

# Researchers find 'large is smart' when it comes to cities

**Cities are considered by many to be a blessing and a curse. Large cities generate considerable wealth, they are home to many high paying jobs and are seen as engines of innovation. But cities also generate pollution, crime and poor social structures that lead to the urban blight that plagues their very existence.**

Now a team of researchers, including an economist from Arizona State University, have studied the growth of cities in different parts of the world and have come up with general equations that can foretell their consumption of resources and their contributions to society. The work has debunked the notion that cities act like biological organisms, that once they start they grow, and consume and contribute at predictable linear rates.

"It's true that large cities have more problems, they are more congested, they create more pollution and they have more crime," said Jose Lobo, an ASU economist in the School of Sustainability. "But also because of their size, cities are more innovative and create more wealth. Large cities are the source of their problems and they are the source of the solutions to their problems."

The researchers working with Lobo -- Luis Bettencourt of Los Alamos National Laboratory, Los Alamos, New Mex.; Dirk Helbing and Christian Kuhnert of Dresden University of Technology, Germany; and Geoffrey West of the Santa Fe Institute, Santa Fe, New Mex. -- detailed their findings in the article "Growth, innovation, scaling and the pace of life in cities," in the current issue of the *Proceedings of the National Academy of Sciences*. An on-line version of the article was published on April 16, 2007.

"Humanity has just crossed a major landmark in its history with the majority of people now living in cities," the researchers state. "The inexorable trend toward urbanization worldwide presents an urgent challenge for predictive, quantitative theory of urban organization and sustainable development."

This will require thinking about cities in new ways, they add.

The old way of thinking about cities is as if they are an organism, which consumes resources and grows in size. Oftentimes, cities are referred to as its own ecosystem and many use the metaphor of it acting like a biological organism, Lobo said. But the team found that this was a false metaphor.

"The one thing that we know about organisms whether it be elephants or sharks or frogs, is that as they get large, they slow down," Lobo said. "They use less energy, they don't move as fast. That is a very important point for biological scaling."

"In the case of cities, it is actually the opposite," he added. "As cities get larger they create more wealth and they are more innovative at a faster rate. There is no counterpart to that in biology."

In fact, Lobo said, the larger the city the greater return on investment.

The researchers base their findings on data on the growth of cities (large urban areas) in the U.S., Europe and China over the past 150 years. They measured cities consumption of resources, (such as water usage), requirements for infrastructure (roads, transportation, lengths of electrical cable) and then measured the creative output of these areas (patents issued, "super creative jobs" generated, R&D employment, total wages). The size of the cities were determined by population.

What they found were some general correlations of size and resource consumption that more or less fit the

biological organism metaphor, meaning as the city grew in size it required less energy (resources) to sustain it in a proportion called sublinear scaling. What was surprising to the team was when they measured creative output (jobs, wealth generated, innovation) as cities grew, the scaling of this output was not sublinear, but superlinear, meaning as the city grew its creative output grew faster and faster.

"It isn't like if you double the size of a city you double its creative output," Lobo said. "The increase you get in wealth creation is greater than the increase in size of the city."

That ratio can range from 1.13:1 when measuring the gross domestic product in Germany, to 1.34:1 when measuring private R&D employment in the U.S.

"We are not saying that any large city is assured of prosperity forever, but if you look at the collection of cities, large cities have managed to out run their problems," Lobo added. "Large is smart."

All of this points to the need of rethinking large cities, both in how they are managed and what they contribute to the greater good. This is especially true today, as cities are on the brink explosive growth. Today a little more than half of the world's population live in large urban areas. By 2030, it is estimated to be two-thirds of the world's population will be living in urban areas.

"Cities are really one of the most important innovations in humans history," Lobo said. "We need to think of them as being very human entities and as engines of creation. We need a different perspective about cities, one that is away from thinking of large cities as a source of problems but as possible sources of solutions."

"The practical application of this work is that the problem is not large cities, the problem is the conditions in which some of the people live in large cities," Lobo added. "Policies should be directed to making large cities more livable not making them smaller."

Source: Arizona State University

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