Study details the quirky geography of knowledge-sharing

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Credit: Christine Daniloff

Scholars have long been interested in tracking "knowledge spillovers," the way technical and intellectual advances spread among communities of researchers and innovators. And a significant body of work has shown that distance matters when it comes to the dissemination of knowledge: advances are more likely to be noted by those nearby to the advance's origin.

Now a new study co-authored by an MIT assistant professor adds a wrinkle to this issue: National and state boundaries have a distinctly limiting effect on knowledge spillovers, as revealed by an examination of roughly 30 years of data on patent citation. A patent is less likely to be

cited by someone working, say, 100 miles away from its point of origin if that distance means crossing a state line, within the United States, or a country line, around the world. The spread of knowledge has a clear geopolitical shape.

"When people tend to work in the same geographic areas, knowledge tends to get shared, not just within companies, but between them," acknowledges Matt Marx, an assistant professor in the MIT Sloan School of Management. "Some people have said this is all about distance, and the closer you are, the more the knowledge is flowing. But we find that there is a state [border] effect, although it's getting weaker over time." More puzzlingly, however, he notes, "The country effect is getting stronger."

In a paper presenting the research, published in the journal *Management Science*, Marx and Jasjit Singh of Singapore's INSEAD business school summarize their findings, based on more than 4 million citations of private-sector patents spanning the years 1975 to 2004. They conclude that citations of patents among firms are 1.3 times as likely to spread a comparable distance when within one country, and not crossing any borders; more than two times as likely to spread a comparable distance when within a U.S. state; and nearly three times as likely to spread when within one metropolitan region within a state.

Simultaneous study

The concept of knowledge spillovers date to the famous economist Alfred Marshall in the 1920s, and gained considerable popularity as a subject for empirical study in the 1990s. Most of those studies, however, have examined patent data at one geographic level at a time—the country, state or metropolitan area. By looking at all three at once, the current study could compare the flow of knowledge across comparable distances, but in circumstances where the political borders varied.

"It's not just how many miles are between researchers," Marx says. "You might think that, with the Internet, those borders shouldn't matter. But they do."

Indeed, Marx and Singh found that patents generated within just 20 miles of a state border are considerably more likely to be cited within the state of origin than in the neighboring state. And even in the roughly 60 metropolitan areas in the United States that are situated in multiple states—such as the Cincinnati area, which is based in Ohio but also extends into Kentucky and Indiana—patents are again more likely to be cited in the state of origin.

The research paper's primary focus is on establishing the empirical landscape of knowledge flow. But Marx suggests a few reasons why knowledge spillovers take the shape they do. For one thing, he says, the still-existing but receding state-level effect in the United States could reflect increased adoption, since the 1990s, of online patent databases. Alternately, it may be that many patent citations are added, as a protective measure, by law firms with specialized local knowledge.

On the international front, it is not especially hard to list possible restrictions on knowledge spillovers: "You might imagine that borders, language, currency, and immigration tend to keep people [and knowledge] in the same places," Marx says. But there are other categories of reasons that could explain some of the phenomena, too.

"It could be that U.S. industries are becoming more specialized," Marx says. That would lead to fewer knowledge spillovers because the innovations would be less applicable among countries.

As Marx notes, perspectives may also differ on the value of that knowledge flow. Local or regional political or business leaders might want to maintain the local impact of knowledge spillovers; one might

also see it as an affirmation of the value of research clusters, or as a spur to create more of them in more localities. But others might prefer to see knowledge flow more easily across boundaries.

"It depends where you're sitting," Marx says.

'Interesting, puzzling'

The study is based on citation data sourced from the U.S. Patent and Trademark Office, which include international patents filed in the United States. The cities used in the study come from a definition of metropolitan areas with surrounding commuting zones issued by the U.S. Office of Management and Budget in 2003.

Other scholars in the field say the findings are notable, and call for further research that can shed light on the precise dynamics shaping the flow of knowledge.

"It's an interesting paper that presents a puzzling fact," says Olav Sorenson, a professor at the Yale School of Management, who is familiar with the findings. When it comes to the transmission of knowledge, he adds, "we had not known whether within-country borders have an effect," but Marx and Singh "have demonstrated quite convincingly that metropolitan areas and state borders restrict the flow of information."

And yet, Sorenson adds, "In order to determine whether it would lead to any policy recommendations, it's crucial for us to understand the underlying mechanism" behind the effect Marx and Singh have found.

For his part, Marx agrees that the paper suggests ways that follow-up research is needed by scholars in this area of study.

"The role of this paper is really to establish some empirical facts and raise questions," Marx says. "The idea is to get those facts on the table, and future work can focus on figuring out the mechanisms at work here."

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