoption by decomposing productivity growth

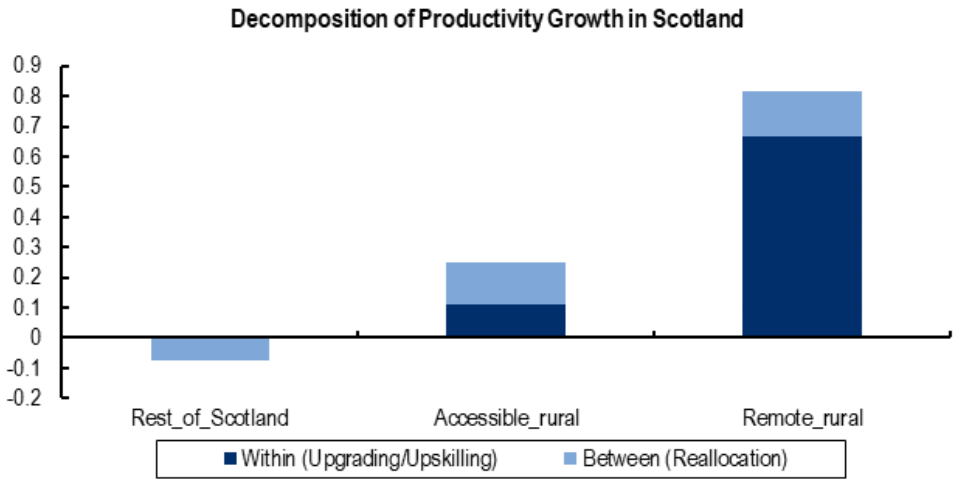
Upgrading skills and investing in innovation can improve productivity growth across all regions, in particular those that are further away from the productivity frontier (OECD, Forthcoming[17]; OECD, 2023[18]; OECD, 2022[19]). Increasing productivity through upgrading skills (upskilling programmes, improved management practices, etc.) and investment in the adoption of new tools (hardware, heavy machinery, software, etc.) can bring large benefits to rural and urban areas alike. In Figure 1, productivity is decomposed into factors that contribute to an increase in productivity using either a.) the same amount of resources (the *within* effect) more efficiently, or b.) additional resources compared to the share of the resources across places (the *between* effect). The much large "within" effect in Figure 1 is often associated with an increase in the productivity of pre-existing resources, and therefore an increased absorption of new products, and processes into the production cycle of a firm. For a large part, it includes the upskilling of

workers and the upgrading of production resources. While we cannot say how much is driven by investment in capital or specifically skills, it provides an estimation of the relative importance of increased absorption of innovations for the productivity of firms. While increasing the relative share of the (national) economy in different types of rural areas (the *between* effect) can bring productivity growth, there is a larger role for innovation absorption and adoption through better use of pre-existing resources (the *within* effect), which, in all cases, is far from being exhausted (i.e. it is not close to 0).

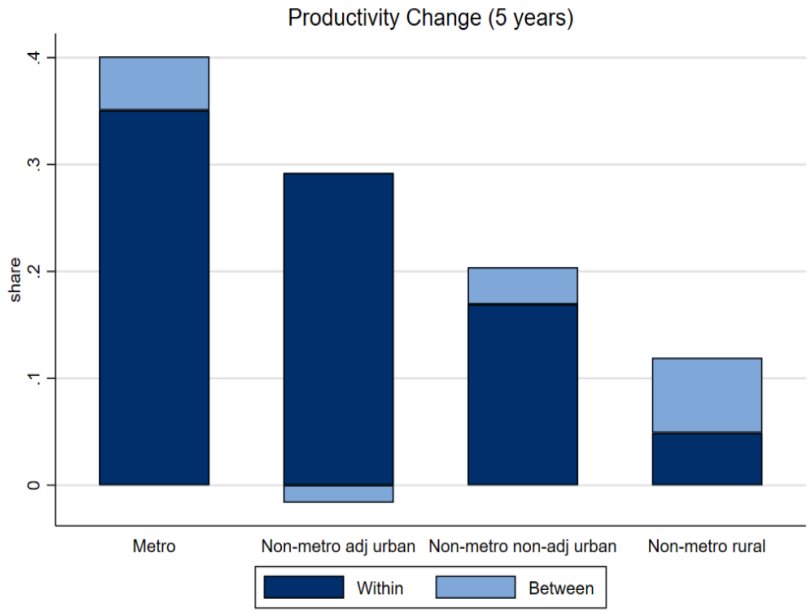
The development of new entrepreneurial endeavours can be part of the solution in bringing innovation and productivity to rural areas. Figure 1 also shows that the reallocation of resources (capital and labour) across territories positively contributes to productivity growth (OECD, Forthcoming[17]; OECD, Forthcoming[20]). These gains have been shown to be important contributors to national measures of innovation and productivity, while still small as compared to the effect of upskilling. For example, between 2010 to 2018 the reallocation of resources into both accessible and remote regions contributed to 28.7% of total productivity growth in Scotland. While the physical distance and administrative (federal structure) differences between rural (non-metropolitan) and urban (metropolitan) territories are larger, the findings are similar in the United States (OECD, Forthcoming[17]), where the share of growth due to reallocation of resources is stronger in non-metropolitan areas, and strongest in the most remote non-metropolitan rural regions. In addition to the role of new entrepreneurial activities, productivity growth through the reallocation of resources across the different types of rural areas is also explained by reallocation of capital and skills in pre-existing firms (ie. more investment and skilled labour within pre-existing firms).

Figure 1. Decomposition of Productivity, by geography

Panel A. Decomposition of productivity from 2010 to 2018, Scotland



Panel B. Decomposition of productivity from 2015 to 2020, United States



Note: Productivity is calculated as value-added per full-time equivalent employee. The decomposition is further explained in Melitz and Polanec (2015[21]). For Panel A, national classifications of territories in Scotland are based on the Scottish Rural Classification (Scottish Government, 2018[22]). For Panel B on the United States, oil counties have been excluded. Data used is pooled and averaged by 5-year intervals. The proxies used refer to 2011-2015 for 2015 estimates; and 2016-2020 for 2020 estimates. Territorial classifications are elaborated by the OECD based on United States Departure of Agriculture (https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/#DataSources).
Source: ONS (2021[23]) *UK Innovation Survey;* ONS (2021[24]) *Business Structure Database;* OECD based on Bureau of Economic Analysis Regional Economic Accounts.

Among other major drivers of innovation, competition in markets can create strong incentives for innovation, but there is still more to be understood about competition in local markets. Competition incentivises the more efficient allocation of resources and pushes firms and individuals to bring new ideas to market (Aghion et al., 2009[25]; Hall et al., 2013[26]). However, innovation adoption can be hindered by anti-competitive behaviour (Bassanini, 2002[15]) that may differ across territory, and product market regulations (Arnold, Nicoletti and Scarpetta, 2008[27]). While a minimum level of competition should exist, too much competition may also hinder innovation, especially in new entrants (firms) who struggle to compete with incumbents (Carlin, Schaffer and Seabright, 2004[28]; Aghion, Carlin and Schaffer, 2002[29]; Aghion et al., 2005[30]; Aghion et al., 2009[25]). Incorporating these two concurrent factors, Aghion et al. (2005[30]), suggest that innovation and competition follows an inverted U-shape pattern with competition initially positively associated with innovation but decreasing association, until eventually becoming a negative association at very high levels of competition on (aggregate levels). Unfortunately, research is not clear on the local market effects of competition and innovation, nor the levels after which competition is no longer innovation inducing. There is room for further research on competition and its effects on innovation in rural and other non-urban markets that may be at different levels of development. Further reflection of the issue is taken up in Box 2.

Box 2. Exploring the role of competition in rural economies

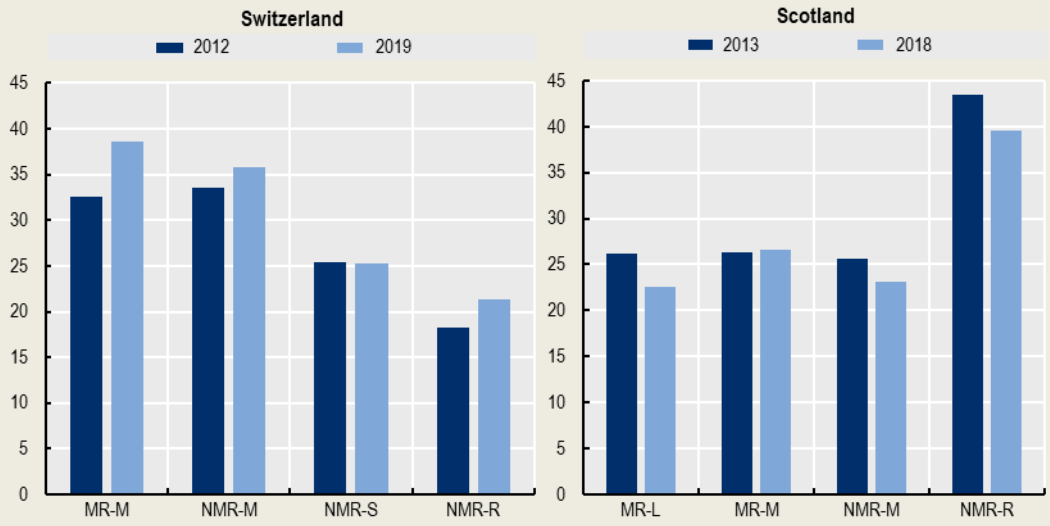
While networks of firms, that compete with each other on a national level, is often the subject of competition policy and a driver of innovation, little is known about the sub-national dimensions of competition. However, some studies suggest that there are variations in the levels of competition across geographies, based on measuring relative shares of the economy captured by the top 10 percent and bottom 10 percent of the economy.

In highly competitive and innovative economies such as Switzerland, we observe relatively high levels of competition in particular in non-metropolitan regions (OECD, 2022[19]) and a relatively low share of sales attributed to top performing firms (Figure 2). In Switzerland, the top 10% of firms[1] in metropolitan regions have over 30 times more of the market share than the bottom 10% of performers. In non-metropolitan regions the ratio is lower, with top performers capturing just above 20 times the share of bottom performers.

On the other hand, in Scotland, the share of the total market captured by top performers are more consistent across territories, with only non-metropolitan rural areas demonstrating high levels of inequality between top performing and bottom performing firms (OECD, 2023[18]).

Figure 2. Market Capture using P90/P10, in Switzerland and Scotland

Share of Sales (Switzerland) and Productivity (Scotland), by OECD Classification of Territories



Note: The P90/P10 ratio for Scotland refers to the ratio of the top 10 share of the most productive firms over the bottom 10 share of the least productive firms, in 2010 and 2018. The P90/P10 ratio for Switzerland refers to the ratio of the top 10 share of the firms with the highest sales over the bottom 10 share of the least sales, in 2012 and 2019. Classifications of territories are harmonized and based on Fadic et al. (2019[31]).
Source: Authors' calculations based on ONS (2021[23]) *UK Innovation Survey;* ONS (2021[24]) *Business Structure Database* and (OECD, 2022[19]).

[1] Ranked by performance in total sales.

Rural places tend to have less competitors in local industries than more dense areas. On the field, this is frequently observed as “company towns”, where one employer may account for a large portion of all employment or economic activity (OECD, Forthcoming[32]), raising risks that they may exercise undue influence over resources and local policies for their own benefit, and reducing, in turn, innovation (Barca, McCann and Rodríguez-Pose, 2012[33]). In some cases, the company will also provide many of the services that is elsewhere provided by the state including health, education, transportation, or amenities. Rural places have smaller local markets and with a different industrial (sectoral) composition than urban areas, where specialized activities are often tied to the local economy or of a traditional nature (for example, fabric manufacturing, or car manufacturing towns or cities). This characteristic often creates local markets with less competitive forces (OECD, Forthcoming[17]; OECD, 2022[19]; OECD, 2023[18]).

Innovation can still occur in such contexts with the right governance mechanisms. Two examples of this can be found in rural areas of Canada. For example, government partnerships with large employers in the nuclear energy sector in Kincardine, created opportunities for local talent and skills to outsource R&D practices of the firm (OECD, Forthcoming[32]). A second example is particularly relevant for work in rural areas nearby or within indigenous lands, where nature-based production (for example forestry production) has regulatory requirements to include agreements with indigenous land owners that incorporate indigenous knowledge on land management. These often favour sustainability over short-term profits (OECD, Forthcoming[32]; OECD, 2021[34]). More research on the scale of competition necessary for innovation-promoting competitive environments is needed to understand how local policies can support innovation in rural areas, through competition-based networks.

2 Enablers of Absorption and Diffusion in Rural Areas to Enhance Innovation

Absorption and diffusion of innovation in rural areas can be facilitated by closer operational proximity. With the recent COVID-19 crisis, it became clear that digital infrastructure is a critical infrastructure for the well-fare or rural places. Promoting access to quality digital infrastructure is equally as important for promoting the adoption and diffusion of innovation in rural areas. Likewise, promoting the circulation of individuals and ideas; enabling foreign investment and trade linkages; making research infrastructure and business eco-systems more accessible to individuals and entrepreneurs in rural areas is important for promoting innovation. The following section explores challenges and opportunities associated with each one of these factors.

Connecting places: Access to quality digital infrastructure for innovation

Distances and limited agglomeration of individuals and resources are inhibitors to innovation adoption and diffusion. As such, a critically important aspect of enhancing the capacity of individuals to innovate is to create the conditions where the flow of goods and people are facilitated. Improved digital infrastructure is critical in this regard. This following section will focus on the importance of digital infrastructure for rural innovation.

The dynamism of rural business will increasingly be dependent on improved digitalisation. This is especially important if the movement to online business and e-commerce continues. Many rural entrepreneurial start-ups driven by urban-rural relocations are also associated with a preference for working from home. Furthermore, business that require increasing data requirements will be penalised if they locate in areas with low levels of access to quality communications infrastructure.

Communications network costs for "last-mile" coverage are often prohibitive. The provision of Next Generation Access (NGA) technologies depends on the expected profits which technology providers expect to achieve from such provision. The costs of network-based infrastructures and services typically falls with population densities, thereby increasing expected investment returns and also bringing forward such investments in denser areas, relative to lower density places. These differences in network provision may inhibit local entrepreneurship and innovation patterns in rural areas, especially where the innovation-related activities are intrinsically related to the quality of the knowledge and data infrastructure locally available. Innovation related to high knowledge-intensive activities would appear to be particularly sensitive to any such differences in the provision of NGA infrastructure or services.

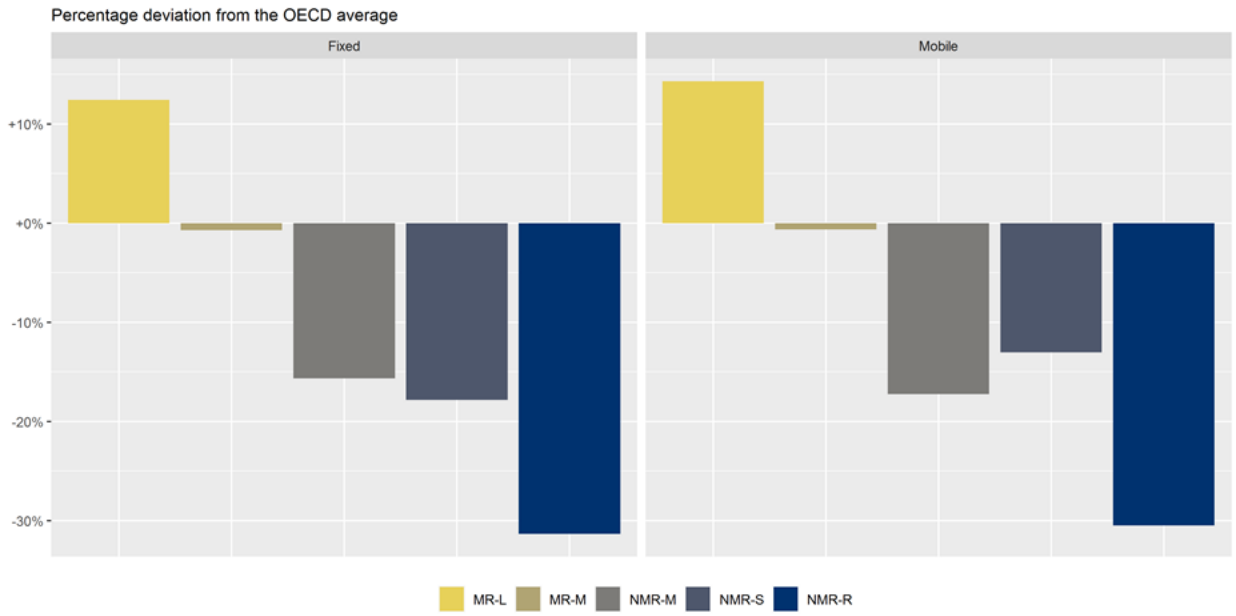
Substantial disparities in connectivity persist between urban and rural areas in the quality of broadband connections. Looking at the availability of fixed broadband services in terms of geographical coverage with a minimum speed of 30 Mbps reveals significant gaps between rural and urban households (OECD, 2021[35]). For example, in 2019, only 59% of rural households in Europe were located in regions

where access to fixed broadband with a minimum speed of 30 Mbps was available, in comparison to 86% of households in all areas overall.

Rural areas can expect experience close to a 50-percentage point difference in local speeds versus those in cities. Classifying rural areas into the degree of urbanisation, as in (OECD, 2021[35]), territorial differences in connectivity also translate into user experiences that vary substantially depending on where people live or work, as evidenced by the differences in actual download speeds experienced by individuals in cities compared to those in rural areas. Data from self-administered connection speed tests by Ookla (Figure 3) (revealing actual differences in download speeds, as opposed to differences in availability) show that download speeds over fixed networks in rural areas are on average 31 percentage points[2] below national averages. Download speeds in cities, on the other hand, are on average 21 percentage points above national averages.

Figure 3. Digital Divide across regions, 2020 Q4

Aggregated average percentage deviations of speeds from OECD averages



Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2020Q4. Ookla trademarks used under license and reprinted with permission.

Connecting people: The flow of people and skills as drivers of innovation

The predominant view in innovation is that agglomeration, or the spatial concentration of firms and people, necessarily leads to new ideas and entrepreneurship (Carlino and Kerr, 2015[36]; Faggian and McCann, 2008[37]). For instance, in the US, Buzard and Carlino (2013[38]) observes that R&D activity for most industries are clustered in the Northeast Corridor, around the Great Lakes, in California's Bay Area, and in Southern California. In France, Carrincazeaux et al. (2001[39]) found that six regions employ 75% of

[2] This is a simple average of the deviations in actual download speeds experienced in rural areas with respect to national average download speeds, in G20 and EU countries (43 countries in total). It is not weighted for the population or territory covered. It is not representative of the population, but rather the average experiences on a country level.

all corporate R&D workers, but only 45% of the production workers.[3] Taking the number of patents as proxy for innovation, 92% of the patents were granted to residents of metropolitan areas, and virtually all venture capital investments were made in major cities. Fornahl and Brenner (2009[40]) found that patents tend to be concentrated in 11 of the 97 German regions they considered, that have a higher concentration of individuals with occupations where patents are commonplace (OECD, Forthcoming[41]). Beyond agglomeration, some industries require walkable proximity (0-1 mile) for knowledge exchange to result in tangible benefits (Rosenthal and Strange, 2003[42]; Arzaghi and Henderson, 2008[43]).

Inter-regional and international migration flows for innovation

Beyond the stock of human capital which agglomerative forces accumulate, the flow of skilled workers is also important in promoting innovation. This is because knowledge accumulated in universities, clusters, and cities, as well as skills acquired in spatially isolated regions (i.e. manufacturing hubs and regions) can flow through and benefit the wider economy, including rural and remote regions, when workers take their skills and experience to the next job**.** In their study of Scotland and England, Faggian and McCann (2008[37]) find that the flow of graduates into regions other than the location of their university significantly improves innovation performance in that region. Such outcomes, however, benefit mainly high technology innovation in regions. Likewise, in Japan, Hamaguchi and Kondo (2016[44]) demonstrate a positive relationship between interregional knowledge turnover and innovation. Similar findings are observable for European-level innovation and movement (Engel, 2010[45]). Rural regions that benefit from such infusion of outside knowledge are better placed to undertake innovative activities and improve existing processes, leading to increased productivity and income levels, in line with neoclassical growth theory (Kanbur and Rapoport, 2005[46]; Mitze and Reinkowski, 2011[47]; Niebuhr et al., 2011[48]; Razin and Yuen, 1995[49]). Therefore, the static accumulation of human resources is a necessary but insufficient condition for innovation, and instead equal consideration should be given to “brain circulation”, whereby a worker, from their time as student to becoming a worker, diffuses knowledge through their employment journey across regions and countries.

The international flow of migrants into a country is associated with positive entrepreneurship and innovation outcomes (OECD, 2022[50]; Kerr, 2018[51]; Guichard, C. Özgüzel and Kleine-Rueschkamp, forthcoming[52]). In the United States, a strong history of migration was associated with more technology areas and inventions. Places where immigrant inventors were prevalent between 1880 and 1940 experienced more patenting and citations between 1940 and 2000 (Akcigit, Grigsby and Nicholas, 2017[53]), despite having lower wages. Immigrants are also strong drivers of new entrepreneurship. A study in the United States demonstrated that first-generation immigrants create about 25% of new firms in America, in some states going up to 40% of new firms (Kerr, 2018[54]; Pekkala Kerr and Kerr, 2020[55]). While there is limited work on understanding the differential effect of migrants to rural and urban areas, recent analysis on rural innovation in Canada suggests positive outcomes related to immigration and innovation and entrepreneurship in rural areas. First, foreign-born individuals are more likely to start a company than Canadian-born individuals in both rural and urban areas. However, the effect is stronger in urban areas (+0.162) than in rural areas (+0.124). Second, companies with a majority foreign-born ownership structure are more likely (+0.226) to participate in formal innovation processes in rural areas than those that are primarily Canadian-born. The is not the case in urban areas, where firms with a majority foreign-born ownership structure are less likely to participate in formal innovation (-0.200). Lastly, firms with a higher percentage of foreign-born workers, are increasingly likely to participate in formal innovation. The effect is stronger in rural areas (+0.440), than urban areas (+0.321) (OECD, Forthcoming[32]). There is also a positive association between entrepreneurship and innovation outcomes in mountainous border regions of Switzerland, where daily cross-border migrants positively contribute to closing the skills gap, such as in the northern border Jura region. Recent work by Beerli et al. (2021[56]) found that the removal of barriers

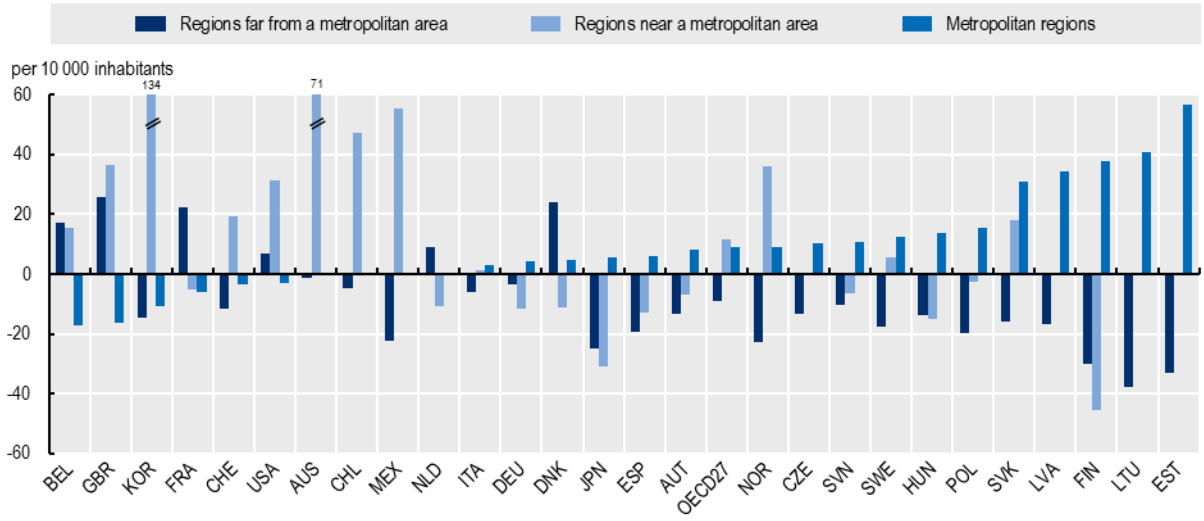
[3] An extensive overview of the literature is provided by Carlino and Kerr (2015[36]).

to European cross-border migrants in Switzerland impacted regions close to the border increasing wages for high-wage native workers, productivity, firm size and innovation in firms where there was a prior skills shortage.

Between 2015 and 2018, 33 million people changed their region of residence each year, on average, in the 30 OECD countries with available data (OECD, 2020[57]). These mobility flows across regions corresponded to 2.5% of the total population in the OECD area. In the same period, metropolitan regions and regions near a metropolitan area experienced an average net inflow of 9 and 12 persons per every 10 000 inhabitants between 2015 and 2018 respectively (Figure 4). In contrast, regions far from a metropolitan area, including rural regions, experienced net outflows of 9 persons, for every 10 000 inhabitants.

Figure 4. Annual regional population flows by type of region, 2015-2018

Net flows across regions per 10 000 population, 4 year average



Note: The net migration flow is defined as the difference between inflows and outflows in a region. A negative net migration flow means that more people left the region than entered it. Countries are ranked in descending order of the net flows share in metropolitan regions.
Source: OECD (2020), OECD Regional Statistics (database), http://dx.doi.org/10.1787/region-data-en

Interregional mobility provides the mechanism by which resource-scarce regions could benefit from individuals with innovation potential from resource-saturated areas. Removing barriers and encouraging inter-regional migration is critical for innovation in rural regions. While human resource spill-over to rural regions is little discussed, it is of interest to examine rural regions bordering on another country, and which allow for the frictionless flow of workers across borders. For such rural regions in Switzerland, the removal of barriers is associated with alleviating skill gaps, increased wages for high-wage native workers, and increased productivity and innovation in firms where there was a prior skills shortage. The international migration literature also makes the case that migrants in general – domestic or international – can help address labour market shortages. It is well documented the positive effects that international migrants bring to their advanced-economy hosts, including long-term gains to GDP per capita and productivity (Jaumotte, Koloskova and Saxena, 2016[58]; Bahar and Rapoport, 2018[59]). International migrants not only contribute to high-tech patent-producing sectors (Choudhury and Kim, 2019[60]; Kerr, 2018[51]; Moser, Voena and Waldinger, 2014[61]), but also low-skill areas as they take on jobs for which natives are in short supply (agriculture, nursing, housekeeping, landscaping, etc.).

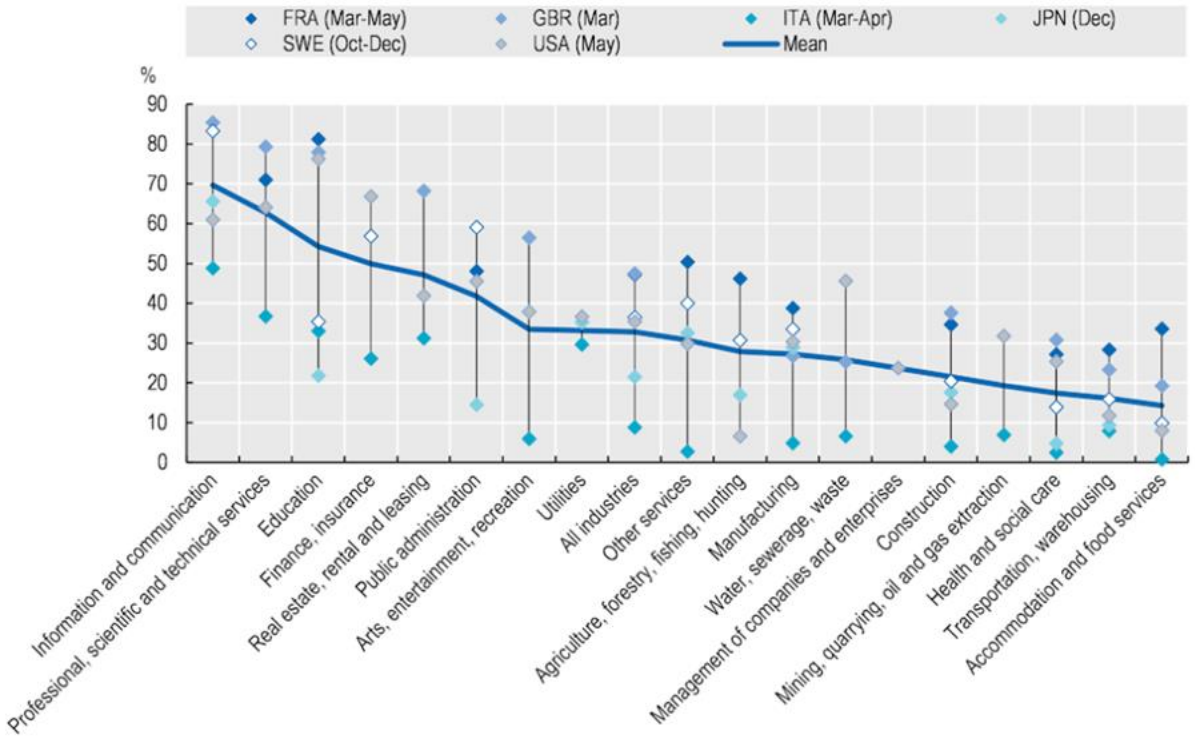
Remote working as an enabler of inter-regional mobility of skills and innovation.

Remote work has increased due to Covid-19, and now is being integrated as a regular part of work life in many countries. In OECD countries, the initial shutdown due to COVID-19 pushed teleworking from a fringe mode of working into the forefront. In 2020, Australia, France and the United Kingdom, 47% of employees teleworked during lockdowns. In Japan, which did not institute a nationwide lockdown, the teleworking rate increased from 10% to 28% between December 2019 and May 2020 (OECD, 2021[62]). As the pandemic unfolded, with measures adopted at various times to combat outbreaks, teleworking proved to be an enduring mode of operation. As recovery ensues, most business and individuals expect to integrate teleworking into the work life, even if employees are unlikely to telework full time (OECD, 2021[62]). Reduced commute time and flexible working arrangement are just some benefits to teleworking.

Remote work tends to be more easily suitable for professions with higher income. Not all individuals are able to remote work, and those that benefit from the possibility are often concentrated in high-wage sectors. In France, the United Kingdom, Italy, Japan, Sweden and the United States, where detailed data are available, sectors that are already highly digitalised (OECD, 2019[63]), including information and communication services, professional, scientific and technical services, and financial services were able to achieve much higher rates of working from home – over 50% on average (Figure 5).

Figure 5. Teleworking peaks during the COVID-19 pandemic, by industry

Percentage of employed persons

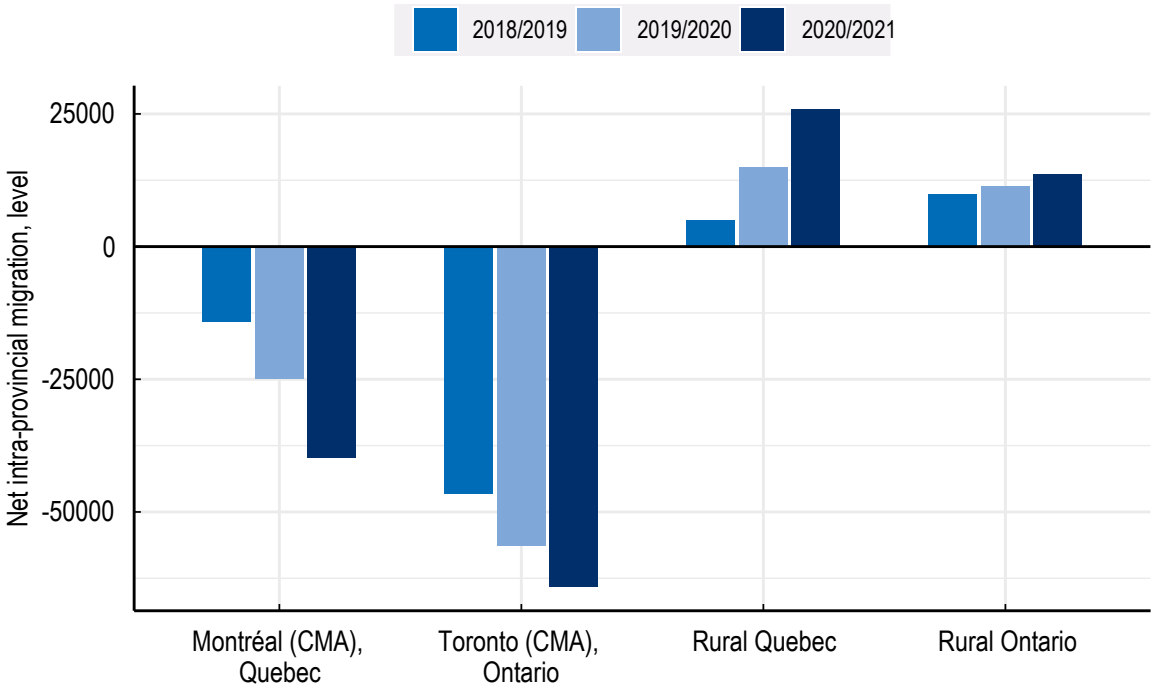


Source: (OECD, 2021[62]).

Urban outflow to places close to urban areas, accelerated by COVID-19, is already apparent in some OECD countries. The lockdown and the possibility to work remotely saw workers, particularly high-earning professionals, leaving urban places to peri-urban or rural places. In Canada, some rural places grew during the pandemic as more people move out of urban area, particularly Quebec and Ontario (StatCan, 2022[64];

Tendil, 2022[65]). This movement coincides with reports of urban departure in Toronto, where more than 64,000 people left the city for other parts of Ontario from mid-2020 to mid-2021 (StatCan, 2022[66]), and is illustrated in Figure 6 alongside Quebec. Likewise, strong inter-provincial migration toward British Columbia and Atlantic Canada was also observed in Canada, with many accessible rural lands in census divisions (TL3 regions) having experienced population growth greater than the previous five-year average, driven by rapid rise of telework, natural amenities, and lower international migration (StatCan, 2022[66]). In France, Tendil (2022[65]) reports longer-term settlement in rural regions using primary school enrolment as a proxy, with metro areas losing over 33,000 students at the start of the 2021 school year, while non-metro areas saw gains. A similar phenomenon is also observed in Germany (Federal Institute for Population Research, 2022[67]).

Figure 6. Net intra-provincial migration in select territories in Canada, 2018-2021



Note: CMA denotes Census Metropolitan Area as defined by Statistics Canada's 2016 boundaries.
Source: OECD re-creation based on Reuters (https://www.reuters.com/world/americas/so-long-toronto-covid-19-pandemic-hastens-canadas-urban-exodus-2022-01-13/). The underlying data is sourced from StatCan, Components of population change by census metropolitan area and census agglomeration, 2016 boundaries (https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1710013601).

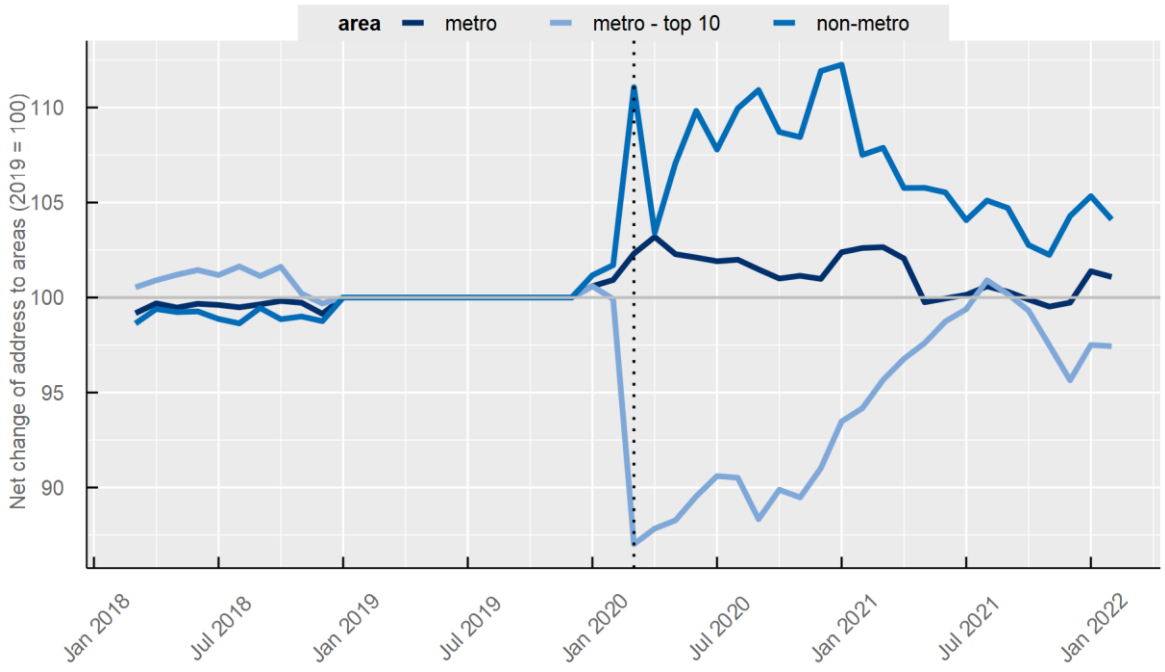
In the United States, urban outflow is particularly striking in the largest cities. Using net change of address from the United States Postal Service as proxy for net migration (in-migration less out-migration), Figure 7 illustrates a spike of movement into non-metro areas in March 2020 at the onset of COVID-19 mobility restrictions. The migration remains elevated up until January 2022, although at a declining rate. Against the dramatic drop in movement into the 10 largest metro areas, this provides further evidence of a continued urban exodus. Despite this dramatic drop in the largest 10 metro areas, as a whole, metro areas saw a relatively mild year-on-year increase in net migration and even showed signs of depopulation from June 2020 onwards.

However, the benefits of this urban outflow depends on housing, local infrastructure and amenities. While such high-earning habitants have the potential to create demand for urban amenities,

leading to new business formation to cater to those needs, anecdotal evidence from some areas such as Gaspé in Canada and Caithness in Scotland (OECD, Forthcoming[32]; OECD, 2023[18]) quickly identified housing as a constraining factor. When regions have tight housing markets, the inflow of high-earning families may distort local markets and lead to housing crisis for locals. This displacement to rural areas has put pressure on the rental market as prices rise more sharply in suburbs and small towns than in urban centres, driving worries that locals could be priced out and putting stress on municipal services (Reuters, 2022[68]; Reuters, 2022[68]).

Figure 7. Net migration to metro and non-metro areas in United States, 2018-2022

Net change of address into the respective areas



Note: Territorial classification follows USDA's 2013 Rural-Urban Continuum Codes (RUCC) (https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/#DataSources). Metro area designates the aggregation of RUCC areas 1-3; metro – top 10 designates the counties with the 10 most populous cities according to 2020 US census data, which includes: New York, Los Angeles, Chicago, Houston, Phoenix, Philadelphia, San Antonio, San Diego, Dallas, San Jose; non-metro area refers to the aggregation of RUCC areas 4-9. Data are normalised such that 2019=100. The dotted vertical line denotes March 2020 at the onset of Covid-19 mobility restrictions in the United States.
Source: OECD calculation based on United States Postal Service (https://about.usps.com/who/legal/foia/library.htm)

The impact of increased teleworking on innovation is not yet clear. On the one hand, increasing the flow of individuals and skills is generally conducive of innovation. As such, local programs such as those in the UK (Mills and Barnett, 2018[69]) and Italy (Bennett, 2022[70]) seek to attract young professionals and digital nomads to migrate to rural locations or smaller cities as part of broader revitalisation plans. However, if remote workers do not participate in the local economy, they may not share these benefits with local entrepreneurs and businesses. One increasingly popular policy response to mitigate this fear is the attraction of remote workers with families, which was an explicit goal of the Great Places: Lakes and Dales program in the UK (Mills and Barnett, 2018[69]). Numerous Italian regions also offer properties for sale at significantly below market rate to encourage settlement, in addition to countering depopulation and underinvestment (Jacobs, 2021[71]).

Nevertheless, capturing this flux of teleworkers will require good public and digital infrastructure. For rural areas to be well positioned to deal with and capture the benefits of receiving mobile workers, good public infrastructure, including public services such as health care, education and social services, is needed. Rural areas are not typically equipped to deal with a sudden influx of habitants, whether in terms of road infrastructure, public services, or the housing stock. Investments in these areas can make rural areas more attractive.

Connecting firms: Firm linkages for innovation

Entrepreneurs do not function in isolation, but often benefit from global supply chains and finance networks, linkages with innovation partners such as universities, and other firms. Furthermore, even though in most rural OECD areas, the service sector is the largest sector, there are often relatively higher shares of tradeable sectors, that function in liaison with other firms, in rural areas as compared to urban areas (OECD, Forthcoming[32]; OECD, Forthcoming[17]; OECD, 2022[19]). This makes networks with other firms and trade relatively more important, despite challenges of physical distances. The following section outlines how university-firm (or firm-to-research institution) and firm-to-firm linkages are important for rural innovation.

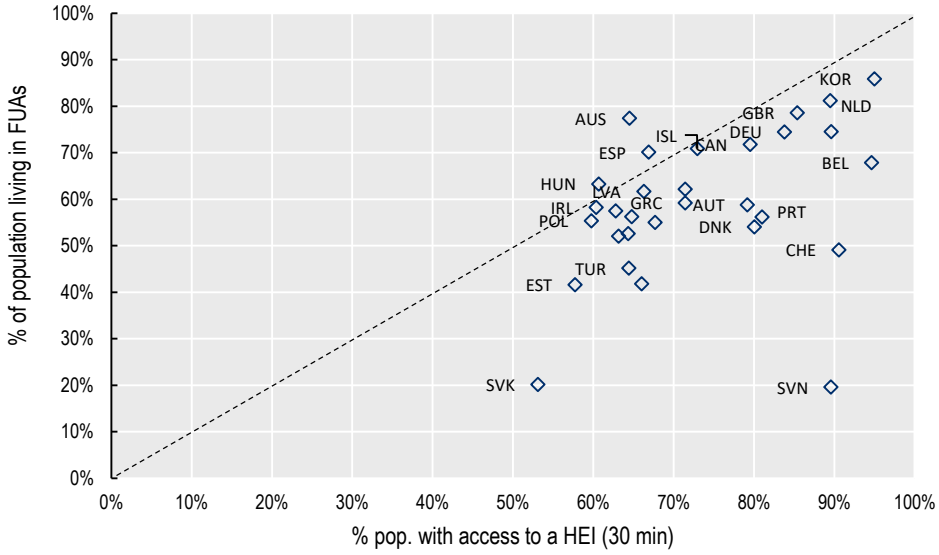
University-firm linkages for rural innovation

Universities and research institutions play an important role in both high-tech innovation and in local spill-over effects that involve knowledge transfer within territories and spin-offs firms (OECD, 2021[72]). The eco-system around universities and research institutions are often closely linked with high-tech and solution-based innovation encouraging a number of spin-off firms and research focused collaborations (Cadavid, Díez-Echavarría and Valencia, 2017[73]; OECD, Forthcoming[32]). Universities and research institutions can be innovation hubs in rural areas. Linking industry initiatives to research institution laboratories often leads to a win-win situation for rural areas and academics, and creates incentives and links for experimentation in rural areas.

For rural innovation, universities and research institutes can bridge a gap for entrepreneurs looking to participate in high-end research requiring heavy R&D investment and technical skills. These research linkages help entrepreneurs to try to solve challenges with university researchers and for university researchers to build partnerships to provide testing for new ideas (OECD, 2022[19]; OECD, Forthcoming[32]; OECD, 2023[18]).

Yet the density of rural areas often means that access to higher education institutions equipped to support rural innovation may be more difficult. Often higher education institutes are further away in rural areas and have limited incentives to cooperate with regional stakeholders. In a recent study in Sweden, innovation (measured as patent publications) decreases as we move further away from higher education institutions. It became insignificant after 50 kilometres away from higher education institutions (OECD/EC, 2021[74]). In Figure 8, the lower share of urbanity in countries is associated with a lower share of the population having access to a higher education institution within a 30-minute drive. However, in relatively small countries, like Slovenia and Slovakia a low share of urban population is still associated with relatively closer proximity to higher education institutions.

Figure 8. Share of population with access to a higher education institution versus the share of population living in FUAs



Note: Data for main campuses only for Canada, Denmark, Korea and Turkey. Percentage of population with access to a higher education institution is based on a 30-minute driving distance.
Source: OECD (2022[75]), *Education at a Glance 2022: OECD Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/3197152b-en; OECD 2022, ADHEP database [unpublished]; Mapbox (2022[76]). *Mapbox Navigation Service*. (accessed: 15 January 2022), https://docs.mapbox.com/api/navigation/.

In many cases, satellite universities play an important role of encouraging innovative activity, but are often have more limited resources. Building networks of research institutions for rural areas generates opportunities for training and up-skilling workforce and tying research and education to local economies. In the United States, Land-Grant Universities became a mechanism through with traditional farming areas were supported by central government funding to enable research and training centres serving farmers and rural communities (OECD, Forthcoming[17]). According to Maloney and Valencia Caicedo (2022[77]), these grants, started in 1862, demonstrated the long-term impact of investing in local research institutions in rural communities, explaining close to 10% of higher US county incomes over a hundred years later.

Facilitating the connection between firms, researchers and universities can reduce organisational distance between rural areas and urban areas. In some cases, research initiatives can only happen through a collaboration between rural communities and university researchers that are facilitated by local, regional or national governments. For example, the IISD Experimental Lakes Area initiative in rural remote area of Kenora, Ontario (Canada) was initiative a government supported research initiatives on environmental impacts on eco-systems, and now is responsible for one of the longest ongoing research initiatives collecting eco-system level environmental and climate change data (OECD, Forthcoming[32]). Research and technology centres can also facilitate access to global knowledge for regional firms through their networks and research collaborations and facilitate cluster interactions among firms (OECD, 2019[78]; OECD, Forthcoming[32]). Likewise, both Scotland and Switzerland provide specific programmes to link entrepreneurs and researchers together for the purpose of encouraging experimentation and innovation (OECD, 2022[19]; OECD, 2023[18]).

International linkages for rural innovation

Networks for innovation are built from interactions between individuals, and often, through business-to-business interactions. Networks between individuals matter for innovation, and, in particular, for new entrepreneurs (Diemer and Regan, 2022[79]). Business linkages, such as those acquired through foreign ownership, foreign investment, global value chains, import and export competition can be a driver of employment growth, productivty and innovation (Shu and Steinwender, 2019[80]; Guadalupe, Kuzmina and Thomas, 2012[81]; Baldwin, 2004[82]; Crescenzi and Harman, 2023[83]; Dachs and Peters, 2014[84]; Crescenzi, Di Cataldo and Giua, 2021[85]). However, not all areas have equal access to networks, both physically and digitally. Furthermore, some drivers of innovation in urban areas may not necessarily have the same impact in rural areas. The following section covers a few aspects of innovation linked to business-to-business or firm-to-firm interactions in rural and urban areas.

Innovation through trade linkages in rural firms

Firm-to-firm linkages with external firms and markets is a critical factor to overcome the barriers to distance that rural firms perceive for both import and export goods. In general, facilitating trade tends to have positive impacts on productivity and innovation (Baldwin, 2004[82]; Melitz, 2003[86]). More specifically, a reduction of tariffs tends to increase the adoption of new technologies, investment in R&D, and the proliferation of innovation in firms in countries at later development stages who are more likely to innovate through trade (Melitz, 2003[86]). However, in less developed may also face some challenges to innovation from external competition. In addition, some studies show that innovation through international trade is more positively associated with firms who already were more productive, than those that were initially less productive (Shu and Steinwender, 2019[80]). Rural firms that can develop supply chain linkages with external customers have larger incentives to innovate and additional avenues to adopt innovation through exchanges within global value chains (Crescenzi and Harman, 2023[83]). However, strategies for exporting and innovation differ by regional attributes associated with firm activity. For example, findings from research in Quebec suggest that exports in the knowledge intensive business sector differ across space (Doloreux, Shearmur and Van Assche, 2018[87]).

Despite limited analysis on the subject, **global supply chain linkages tend to be more beneficial for rural firms**. While not many studies address the trade challenges that may be different between rural and urban areas, forthcoming work in Canada has some relevant finding that support the importance of global value chains for rural areas. OECD (Forthcoming[32]) finds that:

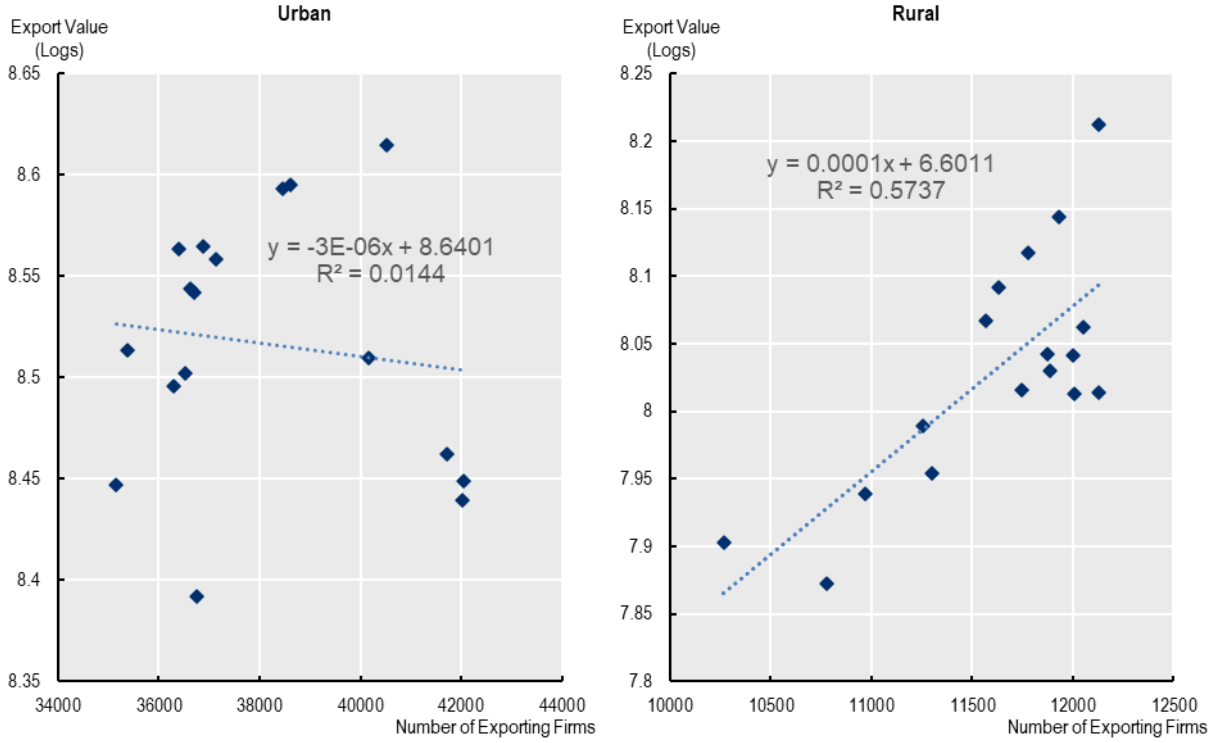
- **A large share of rural firms who innovate participate in global supply chains** (export or import). While less than 5% of firms in rural areas participate in global value chains, 41% of firms that participate in formal firm innovation[4] participate in global value chains. This is a relatively high share, considering that less than 1% of all firms participate in formal firm innovation in Canada. It is, however, lower than in urban areas. In comparison, close to 7% of firms in urban areas participate in global value chains and of those 52% participate in formal innovation processes.
- **The monetary returns to export activity are stronger in rural areas than urban areas**. In Figure 9, the returns to an additional exporting firm are negative and relatively spurious in urban areas. However, one additional exporter in rural areas is associated with an 0.01% increase in export values. Furthermore, increasing the number of export partners has a substantial impact for rural firms. In rural Canada, close to 82% of firms have only one export partner country, as compared to 74% in urban areas. Increasing the share of firms exporting by 1% is associated with a close to 6-fold increase in export values in rural areas, and explains quite a strong share (57% of the variation) of the outcome for export values.

[4] This refers to firms that applied for tax relief related to formal research and development investment.

- **International linkages through trade and foreign ownership tend to have relatively positive impacts on the probability of participating in formal innovation activities**. In rural areas, participating in global value chains, either through imports or exports, has a positive effect on formal innovation activity in urban (0.679) and rural (0.558) areas, despite the relative penalty for rural areas as compared to urban areas.

Figure 9. Correlation between export value and number of exporters in Canada

Two-way correlations between export values (logs) and the number of exporting firms, by geography



Note: The rural economy is measured as all non-census metropolitan areas (CMAs) as a whole. Relative importance measures the rural economy as a share of the total economy in respective activities.
Source: Statistics Canada Tables 12-10-0137-01.

Critically, for governments, the analysis provides ample evidence for the importance of helping rural firms expand supply change linkages. Some countries have regional export facilitators (Crescenzi and Harman, 2023[83]; OECD, Forthcoming[88]). In the case of Japan, prefectures that produce traditional goods and services also help promote trade abroad (OECD, Forthcoming[88]). A recent study in the western Balkans found that live group training and remote counselling was helpful in overcoming constraints in accessing overseas clients for small and medium sized companies (Ana P., Darova and McKenzie, 2022[89]).[5]

Innovation and foreign ownership in rural areas

Extending the firms network abroad can create linkages for encouraging innovation. In particular, an ownership structure, with some foreign ownership and investment, may bring practices from other

[5] The firms that received the training and counselling services were taught techniques such as search engine optimisation and improved social media content to increase digital presence, with positive and significant impacts on number of new clients and increased export sales. In part, this was because of a combination of sector-specific advice on market expansion, and increased confidence in trying new sales strategies.

economies to support the adoption and development of new innovations within the firm. For example, a study on Spanish manufacturing firms found that multinational firms with foreign networks conduct more product and process innovation (simultaneously adopting new machines and organisational practices) and adopt foreign technologies, leading to higher productivity (Guadalupe, Kuzmina and Thomas, 2012[81]). In Canada, foreign ownership has been associated with more intensive use of advanced technology and business practices (Galindo-Rueda, Verger and Ouellet, 2020[90]).

However, it is unclear if foreign ownership, is as strong as a driver for innovation in rural areas, as it may be in urban areas. Forthcoming work in Canada (OECD, Forthcoming[32]) finds that:

- Despite benefits associated with foreign ownership, in rural Canada, a **very small share of firms are owned by foreigners**. The share of foreign ownership in urban areas is 0.48%, while it almost a fifth of the size, 0.11 % in rural areas.
- **There is a lower probability for rural firms with foreign ownership to participate in formal research and development activities, than in urban areas**. Despite having only 0.11 % of total firms in rural areas, foreign firms account for 2% of total firms that apply for R&D tax relief. While this is relatively high given its share of total firms, it is less than half of the share of foreign firms applying for R&D tax relief in urban areas (5%).
- However, part of this effect is most likely due to the composition of firms in rural areas. When controlling for firm characteristics **international linkages through ownership is not a strong driver of innovation in rural areas, while it remains a positive and significant driver in urban areas**. Having a foreign owner increases the likelihood of participating in formal innovation activities by 0.175 in urban areas, while no perceivable (statistically significant) benefit is observed in rural areas.

Clusters as a place-based strategy for innovation

A cluster is a “geographic concentration of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete, but also cooperate” (Porter, 1998[91]). Clusters affect competition by increasing the productivity of companies within them, by driving innovation and stimulating new businesses in the field (Porter, 1990[92]; Malmberg, 2005[93]). Researchers agree that the presence of clusters in an economy is positive and the benefits they bring are a significant incentive for regional development and competitive advantage (Lundmark L. & Pettersson Ö., 2012[94]; Porter, 1998[91]). To date, cluster theory and policy has mainly focused on urban areas and on ‘new’ and high-tech industries, rather than on industries in traditional low-tech sectors (e.g. forestry, mining) – which remain relatively important in non-metropolitan areas.

This section aims to address clusters and cluster policies from a rural angle. First, it presents the different concepts and strategies associated to clusters to better understand their role, objectives and benefits, and shows how rural clusters represent a significant potential for economy and innovation. Second, it sheds light on how rural clusters help regions to identify and develop their competitive advantages, support smart specialisation strategies in the identification of local innovation potential, and contribute to creating shared value and generating a societal impact in rural areas. Third, the section shows how the development of rural clusters – driven by clustering policies or by bottom-up demands – can contribute to address the challenges faced by rural areas.

Clusters as a policy mechanism in rural areas

Clusters bring together different actors, including business associations, research and knowledge institutions, talent and financial service providers, non-profit organisations or public institutions. This multi-actor approach creates vital networks at regional, cross-regional, national and supranational level (EC, 2021[95]) and can lead to both competition and cooperation (Deffobis, H., 2016[96]). Clusters play a significant role in supporting SMEs to achieve their objectives and assess bottlenecks in their performance

(OECD, 2022[97]). Clustered firms benefit from a large pool of specialised and skilled workers to identify previously unobserved opportunities and as a catalyst for entrepreneurial activity – by providing entrepreneurs with the opportunities and resources required to create new firms (Spigel, B. & Harrison, R., 2017[98]). They also have the advantage of providing a positive brand image for companies, optimising their communication to promote national and international visibility, which contributes to positive economic spin-offs (Deffobis, H., 2016[96]).

Clusters have a variety of funding mechanisms and can be driven by both the public and private sectors. Clusters are funded by both the public and private sector (companies), or by other research and civil society actors (e.g. universities). In the EU, they are mainly supported through regions Structural Funds (in particular the European Regional Development Funds) but also within the Rural Development Funds (OECD, 2007[99]). The most successful cluster initiatives are those involving both the public and private sectors (Martinidis et al., 2021[100]) because they can offer a constructive way to change the nature of the dialogue between the public and private sectors (Porter, 1998[101]) and create inter-knowledge between the two sectors (Deffobis, H., 2016[96]). For example, they can help achieve national objectives by forming an area to promote smart specialisation policies and gaining feedback to public agencies on the implementation of effective SME policies (OECD, 2022[97]). In the case of clusters of entrepreneurial origin, business owners and entrepreneurs with shared difficulties on economic activity, employment, innovation and organisation create a network to accelerate market access and economic development responding collectively to needs identified individually (Deffobis, H., 2016[96]).

The different strategies and concepts belonging to the business environment are vast. Table 1 summarises the main differences between clusters, innovation systems, entrepreneurial ecosystems, business incubators and business accelerators, or concepts such as Start-up Villages or Smart Villages.

Table 1. Main concepts and strategies of the regional business landscape

	Definition	Objectives
Clusters	Geographical concentration of interconnected firms, institutions, and other public and private entities, that facilitate collaboration on complementary economic activities in a certain field.	Facilitate collaboration on complementary economic activities and promote industrial diversification based on regional strengths; Increase knowledge spillovers among its members and generate a collective pool of knowledge; Support and connect SMEs/start-ups with large firms; Facilitate expansion into new markets.
Industrial, science and technology parks	Explicitly knowledge-based and location-specific category of clusters and an important source of knowledge and technology spillovers. Often exploiting a competitive advantage in a specific field of technology, they are normally related to one or several universities, research institutes or other higher education institutions (HEI's).	Provide all kind of firms (from corporate foreign firms to local SMEs) with basic infrastructure (e.g. land and office space to set up their activities) and business services (e.g. incentives to grow, diagnostic tools, and programmes involving public-private partnerships).
Regional innovation systems (RIS)	Institutional and policy foundations of the heterogeneous geography of innovation within regions. They are often motivated by external supply chains and depend on central "anchors" such as large multinational firms, universities, or research labs. In both RIS and clusters, entrepreneurial, innovation and research networks facilitate access to the most important resources for innovation, and geographic proximity encourages frequent interaction among entrepreneurs and other actors to build up strong local networks and access to unique resources.	Increase regional innovative capacity by supporting anchor knowledge producers and supporting learning between firms; Foster expansion into new markets.
Entrepreneurial ecosystems (EE)	EE share common characteristics with clusters and RIS: the presence of other firms as a source of competitive advantage for new ventures; the importance of entrepreneurs drawing on knowledge outside of the firm to increase its competitiveness; or a close physical proximity between firms making knowledge processing and creation a core component of firms' success. However, while clusters and RIS make little differentiation between large firms and smaller start-ups and are mainly organised and supported by the public sector, EE are primarily led by and made up of entrepreneurs, start-ups and other business actors (e.g. mentors, advisors, dealmakers).	Encourage entrepreneurial knowledge and culture (rather than focusing on the expansion into new markets); Focus on underlying technology (e.g. digital technology) (rather than focusing on industry or market).
Business incubators	Organisations helping – earlier in the process and without a set schedule – individual entrepreneurs and early-stage/start-up companies.	Incubate disruptive ideas to enable early-stage/start-up companies in regions and sectors with high innovation potential to experiment with new business models, access frontier know-how, and technologies that they can use to further develop their innovative ideas, notably in collaboration with foreign firms.
Business accelerators	Programs – with set timeframes and competitive application processes – for start-ups aiming to scale their business.	Accelerate growth of an existing company; Focus on scaling a business; Help early-stage start-ups to access frontier know how and technologies that they can use to further develop their innovative ideas, notably in collaboration with foreign firms.
Start-up Villages	Rural communities aiming to support start-ups by boosting research and innovation in rural communities and by encouraging a more innovative entrepreneurship to attract more young and talented people.	Support the development of rural innovation ecosystems; Identify and analyse the drivers of innovation in rural areas; Connecting rural innovation actors across the EU, with a focus on start-ups.
Smart Villages	Rural communities providing digital technologies and innovations to improve their inhabitants' quality of life and public services.	Improve standard of living, public services, use of resources, environment; Bring new opportunities for rural value chains (e.g. products, improved processes).

Note: Accelerators and incubators are often associated with technological start-ups, but most of them accept companies in several different fields. Start-up Villages and Smart Villages are relatively new concepts within the realm of EU policy-making.

Source: Authors' elaboration; (EC, 2020[102]; EC, 2021[103]; EC, 2021[95]; EC, 2021[103]; Deffobis, H., 2016[96]; Cooke, 2007[104]; Forrest, 2018[105]; Martinidis et al., 2021[100]; Spigel, B. & Harrison, R., 2017[98]; OECD, 2022[106]) ; (OECD, 2007[99]; Ylinenpää, 2001[107]; Westlund, H. & Bolton, R., 2003[108]).

Clusters generate a positive economic impact in rural areas. Clusters create an environment that favours employment, productivity and regional economy's growth, and companies in clusters outperform those outside clusters (OECD, 2021[109]). Between 2008 and 2017, the turnover of the firms belonging to the rural Food Cluster of Brandenburg in Germany increased by 23.5%, which is above the average of other enterprises, and the number of employees increased by 12.4% in the same period (Martinidis et al., 2021[100]). Clusters are also a way for regional and local authorities to better connect skills with jobs. For example, Wallonia's Public Employment Service in Belgium has undertaken a prospective analysis to identify local skills needs in specific sectors in order to develop appropriate training offerings for regional clusters and to communicate the identified skill needs to relevant audiences (OECD, 2019[78]). Rural clusters can also generate agglomeration externalities reducing production costs – through economies of scale and network effects – as well as in reaching out to international markets (OECD, 2022[110]; Martinidis et al., 2021[100]). Clustered firms benefit from foreign direct investment (FDI) and clusters can be an important determinant of FDI attraction. However, in order to avoid foreign owned firms to react to adverse local economic conditions by restructuring, relocating, or closing their plants (OECD, 2021[109]), cluster building policies may encourage foreign direct investors to locate in such clusters in order to strengthen their collaboration with other local firms and organisations (Potter, 2001[111]). Clusters are effective to help build trust and reinforce local and regional cooperative spirit. They can encourage knowledge exchange and cooperation between larger and smaller firms, newer and older firms, or artisans and individual consumers (OECD, 2019[78]; ANPP, France Clusters, INRA, 2016[112]). A small number[6] of companies in rural clusters favours the logic of co-construction (France Clusters, 2015[113]).

Rural clusters enhance cross-sectoral interactions.

Clusters encourages the development of networks for innovation. As significantly more innovation takes place in communities which have stronger inter-personal networks (Wear, 2008[114]), rural clusters can strongly enhance innovation in rural areas. By physically locating firms, entrepreneurs, researchers and inventors close to one another, clusters can contribute to the definition of new products and to learning, knowledge sharing and R&D at the regional level, as well as to the development of joint projects (OECD, 2019[78]). A space for interaction and exchange of ideas can generate knowledge and innovation spillovers, encourage the necessary innovation actors to remain in the regions and perhaps even attract external actors (OECD, 2019[78]). More broadly, clusters can have an active involvement in reskilling and upskilling the population.

Some clusters follow the logic of innovation by need or by resource, and in this context, the circular economy can create dynamics from the needs and resources of the territory (ANPP, France Clusters, INRA, 2016[112]). The rural environment offers an opportunity to contribute to the development of the circular economy, the economy of use and collaborative sharing (Deffobis, H., 2016[96]). The circular economy – as well as social innovation – is one of the topics most invested in by clusters (ANPP, France Clusters, Collectif Ville Campagne, 2016[115]). For example, in Kokkola Industrial Park (KIP) – the biggest inorganic chemistry cluster in Nordic countries –one firm's waste is another firm's input (heat, steam, gases, metals, etc.) (OECD, 2019[78]). Despite advantages, clusters can slow down entrepreneurial dynamism if they predominantly rely on local champion firms or mature industries. Therefore, it is essential that cluster policies in rural areas invest in the modernisation and diversification of local industry (OECD, 2019[78]).

Rural clusters help regions to identify and develop their competitive advantages. Clusters play a decisive role in creating and maintaining local economic ecosystems, thus anchoring development on the specific needs and resources of each territory. Many rural clusters have been able to take advantage of their local specificities, traditions and assets (Lundmark L. & Pettersson Ö., 2012[94]). The sectors of rural

[6] In most cases, they are made up of 5 to 15 companies, whereas urban clusters can be made up of hundreds of companies.

clusters are diverse but are often linked to agri-food and tourism (Table 2) (ANPP, France Clusters, Collectif Ville Campagne, 2016[115]). Some are more generalist and focused on different entrepreneurship support projects (e.g. Pays Beaujolais in France) (Deffobis, H., 2016[96]). Rural clusters can also increase practical knowledge about activities or sectors with under-exploited economic potential and about how new value chains should be organised (e.g. Green Bio-Refining Cluster in Denmark with the growing and processing of organic clover grass) (Martinidis et al., 2021[100]). Therefore, rural clusters have a significant role in smart specialisation strategies[7] and in fostering regional competitive advantages, as demonstrated in the case of Portugal cluster and regional smart specialisation strategies (Box 1).

Table 2. The main sectors of rural clusters

Sectors	Description and fields of activity	Rural cluster's example
Agri-food	Agro-resources, horticulture, livestock, product processing, new technologies involved in the transformation processes (e.g. monitoring, traceability, autonomous agricultural machinery, artificial intelligence, precision agriculture), commercialisation of organic products, wine industry, among others	North Savo and Arctic Smart Rural Community Cluster in Finland; EUVITA Cluster in Croatia
Tourism	Promotion of the territory through the specialisation in various niches (e.g. agrotourism, eco-tourism, cultural and historical tourism, elderly, families with children, sports and hiking, gastronomic tourism, or religious tourism)	ASTURAS Rural Tourism Cluster and CLUTUREX in Spain
Silver economy	Due to population decline and ageing in rural areas, this sector has the capacity to generate new business opportunities to provide a wide range of products and services (e.g. home personal and smart home services, accessible medical care, mobility, security and autonomy)	Interreg SUDOE's project ICT4SILVER in Spain and Portugal
E-services	Digitalisation of services (health, education, transportation, among others)	INNOLABS project in Norway, France and Spain
Bio-economy	Bioenergy, industrial biotechnology, biofuels, biorefineries, chemical industry, transport, recycling	H2020 BE-Rural project in Germany on circular economy; 3BI intercluster – Brokering Bio-Based Innovation in Netherlands, France, the UK and Germany
Construction	Sustainable construction, energy efficiency and renewable energy, eco-efficient technologies, circular economy	Cluster éco-construction in Belgium

Source: Authors' elaboration

[7] Conceived within the reformed Cohesion policy of the European Commission, these place-based strategies allow regions to identify strategic areas for intervention based on the analysis of the strengths and potential of the regional economy.

Box 1. Cluster building policies and smart specialisation in Portugal

Cluster building policies in Portugal rely on sectoral considerations and priorities identified in the national and regional smart specialisation strategies. The Norte region implemented its own cluster policies through its Norte Regional Operational Programme 2014-2020, which included a number of initiatives in favour of clusters such as the Internationalisation Incentive Schemes. These initiatives target Smart Specialisation industries in order to concentrate resources in projects and activities generating spillovers.

Recent cluster policies have successfully mobilised the public and private sectors and provide them with the necessary technical and financial support to foster greater collaboration. Since 2017, the Portuguese Agency for Competitiveness and Innovation (IAPMEI) led the recognition and establishment of 18 industrial clusters in various sectors of the economy. In addition, the Ministry of Economy and some clusters signed in 2019 several agreements (Sectoral Pacts for Competitiveness and Internationalisation) to implement collaborative actions in line with smart specialisation, such as training and skills development programmes, measures to promote industry 4.0 practices, innovation activities, and targeted reforms in the regulatory environment to address barriers to innovation and internationalisation in specific sectors and value chains.

Source: (OECD, 2022[97])

Rural clusters can support the sustainable development of rural areas through the creation of shared value. Rural firms and local communities provide mutual benefits to each other. This virtuous cycle is strengthened by clusters, which create social and environmental shared value[8] for the local communities (Martinidis et al., 2021[100]) and tackle wider rural socio-economic issues by upskilling the local workforce or fostering connectivity and climate-friendly solutions. Rural clusters can support the sustainable development of rural areas by bringing beneficial social consequences. A few benefits of clusters for rural innovation are summarized below:

- **First, rural clusters strengthen the regional attractiveness of territories.** Rural areas represent an opportunity for clusters to be « incarnated » in a place and to find a particular meaning for the products of firms, valorising a history and an identity (Deffobis, H., 2016[96]). This territorial connection is reflected by the promotion of local identity. The strategies of clustered companies in terms of local attractiveness, in particular through mutualised actions (e.g. brand image, labels, brands), benefit the territories where the clusters are located (ANPP, France Clusters, Collectif Ville Campagne, 2016[115]). Rural clusters also contribute to the promotion of their region by organising calls for proposals, training, advice and consultation – including for those interested in subsidies –, co-financing of local events, and promotional materials (Martinidis et al., 2021[100]).
- **Second, clusters can enhance connectivity and accelerate the digital transition of rural areas**. Rural clusters can be important instruments to accelerate technology adoption and diffusion and digital transition in rural areas (OECD, 2019[78]). They can support their members demanding skills by promoting reskilling, upskilling and talent attraction regarding digitalisation. Clusters in rural areas can also contribute to the adoption of ready to use IT solutions and digital business models in early-stage firms – with lower R&D and capital intensive. (EC, 2021[95]). In Värmlandin (Sweden), the rural cluster Paper Province and the Karlstad Innovation Park provided help to companies affected by the COVID-

[8] Despite having different literature definitions, the concept of “shared value” combines a business’s success with increased financial and social capital – added dimension of trust, relationships, and contact networks between people – for the community in which the said business is based.

19 crisis – wishing to set up and innovate new products and services – by developing and strengthening digital adaptability (Martinidis et al., 2021[100]).

- **Third, rural clusters have a positive environmental impact through innovations for local sustainable development.** Rural clusters can create new and sustainable technologies for emerging industries, generate new business opportunities and connect local firms to sustainable value systems (OECD, 2021[116]). Besides employing circular processes, clusters can also develop innovative green solutions for rural areas and help their members creating technologies, products, services and business models that are environmentally and climate-friendly (EC, 2021[95]). In addition, clusters can play a significant role in reducing regional carbon footprint. The Paper Province cluster in Sweden, for example, intends to increase knowledge on how forests play a major role in the transition to a fossil-fuel-free society (Martinidis et al., 2021[100]).

Rural clusters emerge to overcome rural challenges. In addition to population decline and ageing, rural areas and businesses face several challenges due to isolation and remoteness: lower broadband connectivity, higher costs of service delivery and transportation, higher distance to markets, industrial restructuring, as well as significant gaps in productivity and employment rates (OECD, 2020[9]). Faced with these challenges, innovation in rural regions often occurs through adaptive measures that try to overcome market and policy failures, with entrepreneurs in rural regions often creating innovative products and processes through an aggregation of smaller changes (OECD, 2020[9]). In this context, rural areas need to foster effective knowledge infrastructures and the spatial proximity of firms. The low population density makes it more difficult to meet and interconnect actors, promoters of ideas and projects, providers, customers, or funders (ANPP, France Clusters, INRA, 2016[112]). Of course, even then, proximity does not guarantee knowledge sharing and, by nature, proximity is difficult to achieve in rural areas. This is where cluster policies can play a role by forming specific actions and strategies to effectively connect.

3 Conclusions and Policy Messages

Building on the enablers of innovation absorption and diffusion, the following section outlines policy takeaways and key messages for policy makers.

Overcoming the challenge of distance and low economies of scale

While it has been long documented that economies of scale can boost productivity and innovation, policy responses have not fully exploited these when delivering programmes for areas with low density. In some cases, the challenges are related to the topography of the region, and may require heavy infrastructure and long term planning. In other cases challenges are solvable through policies to encourage economies of scale in low density areas, such as those that promote partnerships between regions within a functional area such as the economic development areas in the US (OECD, Forthcoming[17]) , the community futures programme in Canada (OECD, Forthcoming[32]) and partnership requirements in the Swiss Regional Innovation System (OECD, 2022[19]).

Increasing digital economic transition makes digital communication infrastructure a necessary, but insufficient condition for innovation in rural regions.

A growing number of OECD and G20 countries consider the Internet as a basic right for citizens, and many have changed their universal service frameworks to include broadband. Policies to enable access to critical digital communications infrastructure should include the following (OECD, 2021[35]):

- Promote broadband deployment, through competition and investment, and reducing network deployment costs.
- Encourage a sound regulatory and institutional framework, that considers reducing territorial disparities rather than set levels of national targets.

Closing the gap in communications infrastructure for rural regions requires going beyond over-arching nation-wide policies to policies that think about provision and access to regions often left behind.

Tailored policies and regulation to close connectivity divides in rural and remote areas are equally as important. In areas where market forces have not proven to be able to fulfil policy objectives (i.e. in terms of broadband coverage or service quality), additional interventions by governments may be necessary. Some of the tailored initiatives to bridge connectivity divides in rural and/or remote areas, in addition to promoting market forces and reducing deployment costs, include:

- demand aggregation models to ensure financial viability of projects,
- public private partnership (PPP) initiatives,
- public funding to expand connectivity in rural/remote areas, often making use of market mechanisms, such as reverse auctions, to provide funding to market players to deploy their networks in rural and remote areas,
- bottom-up approaches: open access municipal and community-led networks,
- addressing particular “the last mile” challenges in rural and remote areas, and

- coverage obligations in spectrum auctions (for wireless networks)

Innovation and mobility of people and skills

The widespread adoption of teleworking, accelerated by COVID-19, has led to rural regions being viewed increasingly as a viable alternative to living in cities. Some of those who can afford to have already voted with their feet, but not all rural regions are prepared to receive this new wave of city migrants.

Government leaders need to increasingly implement a rural lens on innovation policies that seek to attract innovative labour and resources to rural regions. This includes migration policy.

The attractiveness of regions are complex and multifaceted. Its application in the rural context is an ongoing subject of concern in many OECD countries (ESPON, 2012[117]; PoliRURAL, 2020[118]) and is still being defined (Melece, Kogut and Shena, 2020[119]). As such, the type and activeness of workers that governments seek to attract is important. For example:

- Keep older inter-regional migrants ("silver migration") active to bring knowledge and know-how to support rural innovation and entrepreneurship (ESPON, 2012[117]; Pernin et al., 2019[120]).
- Strengthen the offer of amenities and socio-cultural events (Pernin et al., 2019[120]), combining with longer-term growth strategies, to engage with youth.
- Enable flexible work-study apprenticeship programmes or on-the-job training, and quality in distance learning for youth in rural regions.
- Build partnerships and regional networks to encourage the flow of ideas and skills, and reduce the cost of moving for potential migrants (Rodríguez-Pose and Ketterer, 2012[121]), in a longer-term inter-regional migration strategy for innovation and entrepreneurship, such as those in Canada (OECD, Forthcoming[32]), Scotland (OECD, 2023[18]) and border regions in Switzerland (OECD, 2022[19]).

With all the benefits that remote work and interregional mobility can bring, there are structural aspects to consider in order to make rural regions an attractive option for high-skilled workers and innovative entrepreneurs.

As preliminary results suggest in France and Canada, teleworking results in positive spillover of skills to rural regions. Nevertheless, it is clear that housing, labour market, and social protection, access to education and governments services as well as business regulations shape the responsiveness of inter-regional migration (Causa, Abendschein and Cavalleri, 2021[122]; OECD, Forthcoming[32]). Digital connectivity among regions enables worker mobility for innovation, provides opportunities to address labour shortages, enlarging the job market in rural areas (Heuermann and Schmieder, 2018[123]).

Aligned with OECD (2021[124]), the following can help facilitate remote working for innovation:

- ensuring digital upskilling and remote skilling and learning opportunities;
- ensuring programs, policies and initiatives to improve digital infrastructure takes into account the challenges of individuals living in non-metropolitan regions;
- ensuring housing, social services and amenities in remote areas, in particular for families
    - this can include supporting community-led opportunities to incentivize mobility of young workers and families through affordable housing, child care and education;
- easing labour conditions to ensure that residential location is not a discriminatory factor in hiring.

Enabling innovation through firm-to-firm linkages

Firm-to-firm linkages can be the vessel of opportunity for firm-research innovation partnerships, competition-based innovation, as well as, trade and foreign investment-induced innovation.

Enabling innovation and the transfer of knowledge through University-Industry Linkages can close the gap to access to resources and training for innovation in rural regions.

Reducing the gap between firms and research entities can help overcome some of the challenges related to a relatively lower level of physical access to research institutes in rural areas. Initiatives to enable transfer of knowledge through University-Industry Linkages include:

- Specific programmes to link entrepreneurs in industry with researchers in universities or research institutions;
- Access to quality higher education tied to industry and opportunities in rural regions; and
- Reinforcement of the important role of rural universities or satellite universities for training workers.

Encouraging trade for rural firms can diffuse innovation through global-supply chains.

Trade linkages tend to be positively associated with innovation, with the act of getting firms to their first trade partners as particularly advantageous for rural firms. While the association with innovation and trade tends to be positive, there is still a penalty for rural firms. Furthermore, while still helpful, it is not clear that foreign investment and foreign ownership are as positively associated with innovation to the same extent in rural areas as they are in urban areas. More research is needed on understanding such mechanisms. Practices in enabling trade for rural firms include:

- Regional export agencies that promote local rural trade and services;
- Export training programmes focusing on building skills for trade such as live group training and remote counselling in engine optimization, improved social media content for digital presence, sector-specific advice on market expansion and motivational exercises.

Increasing clusters tailored to rural communities and cross-cluster collaborations is needed.

In rural areas, low density of population, firms dispersion, weak physical infrastructure and long distances to metropolitan areas, are a challenge to the creation of clusters and their ability to contribute to regional development. The proliferation of cluster-specific regional policies in OECD countries, however, can enable policy-makers and rural clusters to learn from good practices with recommendations, such as the following:

- **Strengthen empirical research on the preconditions for cluster development in rural and sparsely populated areas.** As the concept of cluster in policy on the regional level is used without references to empirical evidence from relevant geographical settings, it is therefore necessary to develop more empirically based research on the preconditions for cluster development in rural and sparsely populated areas (Lundmark L. & Pettersson Ö., 2012[94]), with a set of relevant indicators.
- **Create monitoring frameworks and requirements for frequent policy evaluations** is fundamental in order to assess and improve the performance of clusters, such as in the case of Portugal with two annual monitoring exercises that allows rural regions such as Alentejo to assess the effectiveness of cluster strategies and evolve with global value chains (OECD, 2022[97]).
- **Encouraging dialogue and political buy-in with political actors in the process of activating innovation potential of local resources.** The success of rural clusters largely depends on elected representatives supporting a global development strategy for the territory. In order to guarantee political involvement, it is essential that clusters implicate elected representatives as much as possible (e.g. meetings, presentation of projects, etc.) (ANPP, France Clusters, INRA, 2016[112]).

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Unlocking Rural Innovation via Networks and Rural-Urban Linkages

This report examines the role of networks and rural-urban linkages to absorb and enhance innovation in rural regions. It places a special focus on the distinctive characteristics of rural areas that drive the different ways they adopt and diffuse innovation.

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