Digital divide hinders rural innovation, study shows

June 12 2023, by Kristen Devlin

A study by researchers at Penn State and National Science Foundation found that when rural businesses can access the cloud, they do so at similar rates as urban firms, and they engage in a similar volume of innovation. Credit: Jason Goodman on Unsplash

Cloud-based computing directly contributes to business innovation, but rural businesses lacking sufficient broadband capacity to access cloud services are missing out on their innovation-boosting potential, according to a team of researchers from Penn State and the National Science Foundation. The findings can be used by policymakers and business-support organizations to foster greater opportunities for rural innovation.

"Innovation plays a critical role in keeping businesses competitive and viable, and in turn, healthy businesses are essential to vibrant rural economies. Therefore, we're interested in understanding how best to support innovation among businesses, particularly rural businesses," said Luyi Han, a postdoctoral scholar at the Penn State-based Northeast Regional Center for Rural Development.

"Our findings provide concrete evidence that when rural businesses can access the cloud, they do so at similar rates as urban firms, and they engage in a similar volume of innovation."

The study, published in the journal *Telecommunications Policy*, is the first to demonstrate that the use of cloud computing services contributes to business innovation, according to Timothy Wojan, a fellow with the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation, and a co-author of the study.

"We knew from earlier research that firms that subscribe to cloud services also report more innovation activity, but we didn't know whether using the cloud actually enables innovation or is simply an indicator of an already innovative business," said Wojan. "In this study, we used a relatively new and very detailed data set known as the Annual Business Survey, which allowed us to isolate any innovation-enabling effects of the cloud."

The Annual Business Survey (ABS), which is conducted jointly by the

U.S. Census Bureau and the NCSES, provides detailed data on U.S. firms, including their adoption of cloud computing and the different kinds of innovation they engage in.

Using this data set, the researchers conducted a statistical analysis known as propensity score matching, in which they constructed groups of firms that are similar in terms of size, industry, age of the firm owner, and other variables known to affect innovation. Then they isolated firms that have adopted cloud computing from those that have not to compare their innovation activity.

"Propensity score matching allowed us to compare apples to apples, so to speak," said Han. "By comparing firms that are similar in all respects except for their use of the cloud, we can be sure that any differences in innovation activity we see are a result of their cloud use."

The researchers found that cloud adoption enables innovation, and the effect tended to be stronger on innovations in marketing and business practices than on other types, such as process innovation or new product development. For example, firms that use a cloud service are almost 6% more likely to report new-to-market innovation than a firm not using the cloud.

This is expected as many marketing and business practice innovations rely on digitalization such as point-of-sale tracking or document control whereas process and product innovation may depend less on new computing capabilities.

Cloud-based services provide access to computing resources over the internet, allowing businesses to store data, access software applications and more, through online platforms such as a web browser or smartphone app. As a result, businesses often can replace in-house IT infrastructure with solutions that are generally more scalable, flexible

and cost-effective. It's therefore not surprising that its uptake creates opportunities for innovation, said Han.

"The cloud reduces the need for large up-front IT costs, so it reduces the cost of experimenting," Han said. "Firms and their investors can make smaller investments in a larger number of ideas."

The researchers also considered the rural-urban status of the firms in their study and found that use of cloud computing boosted innovation at similar rates across nine categories of community size, ranging from very small, rural towns to large metropolitan centers.

"There is a misconception that innovation is limited to big cities and companies with large research and development budgets," said Stephan Goetz, professor of agricultural and regional economics at Penn State and director of the Northeast Regional Center for Rural Development, and a study co-author. "Our findings suggest that lower rates of business innovation seen in rural areas can be partially explained by their more limited access to the broadband speeds required to access the cloud."

Goetz also noted that the team's ability to carry out this research hinged on their access to Penn State's Census Research Data Center, one of 33 Federal Statistical Research Data Centers in the country. Han and Wojan went through a high-security clearance process to access the ABS data, one of several data sets used by the research team as part of a multiyear project led by Goetz examining innovation in rural communities and ways for communities to support rural entrepreneurs.

More information: Luyi Han et al, Experimenting in the cloud: The digital divide's impact on innovation, *Telecommunications Policy* (2023). DOI: 10.1016/j.telpol.2023.102578