

Innovation flows across regions and sectors in complex ways, study shows

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Knowledge creation—the generation of new ideas and patents—is an important driver of economic growth. Understanding how knowledge moves across industry sectors and regions can inform research and

development (R&D) efforts, promote university-industry partnerships for innovation, and impact private businesses' location decisions. A new study from the University of Illinois in collaboration with Stockholm University and Korea Labor Institute provides a thorough look at the flow of knowledge in five industrial sectors across the United States.

"Our work provides a sort of cooking recipe for patent creation, with a list of ingredients that vary by industrial sector," says Sandy Dall'erba, professor in the University of Illinois Department of Agricultural and Consumer Economics (ACE) and director of the Center for Climate, Regional, Environmental and Trade Economics (CREATE) at U of I. Dall'erba is a co-author on the study.

"Some sectors depend very much on local input factors, such as the presence of a university, versus elements located further away, such as spending in R&D by another private company. In some cases, this type of collaboration takes place across companies located thousands of miles apart as virtual meetings increasingly have replaced face-to-face meetings," Dall'erba states.

"In addition, our research measures the extent to which innovation in one sector depends on R&D in the same sector or other sectors. For instance, new patents in the drug and medical industry depend on local and distant R&D in the chemical industry."

Traditionally, geographical proximity was considered essential for [knowledge](#) flows. Clusters such as Silicon Valley's high-tech industry or Detroit's automobile industry facilitate face-to-face interactions and informal networking. Economists now acknowledge innovations may be shared across greater distances, but most studies have looked at aggregate results rather than location- and industry-specific patterns.

"We wanted to see the importance of geography for the patterns of

knowledge creation in specific industries. We also wanted to examine how information flows across similar or different industries. Finally, we look at spillovers from private and university research and development activities," says lead author Orsa Kekezi, a scholar at the Swedish Institute for Social Research at Stockholm University. Kekezi began working on this research while she was a visiting scholar at Illinois.

The researchers analyzed knowledge transfers across 853 metropolitan U.S. counties in five manufacturing industries: chemical, drugs and medical, mechanical, computer and communication, and electrical and electronic.

The study uses patent applications as a proxy for knowledge creation, tracking the flow from where patents are created to where they are cited (based on data from the U.S. Patent and Trade Office). This measures the directionality of innovation and identifies the role of external factors in knowledge output.

The core elements in the analysis are intra- and inter-sectoral knowledge spillovers, as well as intra- and interregional flows, defined as local (within county), short distance (neighboring counties in 50-mile radius), and the rest of U.S. (beyond 50 miles). The researchers also looked at the presence of university and private research and development, as well as other factors, such as the number of graduate degree holders and the industrial diversity in a county.

"Overall, the local environment matters greatly for all the sectors. The industry structure in the region, the size of firms, whether there is a university—these elements all matter for innovation. All sectors benefit from the local environment," Kekezi states.

But the specifics vary by sector and provide a complex picture of [interactions](#). There is no one-size-fits-all approach for the development

of patents, and if you look at average results, you'll miss the intricate details and patterns across sectors and regions.

"While university research matters for all the sectors, there is large heterogeneity here as well," says study co-author Dongwoo Kang, a research fellow at the Korea Labor Institute, South Korea. "For example, it matters more for the chemical industry and the drugs and medical industry; those sectors really benefit from basic research.

"Universities provide the core research that is needed for the chemical industry to work. Unlike perhaps the mechanical or electric industries, the chemical industry relies more on faculty scholars who are looking at basic processes," he adds.

Interregional spillovers matter less in the chemical industry, so face-to-face contact is important. On the other hand, for the drugs and medical industry, both inter-sectoral and long-distance regional spillovers matter, so geographic proximity is not as necessary. And for the electrical and electronic industry, inter-sectoral short-distance spillovers play a significant role.

The study findings can help companies decide where to locate their establishments.

"The idea that a company values proximity to a university, or where research and development are already happening, still holds true. But we also show the [network](#) of innovation is not completely local," Dall'Erba states.

"The main takeaway from the paper is that we should not only look at local spillovers. We should look at knowledge that comes from further away, and from other industries," Kekezi notes. "New ideas don't come only by looking at what has been done in one's field, but also from

looking at the broader picture and how we can combine different types of knowledge to create something new."

The development of COVID-19 vaccines serves as an example, Kang adds.

"The U.S. invested a lot of money in research and development to stimulate innovation in creating the first COVID-19 vaccines. This is typically done through a central cluster that serves as a basis for innovation. But there are also other networks making new COVID-19 vaccines. Our findings imply that not only local activities, but also research and development in other places are important for making new COVID-19 vaccines," he explains.

The findings can also help improve the design of future local and national innovation policies.

"We need to move away from an approach whereby everything is driven by similar mechanisms and instead understand much better what really works for one industry might be quite different from what works for another industry. It's not just about promoting industry clusters; it's more complicated than that. When governments try to promote [innovation](#), they need to define a strategy that works for a specific industry and a specific location," Dall'erba says.

More information: Orsa Kekezi et al, The role of interregional and inter-sectoral knowledge spillovers on regional knowledge creation across US metropolitan counties, *Spatial Economic Analysis* (2022). [DOI: 10.1080/17421772.2022.2045344](https://doi.org/10.1080/17421772.2022.2045344)

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