

Why innovation thrives in cities

June 4 2013, by Larry Hardesty

In 2010, in the journal *Nature*, a pair of physicists at the Santa Fe Institute showed that when the population of a city doubles, economic productivity goes up by an average of 130 percent. Not only does total productivity increase with increased population, but so does per-capita productivity.

In the latest issue of *Nature Communications*, researchers from the MIT Media Laboratory's Human Dynamics Lab propose a [new explanation](#) for that "superlinear scaling": Increases in urban [population](#) density give residents greater opportunity for face-to-face interaction.

The new paper builds on previous work by the same group, which showed that increasing employees' opportunities for face-to-face interaction could boost corporations' productivity.

In those studies, the researchers outfitted employees of a bank, of an IT consulting firm, and of several other organizations with tiny transmitters, developed by the Human Dynamics Lab, that actively measured the time the wearers spent in each other's presence. Obviously, that approach wouldn't work in a study of the entire populations of hundreds of cities.

So Wei Pan, a PhD student and first author on the new paper, looked at a host of factors that could be used to predict what the researchers are calling social-tie density, or the average number of people that each resident of a city will interact with in person. Those factors include things like the number of call partners with whom a [cellphone user](#) will end up sharing a [cell tower](#), instances of colocation with other users of

location-tracking social-networking services like Foursquare, and the contagion rates of diseases passed only by intimate physical contact.

The availability of different types of data varied across the hundreds of cities in the United States and Europe that the researchers considered. But Pan and his colleagues concocted a single formula that assigned each city a social-tie-density score on the basis of whatever data was available. That score turned out to be a very good predictor of each city's productivity, as measured by both gross domestic product and patenting rates.

Planning for productivity

"When you pack people together, something special happens," says Alex "Sandy" Pentland, the Toshiba Professor of Media Arts and Science and director of the [Human Dynamics](#) Laboratory. "This is the sort of thing that Adam Smith wanted to explain. He explained it through specialization: People were able to narrow what they did to get better at it, and because they were nearby, they could trade with each other. And Karl Marx described a different kind of specialization, which is classes—management class, owner class and proletariat. And other people have come up with other explanations for this basic phenomenon."

What the new work shows, Pentland says, is that "a lot of the things that people have been arguing about for centuries are not actually things that need explaining. They just come from the basic pattern of social networks."

The work could, however, have very real consequences for urban planning. For instance, Pentland says, there's evidence that the principle of superlinear scaling does not hold in poor countries, even in cities with the same population densities as major European and American cities.

"The reason is that the transportation is so bad," Pentland says. "People might as well be in the village, because they only interact with their little local group."

Similarly, Pan says, "People know that when a city's population grows, there's scaling, and the productivity increases. But in these megacities, especially in China, no one knows whether that scaling will continue, because no other city is that big."

In Beijing today, Pan says, "it's really hard to move from one side to the other. I believe, personally, that social-tie density will drop because you can't really move freely anymore with the population increases. Unless Beijing solves these transportation problems, pumping in more people won't continue to drive the density."

Pentland adds that another figure that usually scales superlinearly with urban population is crime. But an exception to that rule is Zurich. "For various reason, its population has exploded in the last 20 years," Pentland says. "And they knew this was going to happen because of demographics. So they invested just an unholy amount of money in public transportation. You end up with this cloud of towns around Zurich, but everybody can get into Zurich in 15 minutes. More than 60 percent of the population moves into the center of Zurich during the day." As a consequence, Pentland says, Zurich enjoys all of the productivity benefits of social-tie density with much lower crime rates.

"In the next 10 years, we expect that India and China will each build a hundred cities of a million people or more," Pentland says. "Hopefully, what we can do is help them make better choices in designing these cities."

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