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VIEWPOINT

U.S. Office

What do advances in automation promise for U.S. office demand?

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- Among the CRE sectors, Office currently appears to face the greatest potential loss of demand as technology continues to automate the tasks that make up occupations.
- Based on Oxford University's recently published probabilities for the future automation of 700+ occupations, EA has estimated the exposure of individual U.S. office markets to job automation as a risk.
- Smaller U.S. office markets tend to have concentrations of the jobs most subject to automation; risk exposure generally decreases as market size increases.
- Some office-occupying occupations may be lost, but others will rise in their place—long term, these occupations need not be equated with demand.

BACKGROUND

We are awash in the digital exhaust of human activity, with terms like *big data*, *machine learning*, and *artificial intelligence (AI)* now common (if imprecisely used) in everyday speech. The wave has been long in coming, as automation is not new. The automation of tasks—and their modern equivalent, jobs—has been a prominent part of economic development throughout human history. Consider printing: the invention of the woodblock in China, c. 200 CE; the invention of the Gutenberg press (allowing mass dissemination of information for the first time), c. 1440; and the slow process of advancement that occurred in the interim. Ultimately, automation in printing would give rise to photography, laser printing and the 3D printer, with the last of these combining the digital and the physical to potentially create almost any object.

Although the 15th Century saw scribes lose their source of income as printing became automated, no one would now suggest that we are worse off as a result. As this process of automating physical tasks has played out in virtually every area of human production, wages, incomes, and living standards have simultaneously increased—immensely—as the stock of human capital has grown via increased education and training and the specialization of labor. As economist Brad DeLong notes, productivity and living standards are now 20 times the levels that prevailed prior to Gutenberg inventing his press. Moreover, current annual economic growth rates of 2% are 100 times higher than those that prevailed before the Industrial Revolution.[1] While we can—and probably should—debate how to offset the short-term job losses that result from automation, it is undeniable that living standards are higher in aggregate as a result of it.

The earlier epoch of automation, which saw machines like Gutenberg's press invented to take over or speed physical tasks, has been called the First Machine Age. The so-called Second Machine Age involves the automation of intellectual tasks using electronic computers and algorithms.[2] Indeed, one of the earliest electronic computing devices, in the late 1940s, was described as "an electronic brain." Now, much of the ever-growing discipline of computer science is focused on automating intellectual tasks using algorithms that scale to analyze massive datasets. It has been suggested that the Second Machine Age may differ from the first in that the automation of intellectual tasks will result in wide-scale and permanent job loss "as the robots take over."[3]

CURRENT CONTOURS: BIG DATA, MACHINE LEARNING AND AI

Big data covers the size, scope, and scale of the digital exhaust that we create every day, frequently with a geospatial component. Consider the *Uber* app, which employs a geospatial matching algorithm to create a market between drivers and passengers at prices that vary depending on time of day or local weather conditions. **Machine learning** is an old phrase that has gained new luster through its highly successful application to almost every aspect of daily life.[4] Consider Netflix's movie recommendation system, which is able to make recommendations to users based on how they and their social network contacts have viewed and rated other movies. Finally, **AI**—still a vague concept that is frequently misused in the popular press—is clearly something much more than standard machine learning algorithms that make movie recommendations. In the sense of a universal learning algorithm, as described by computer scientist Pedro Domingos, AI does not currently exist.[5] Nevertheless, current advancement in machine learning, combined with big data and sometimes manifested in robotics, suggests that automation will continue to have a substantial impact on employment in the future.

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[1] Brad DeLong, "Economic history: The roots of growth," *Nature,* 538, 456–457 (27 October 2016).

[2] Erik Brynjolfsson and Andrew McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies,* W.W. Norton Company, Inc., 2014.

[3] As a matter of basics economics, there is a fundamental trade-off between leisure and work, given that there are only 24 hours in a day, and leisure is the economic "good." Holding income constant, we are better off with more leisure time.

[4] Stanford University statisticians Trevor Hastie and Robert Tibshirani (and others) prefer the more accurate term "statistical learning," which is the application of statistical models or algorithms to real-world data, however generated, to make predictions or to draw inferences regarding hypotheses. In other words, it is something the economists at CBRE Econometric Advisors do on a daily basis.

[5] Pedro Domingos, *The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World,* Basic Books, 2015.

IMPLICATIONS FOR JOBS AND COMMERCIAL REAL ESTATE

It can be useful to think about a "job" as a bundle of tasks performed by a single individual in the workplace. Such jobs vary in the mix of tasks that they comprise, and these tasks can be judged to be automatable or not in the near term, given current technology and expectations for technological change. This is the exercise that Oxford University researchers completed in 2013, categorizing more than 700 U.S. occupations based on the mix of knowledge, skill, and physical ability that each requires.[6] Identifying impediments to the automation of specific tasks, they used a standard machine learning algorithm to estimate the *probability* that a given occupation is automatable, based on its mix of tasks.

Generally speaking, tasks associated with perception and dexterity, creative intelligence, and social perceptiveness are subject to impediments to automation. They found, for example, that musicians are only 7% likely to be automated. Packagers face a 38% likelihood; merchandise displayers, 48%; and legal secretaries are almost certainly automatable. Employing U.S. Census data, the study finds that nearly half of the U.S. workforce is concentrated in occupations that have a 70% or greater likelihood of being automated.

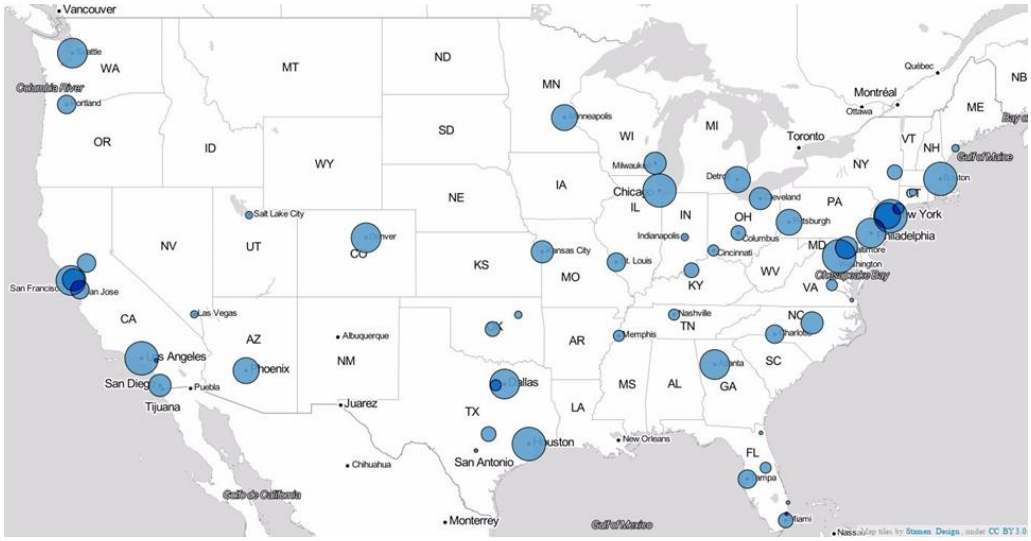
Because automation's most direct mechanism for affecting commercial real estate is to alter demand trends for existing space, Econometric Advisors has classified the Oxford study's 700+ occupations according to the type and size of commercial real estate they occupy. Legal secretaries occupy office space, packagers occupy industrial space, and merchandise displayers occupy retail space, for example. As legal secretaries' eventual robot replacements are unlikely to require office space, automation of that occupation will directly impact the demand for existing office space. Meanwhile, packagers will be replaced by robots that need, on average, at least as much space as the humans they replace, so automation will have limited impact on the demand for industrial space. Finally, merchandise displayers do not occupy much retail space to begin with, but the space liberated in automating this function will be replaced with additional merchandise, so this should have no impact on retail space demand. All in all, we think it is existing office space that is most at risk from automation.

WHERE IS THE OFFICE STOCK AND WHAT'S AT RISK?

In our more than 60 Tier I markets, we track about 4.8 billion sq. ft. of existing office stock. This office space is highly concentrated in key markets, with 56% of it in the largest 15 (23% of markets), and nearly 71% in the largest 25 (40% of markets). Figure 1 shows the distribution of office space across the continental U.S., with the relative size of each market's existing office stock indicated by its bubble size. One can see concentrations of existing office space on the coasts, with substantial inland markets in Atlanta, Chicago, Dallas, and Denver.

[6] Frey and Osborne, "The Future of Employment: How Susceptible Are Jobs to Computerisation?" Working Paper, September 17, 2013.

Figure 1. Where is the Office Stock?



Source: CBRE Research, 2017.

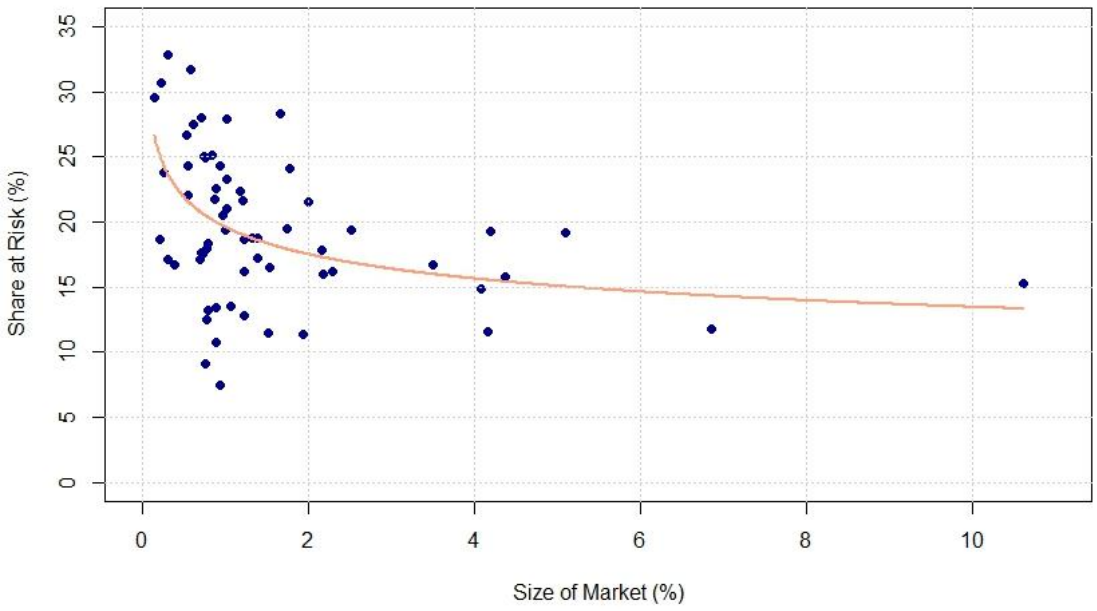
Having assigned each of the Oxford Study's 700+ occupations to a property type, it is possible to use the study's automation probabilities to calculate the share of each market's office stock that is at risk from automation. In aggregate, automation would put demand for approximately 18% of existing office stock at risk. Figure 2 displays this risk by market, with the size of each bubble proportional to the at-risk share of that market's existing office stock. You'll notice that Figure 2 is considerably different than Figure 1. Almost all of the larger markets are relatively immune to automation, as their existing office space is occupied by jobs that are the least subject to automation.

Figure 2. What is at Risk?

Source: CBRE Research, 2017

Automation that reduces demand for office space represents a non-trivial risk for all markets. The risk, however, tends to decrease as the size of the market increases. Figure 3 illustrates this; the point furthest to the right in the chart, for example, is New York City. In contrast, highest point on the plot is Wilmington. The curve on the chart fits the data easily, and makes the point more concrete. We find concentrations of the jobs most subject to automation in smaller U.S. office markets. Many of the points clustered below and to the left of the curve are state capitals, such as Albany, Oklahoma City, and Raleigh.

Figure 3. Selected Economic Indicators: Recession-Period Changes



Source: CBRE Research, 2017.

As a matter of economic history, the so-called Second Machine Age should be seen as part of a long-term trend in automation that goes back centuries. It is a process that has dramatically increased living standards because, through education, training, and specialization, human capital and physical capital are complimentary. Some occupations may disappear completely, but new and higher-paying occupations arise in their place. As such, the Second Machine Age may be far less disruptive to employment—and therefore to commercial real estate—than the Oxford University study suggests.

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