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# The Healing Economy: An Economic Development Framework for Cleveland

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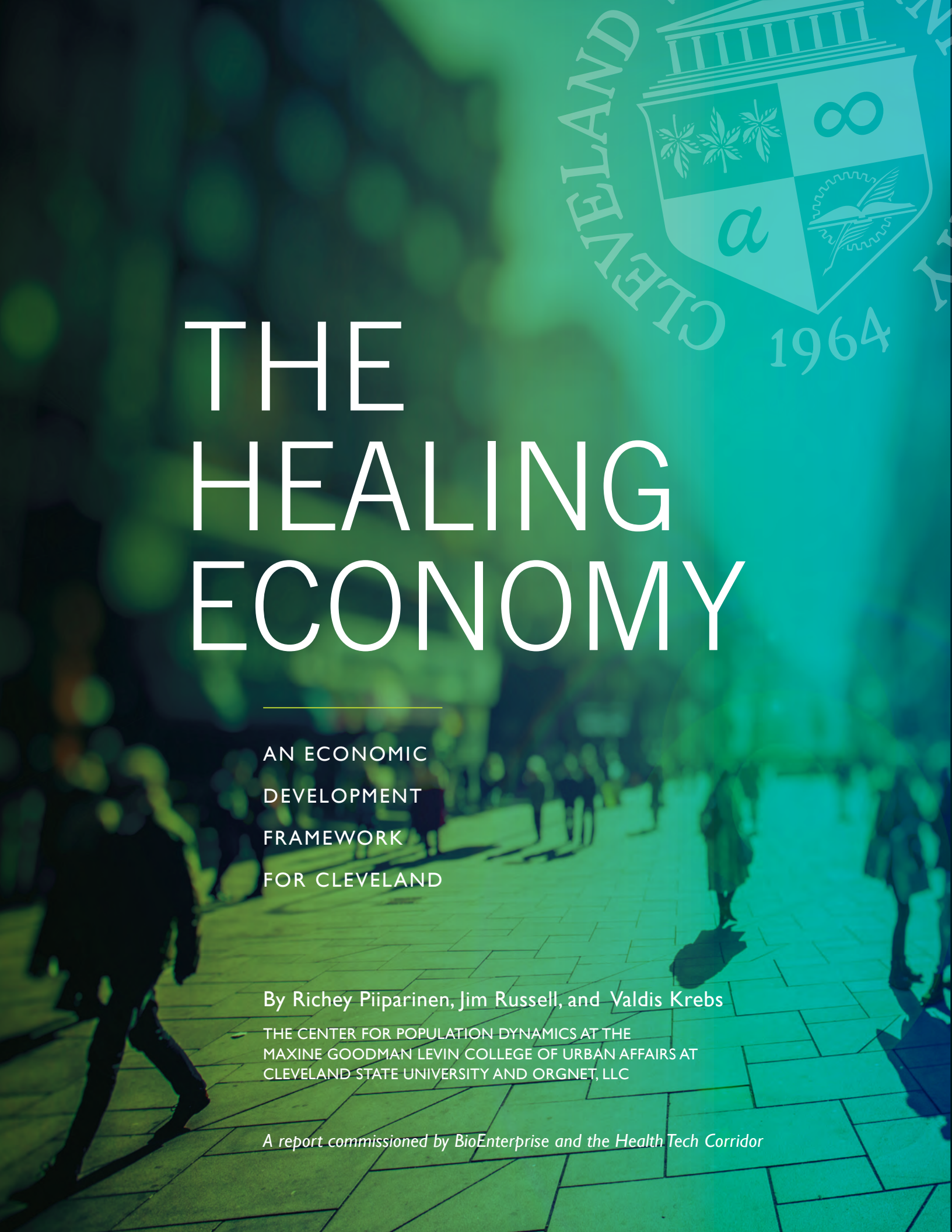

# THE HEALING ECONOMY

## AN ECONOMIC DEVELOPMENT FRAMEWORK FOR CLEVELAND

By Richey Piiparinen, Jim Russell, and Valdis Krebs

THE CENTER FOR POPULATION DYNAMICS AT THE
MAXINE GOODMAN LEVIN COLLEGE OF URBAN AFFAIRS AT
CLEVELAND STATE UNIVERSITY AND ORGNET, LLC

*A report commissioned by BioEnterprise and the Health Tech Corridor*


Maxine Goodman Levin
College of Urban Affairs

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# Executive Summary

- The Cleveland metro has the densest health science labor market in the nation, with 14.5% of the region's workforce employed in high-skilled healthcare delivery. Cleveland is ahead of Philadelphia (14.1%) and Boston (14.1%).
- Since 2002, healthcare and social assistance jobs in Cuyahoga County increased from approximately 104,500 to 131,700, with the aggregate income from those jobs growing from an inflation-adjusted $4.8 billion to $6.9 billion in 2016.
- A significant amount of Cuyahoga County's healthcare jobs are clustered in Cleveland's Health Tech Corridor. In 2003, 26.4% of all healthcare and social assistance jobs in Cuyahoga County were in the Health Tech Corridor, increasing to 36.2% by 2015.
- Total employment in the Health Tech Corridor increased from approximately 41,200 in 2002 to 75,000 in 2015—a gain of 82%. Also, about 1 out of every 20 jobs in Cuyahoga County were in the Health Tech Corridor in 2002, increasing to 1 out of 10 by 2015.
- Much of the year-over-year job growth in the region is happening in the Health Tech Corridor. From 2014 to 2015, 25% of all job growth in the Cleveland metro occurred in the Health Tech Corridor, whereas 39% of Cuyahoga County's job growth happened in the corridor.
- The job growth in the Health Tech Corridor is associated with increased real estate valuations. Inflation-adjusted assessed values for all property types in the corridor went from $3.85 billion in 2009 to $4.72 billion in 2015—a gain of 23%.
- The clustering of healthcare services in Cleveland—termed a "knowledge cluster" in the current analysis—relates to the fact healthcare has become tradable, or exportable. Cleveland not only brings patients into the region, but delivers services nationally and internationally.
- While Cleveland excels as a "knowledge cluster" in healthcare, the region performs less well as a "knowledge hub," described as the region's ability to produce life science research. Cleveland ranked 22nd nationally in R&D funding from the National Institute of Health (NIH) in 2016.
- The current analysis suggests state- and local-level policies should supplement seeding "downstream" innovation that facilitates start-up formation and technology transfer with the funding of "upstream" innovation that attracts "star scientists," particularly in frontier fields.
- In delineating frontier fields, the analysis borrows from the Four Sector Theory of economic development, which illustrates how a given nation's or region's economy evolves from primary (agriculture), to secondary (industrial), to tertiary (services), to quaternary (information). Today, Cleveland is still economically restructuring from a secondary to tertiary economy. Yet many regions are in the midst of a second economic restructuring from secondary/tertiary to quaternary, in which economic value is the data capital derived from a good or service, rather than the good for service itself. This data capital is the "oil" for the next-wave of innovation, principally in the fields of artificial intelligence (AI) and machine learning.
- The analysis speculates on a potential "long game" for Cleveland in terms of developing an R&D hub in a frontier field, looking specifically at healthcare analytics. Due to regional assets, Cleveland can be a global node in population health research, in effect developing a data capital and AI/machine learning ecosystem that creates leading knowledge in the social determinants of health and reduction of health disparities.
- A systematic, Cleveland-based intervention to reduce health disparities can be exported globally, igniting a tradable healthcare model that goes beyond selling services outside the region. This is a new type of economic development model operating as a global-local feedback loop. Here, the global export is the health of the local community.

# Cleveland's Healthcare Cluster

In 1985, Rabbi Daniel Jeremy Silver delivered a sermon called "What's Wrong with Cleveland."[1] Part of what was wrong was there was little magical about the birth of the region, but rather it came as a "matter of historical accident." Cleveland's geography enabled its rise as an industrial power: it was on a lake and a river, and in between a region of iron ore to the north and coal to the south. These raw materials met in Cleveland to make steel. Steel-making evolved to include off-shoot industries like metallurgy, machining, and automobiles, with manufacturing employment totaling over 356,000 in the region by 1969. That year, Cleveland's per capita income ranked 11th out of the nation's largest cities, one spot ahead of Boston.[2]

But the benefits of serendipity don't last forever. The region lost over 114,000 manufacturing jobs by 1985, the year of Silver's speech. The sector employed only 22% of the workforce, whereas the service sector comprised 27% of the regional labor market[3]. But as manufacturing declined so did Cleveland's income rankings, dropping to 17th by 1985. Meanwhile, Boston ranked 5th.

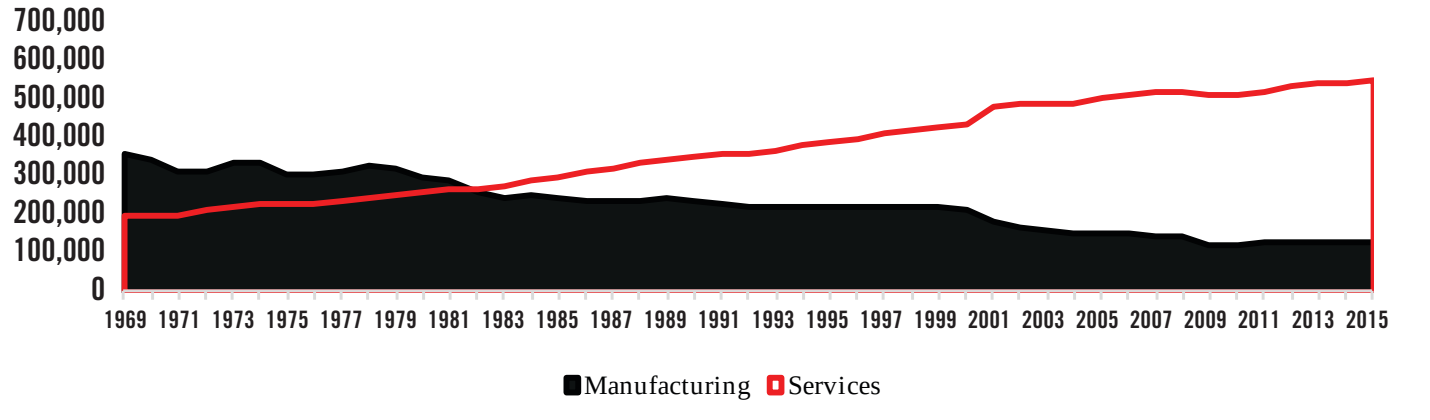
What happened? The Industrial Revolution wasn't so revolutionary anymore. "The Steel Age is over and so is the age of the assembly-line factories that used our machine tools," Rabbi Silver continued, indicating the economic future is one of "electronics and robotics, and these are not the goods in which we specialize."

Cleveland did not, however, fall behind in one area: healthcare. "Our hospitals have been well-financed," the rabbi explained. "Medical research has been promoted. Such research was valuable and non-controversial, and the results of this continuing investment are clear. The medical field has been the one bright spot in an otherwise gloomy economic picture."

The importance of the healthcare industry to the region is obvious today. The current analysis measured the largest concentration of health science workers[4] for the nation's top 50 metropolitan labor markets. Over fourteen percent (14.5%) of Greater Clevelanders[5] are employed in health sciences, ranking first ahead of Boston (14.1%) and Philadelphia (14.1%). Translating these figures to a statistic known as a location quotient (LQ)—a higher LQ equates to a greater concentration of a given industry relative to the nation—Cleveland again leads with an LQ of 1.11, ahead of Philadelphia (1.08) and Boston (1.07) (See Figure 1, page 6). The majority of Greater Cleveland's health science jobs are in Cuyahoga County.

**Jobs in Cleveland Metro in Services and Manufacturing, 1969 to 2015**

*Source: BEA*




[1] Rabbi Daniel Jeremy Silver, "What's Wrong with Cleveland" sermon, 1985.
[2] Bureau of Economic Analysis
[3] Bureau of Economic Analysis
[4] Health Science workers comprise occupations in the Health Sciences Sectors in the 6-digit NAICS code.
[5] "Greater Cleveland," or the Cleveland metropolitan area, is defined as the five-county region comprised of Cuyahoga, Lake, Lorain, Geauga, and Medina counties.

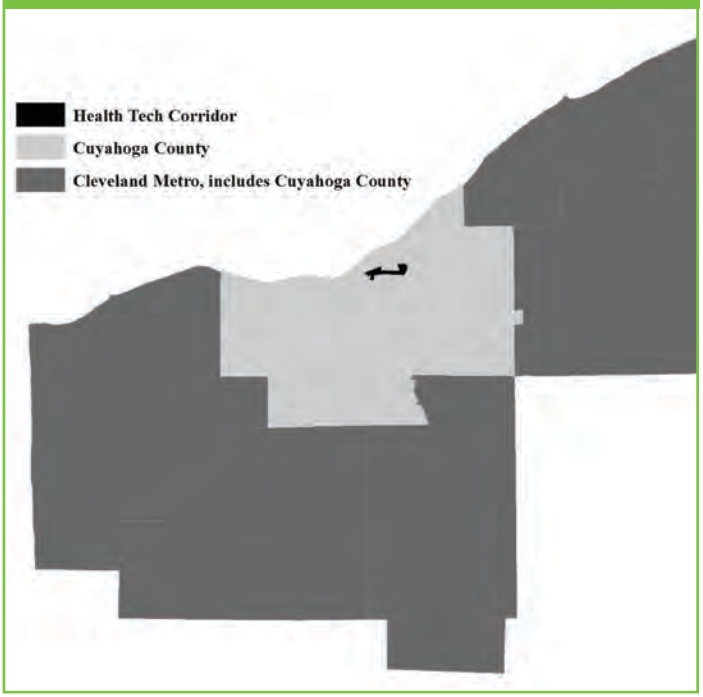
Seventy-six percent of health science workers in the Cleveland metropolitan area are employed in the core county.[6] Comparing Cuyahoga County's health science LQ with the core counties of the top 50 labor markets is also revealing: Cuyahoga County is second with an LQ of 1.42, trailing only Philadelphia County (See Figure 2). The clustering of healthcare in Cuyahoga County has coincided with enlarging economic impacts. Between 2002 and 2016, healthcare and social assistance jobs in the county increased from approximately 104,500 to 131,700, with the aggregate income from those jobs growing from an inflation-adjusted $4.822 billion to $6.892 billion (See Figure 3).

A last slice of the data examines to what extent life science employment is clustering within Cuyahoga County itself. Answering the analysis measured total employment and healthcare employment within the Health Tech Corridor (HTC), a 1,600 acre area which houses the city of Cleveland's "eds and meds" institutions, namely Cleveland State University, Case Western Reserve University, the Cleveland Clinic, and University Hospitals (See Map 1 for geographic reference). Total employment in the HTC increased from about 41,200 in 2002 to 75,000 in 2015—a gain of 82% (compared to minus 2.2% for Cuyahoga County).[7] Also, 5.9% of all jobs in Cuyahoga County were within the boundaries of the HTC in 2002, increasing to 10.9% by 2015 (See Figure 4). Examining year-over-year growth from 2014 to 2015, 24.7% of all job growth in the Cleveland metro occurred in the HTC. Those concentrations were even higher for Cuyahoga County (39%) and the City of Cleveland (57.3%) (See Figure 5). The clustering of healthcare employment is what's driving this change: 36.2% of healthcare and social assistance jobs in the county were in the HTC in 2015, up from 26.4% in 2003 (See Figure 6).

The coring of life science work has corresponded with significant real estate appreciation within the corridor's boundaries, with an increase in valuations of nearly $900 million since 2009. Specifically, inflation-adjusted assessed values for all property types in the HTC went from $3.849 billion to $4.723 billion—a gain of 23% (See Figure 7). Compare this to an 11% decline in Cleveland and a 12% decline in Cuyahoga County, and the influence the region's anchor institutions have on real estate appreciation is apparent.

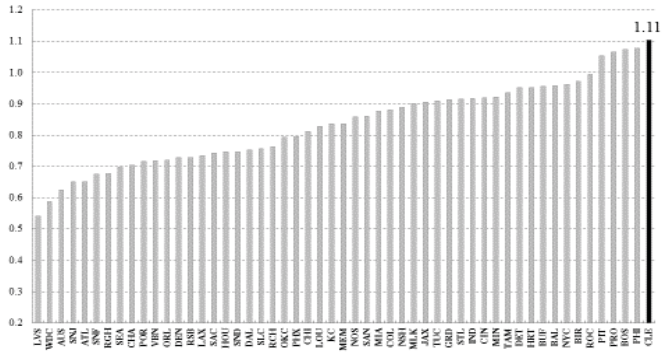
Why is this coring occurring? Is Cleveland just sicker than other regions nationally, translating to a higher demand for healthcare and thus a greater supply of doctors, nurses and other workers? Or is an industry cluster developing locally, one fed by Cleveland's global notoriety as a premier healthcare destination? The remainder of this paper will shed light on these questions. In doing so, a regional economic development framework will be articulated to facilitate Cleveland's ongoing economic restructuring from the Steel to Information Age, with the life sciences the vehicle for this transformation.

**Map 1: Cleveland Metro, Cuyahoga County, and Health Tech Corridor**



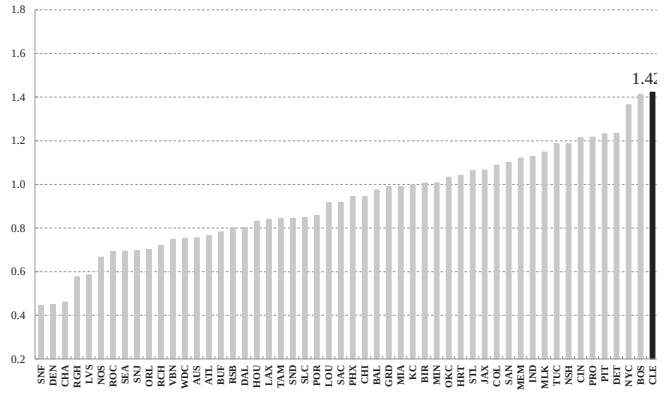

[6] Quarterly Census of Employment and Wages (QCEW), 2006, 2016.
[7] LODES, 2002, 2015.

## Figure 1: Metro Rankings by Health Science LQ




*Source: Quarterly Census of Employment and Wages, 2016 Q2*

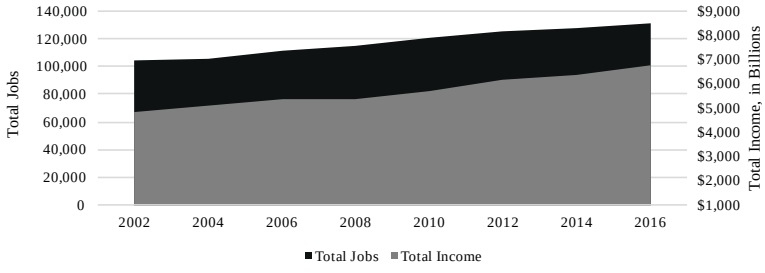
## Figure 2: County Rankings by Health Science LQ




*Source: Quarterly Census of Employment and Wages, 2016 Q2*

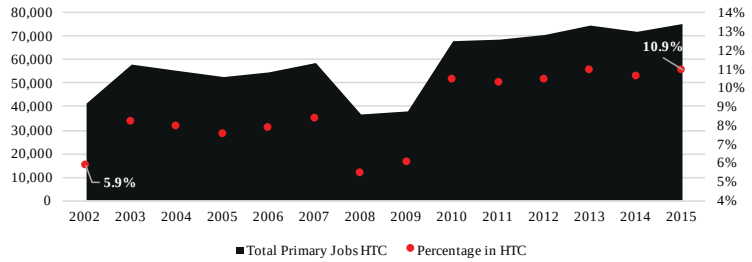
## Figure 3: Total Jobs and Total Income in Cuyahoga County in Health Care Sector

*Source: LODES*



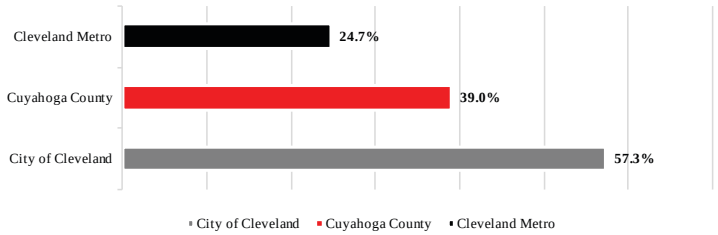

## Figure 4: Total Jobs in HTC and Concentration of County Jobs in HTC

*Source: LODES*



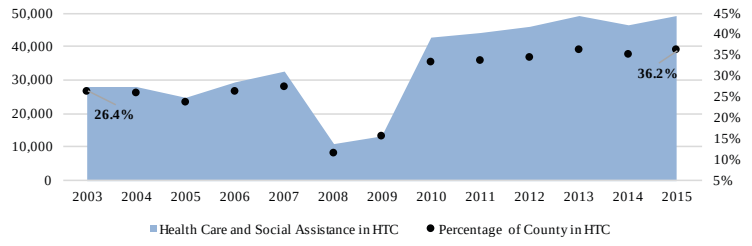

## Figure 5: Percent of Year-Over-Year Job Growth Occurring in HTC 2014-2015

*Source: LODES*




## Figure 6: Health Care Jobs in HTC and Concentration of County Healthcare Jobs in HTC

*Source: LODES*




## Figure 7: Inflation-Adjusted Assessed Value Change All Property Types 2009-2015

*Source: Cuyahoga County Auditor*

# From Metal to Medical

Globally-renowned cities have tradable, or exportable, economies. Detroit and cars is one iconic example. Here, a good is produced, then exported, with imported profits benefiting the exporting region. Professional services like healthcare, education, and legal have long been viewed as being an outcome of an export economy (e.g., the factory worker needs a doctor), rather than exports in and of themselves. "The conventional view of the service-producing sector," explained the Cleveland Fed in 1986, "was that it grew only as a result of healthy manufacturing, and did not generate wealth for the area."[8]

This view of service provision is outdated. Higher education is increasingly traded on the global market, with nearly 1 million international students attending American universities and colleges, up from 650,000 in 1998.[9] These students contributed $36 billion annually to the nation's economy,[10] and there's room for growth: international students comprise only 5% of U.S. enrollment, compared with 20% in Australia.[11] Locally, the nearly 5,500 international students in Greater Cleveland paid over $137 million in tuition between 2008 and 2012, with another $58 million in living costs.[12]

The healthcare industry is mirroring higher education with services increasingly being transacted out of the local market. In a recent analysis co-authored by Harvard economist Michael Porter called "Cleveland Clinic: Transformation and Growth, 2015," it was found nearly 30% of the patients the Clinic served were not from Greater Cleveland, with 13% from outside Ohio.[13] Approximately 2% of all patients the Clinic receives on its main campus arrive from outside the U.S., with estimates of international patient spending totaling between $3,800 and $6,000 per visit.[14] This is outside money coming into Cleveland, employing not only healthcare workers but workers in the local economy. In all, it's the same formula that built Cleveland into an early 20th century powerhouse, yet instead of exporting metal, the region exports medical.

The tradability of Cleveland's healthcare industry goes beyond gaining market share by bringing patients into Cleveland. There's also the strategy of geographic expansion. The Cleveland Clinic is growing its reach by developing a vast consultancy industry through its affiliate and alliance network, particularly in well-accessed fields of global renown: cardiovascular and orthopedic services (See Image 1). Partnering hospitals, such as MedStar Heart Institute in D.C., gain a competitive edge, access to expertise, and research opportunities by partnering with the Cleveland Clinic, while the Clinic can extend institutional "brands across the

**Image 1: Geographic Expansion of Cleveland Clinic**

*Source: Cleveland Clinic*


[8] Federal Reserve Bank of Cleveland, Annual Report, "Common Bonds, Divergent Paths: An Economic Perspective of Four Cities," 1986.
[9] Marber, P. "Trump Doesn't Realize that America's Greatest Export is Higher Education." *Quartz.* May 2017.
[10] ICEF Monitor. "More than One Million International Students in the US." November 2016.
[11] Ross, J. and Hare, J. "Foreign Students Bring $20 Billion to Australia," *Inside Higher Ed.* (November 2016).
[12] Ruiz, N. "The Geography of Foreign Students in U.S. Higher Education: Origins and Destinations." Brookings Report (May 2014).
[13] Porter, M, Teisberg, E. 2015. "Cleveland Clinic: Transformation and Growth: 2015." Harvard Business School.
[14] Patients Beyond Borders. "Medical Tourism Statistics & Facts." October 2, 2017.

U.S. — and attract national employer contracts — without bearing costs associated with actual acquisitions."[15]

Another strategy of geographic expansion is to go beyond partnering and actually operating a facility in another region of the country. "You're beginning to see people leapfrogging outside of their immediate service areas," explains a Standard & Poor's analyst.[16] "[There's] this whole sense that people need to get bigger, and want to put their stake in the ground in more places, because they want a bigger funnel back to the mothership." The piece explains the thought behind establishing the Cleveland Clinic Florida in Weston, a full-service hospital just west of Ft. Lauderdale, with the rationale being to go where the aging population is growing in order to provide care where it is not only needed, but where customers have the means to pay.

This geographic expansion strategy extends to international outposts, like the newly-opened Cleveland Clinic Abu Dhabi. Cleveland Clinic CEO Toby Cosgrove described the genesis of international expansion, noting that after 9/11 the patient flow to Cleveland from the Middle East slowed.[17] "So we began to think, perhaps we should go where our patients were," he said. The Clinic's latest addition to its international network will be in London, with construction of a 205-bed specialty clinic overlooking the Buckingham Palace. Other international outposts are currently in the works, including one in Shanghai.[18]

What's beginning to occur in the healthcare industry—with Cleveland a main player—is it's scaling, with the nation's top medical centers integrating less-resourced and -renowned facilities into their respective systems, or building new systems in high-demand, affluent areas. Dubbed the "Healthcare Hunger Games" by one local expert[19]—referencing the likelihood the nation will be served by a few hospital brands in the future—the mechanism behind the movement is about efficacy and cost, or about the industry being able to deliver a better product more efficiently and affordably. Here, healthcare is following the path that other sectors, such as agriculture and manufacturing, laid before it. Think


*Image 2: Source: Cleveland Clinic*

Ford's assembly line revolution reducing the cost of a car. Except in this case the product includes things like knee replacements, and the assembly line—using the Cleveland Clinic's own terminology—is called a "care path."[20]

This push to efficiency isn't going away. It is estimated healthcare will comprise nearly 20% of the national GDP in the near future,[21] up from 17% over the last few years (see Figure 8). By contrast, the remainder of the world's economies spend less than 10% of GDP on healthcare costs. Simply put, innovation in healthcare is needed, and it's increasingly in the national interest to incentive efficiency gains via scaling, in effect creating an industry environment "of winners and losers observed in other industrial sectors, as top…hospitals become larger and absorb most of the increase in…patients from across the nation," notes former White House economist Aaron Chatterji.[22]

Echoing that sentiment is CEO of Cleveland-based University Hospitals Thomas Zenty, who in discussing UH's strategy of creating a "super-regional system" that has expanded the geographic footprint beyond their main campus, noted the need of "building to scale, which is important to reduce cost."[23]

[15] Packer-Tursman, J. "One network to rule them all: The future of Mayo, Cleveland Clinic hospital affiliates." *Healthcare Dive*. July, 2014.
[16] Snowbeck, C. "Mayo Clinic in race for Florida patients." *Star Tribune*. May, 2016.
[17] Knowledge@Wharton. "Cleveland Clinic's Delos M. Cosgrove: 'We are in Abu Dhabi to Help a Country Shape its Healthcare Delivery System'." March, 2011.
[18] Masterson, L. "Cleveland Clinic involved in deal to open China hospital." Healthcare Dive. August, 2017.
[19] Personal interview. Feb., 2017.
[20] Katzman, I. "8 Lessons from the Care Path: Insights on a Leading Cleveland Clinic Value Initiative." Consult QD. July, 2015.
[21] Keehan, S. et al. 2017. National Health Expenditure Projections, 2016–25: Price Increases, Aging Push Sector To 20 Percent Of Economy. Health Affairs, 36, p. 26-36.
[22] Chatterji, A. "The Bad News for Local Job Markets." The New York Times. October, 2013.
[23] Coutre, L. "University Hospitals at 150." Crain's Cleveland. May, 2016.

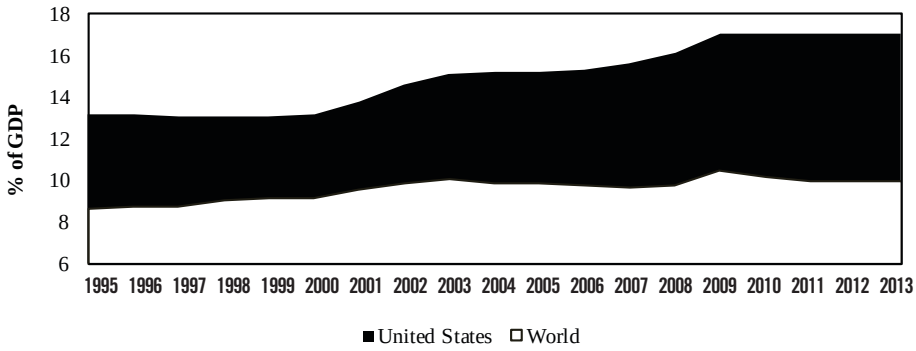



**Figure 8: Health Expenditure, total (% of GDP)**
*Source: World Health Organization Global Health Expenditure Database*

"I think you're going to have to begin to understand that you've got to consolidate the healthcare delivery system," reaffirms the Cleveland Clinic's Cosgrove. "And if you look at every other industry in the United States, you've seen consolidation of those industries for efficiency."[24]

So, can Pittsburgh and steel, Detroit and cars, Silicon Valley and tech, become Cleveland and health? It's an open, if admittedly aspirational, question. At the very least, the tradability of healthcare services in Cleveland has played a role in the creation of a life science cluster locally, and it's a cluster of increasing national importance. Yet a strategy to leverage this "healing" economy is needed. This involves strategizing within industries that both feed it (research and development), and flow from it (health information technology and healthcare analytics).

# When Smokestacks Chase: The Importance of R&D

In 2016, institutions in the City of Cleveland received about $284 million dollars in R&D funding from the National Institute of Health (see figure 9). The vast majority of that funding went to University Hospital's Case Western Reserve University School of Medicine, which ranked twenty-seventh among American medical schools in NIH funding; and the Cleveland Clinic Lerner College of Medicine, which ranked forty-fifth (see Figure 10). Combined, those institutions drove Cleveland's 22nd-place ranking out of the some 900 cities that received NIH funding in 2016. Boston ranked first, totaling over $1.85 billion in funding.

While Cleveland performed well nationally, a case can be made that the region is punching below its weight in R&D funding.

Recall the counties of Cuyahoga (Cleveland), Philadelphia, and Boston all ranked tops in the concentration of health science workers, yet Cleveland is far behind those cities in medical research funding, indicative of a local divide between the *practice* of healthcare, termed a "knowledge cluster," and the production of healthcare research, termed a "knowledge hub."

Unpacking the distinction further, knowledge clusters are groups of organizations that are production-oriented and have the organizational capability to drive innovations and create new industries.[25] Such clusters are the "downstream" effect of knowledge. Conversely, knowledge hubs are the "upstream" driver of innovation, described as *nodes in networks* of knowledge produc-

[24] Bloomberg Markets, "Toby Cosgrove on Obamacare, Drug Prices, Tom Price." (aired December 8, 2016).
[25] Hans-Dieter Evers, "Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development," ZEF Working Paper Series, no. 27 (2008).

tion, knowledge sharing, and knowledge application.[26] Developing a knowledge hub in Cleveland is paramount to the region's economic viability.

The goal of economic development is prosperity, commonly measured by income per capita. A landmark Cleveland Fed study examined 75 years' worth of state-level data and found three factors predicted gains in per capita income: concentration of a population that's college educated, the industry mix of a region, and levels of innovation.[27] Importantly, each factor is influenced by a city's R&D intensity. A recent New York Fed paper noted that an area's concentration of R&D funding was strongly correlated with the amount of college graduates in a region, whereas the number of graduates local colleges produce was not.[28] Why?

R&D, via innovation, influences the region's industry mix, cultivating high-skill industries that demand knowledge workers, subsequently expressed as increased educational attainment rates and income growth. Put another way, if there's no new economy jobs, college graduates leave, along with their salary. As such, R&D matters, a lot. The issue now turns to how R&D manifests into regional economic development.

A 2015 analysis "Killing the Golden Goose? The changing nature of corporate research, 1980-2007," Duke Economist Ashish Arora detailed how private industry has become less willing to maintain R&D capacity in-house.[29] That's because shareholders place less value on scientific capability, and more emphasis on short-term profit. Innovation thus shifted elsewhere, with academic in-

**Figure 9: City Rankings of Total NIH Funding**

*Source: Star Metrics*

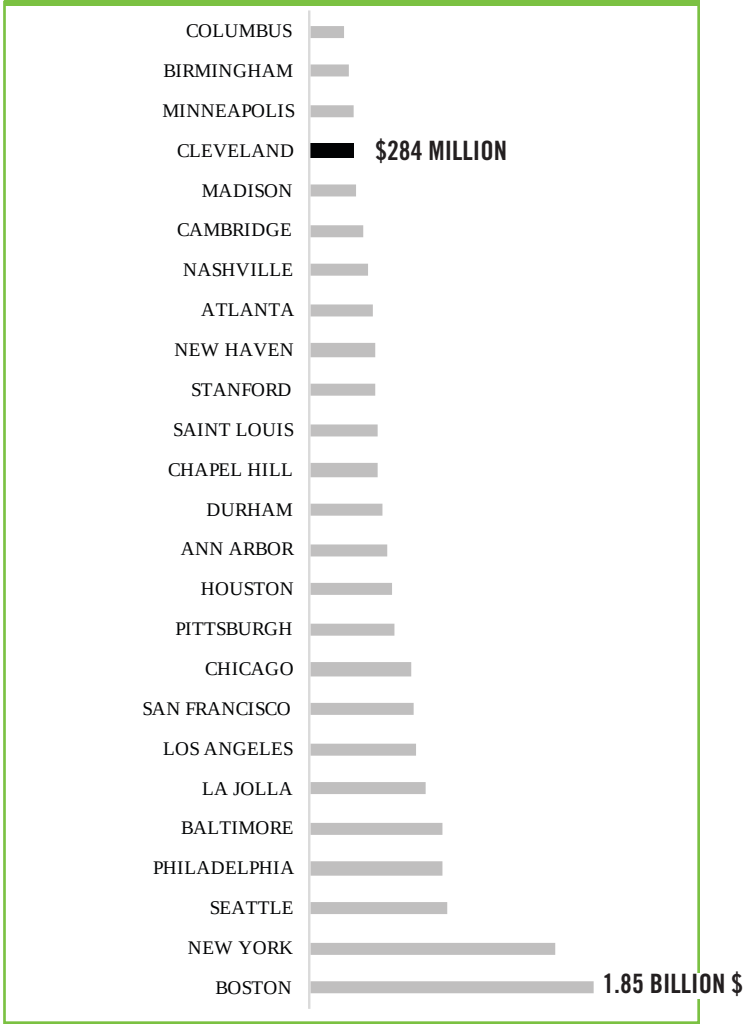
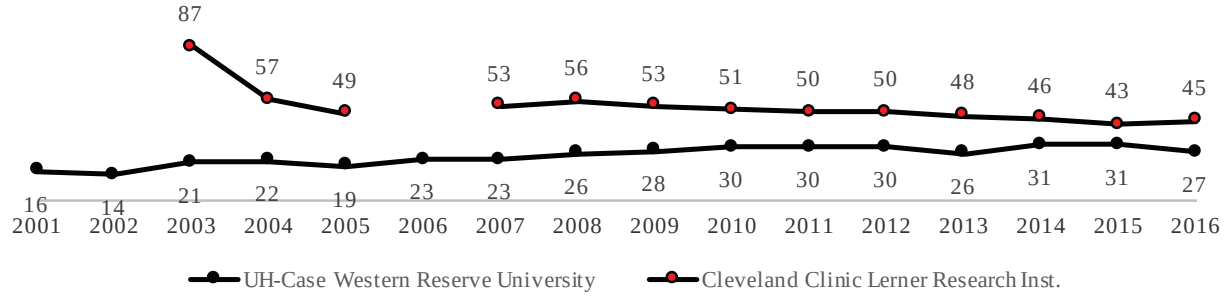



**Figure 10: National Rankings of Cleveland-Based Medical Schools per NIH Funding**

*Source: Blue Ridge Institute for Medical Research*




[26] Ibid

[27] Cleveland Federal Reserve Bank of Cleveland, "Altered States: A Perspective on 75 Years of State Income Growth" (annual report. 2015).

[28] J. Abel and R. Deitz, "Do Colleges and Universities Increase Their Region's Human Capital?" *Journal of Economic Geography* 12 (2012): p. 667-691.

[29] A. Arora, S. Belenzon, and A. Patacconi, "Killing the Golden Goose? The Changing Nature of Corporate Research, 1980-2007," NBER Working Paper Series, Paper 20902 (2105).

stitutions performing an estimated 75% of the nation's basic and applied research.[30] Given R&D's well-documented influence on economic growth, the importance of academia is inarguable. The issue has been explaining to politicians and purse-string holders alike how exactly knowledge production impacts progress, particularly within those areas where it's taking place.

The first impact is direct. "[A]lthough science is complicated, it is not magic. It is productive work. Scientific endeavors employ people," notes one scholar.[31] For every one employee in direct research, there are 3.2 jobs created in the regional economy, and whereas every dollar in research funding meant an additional $2.90 in the local economy.[32] So, the $284 million dollars Cleveland gained in NIH funding last year had an $816.5 million dollar impact, a figure approximate to the value of the Cleveland Cavaliers.

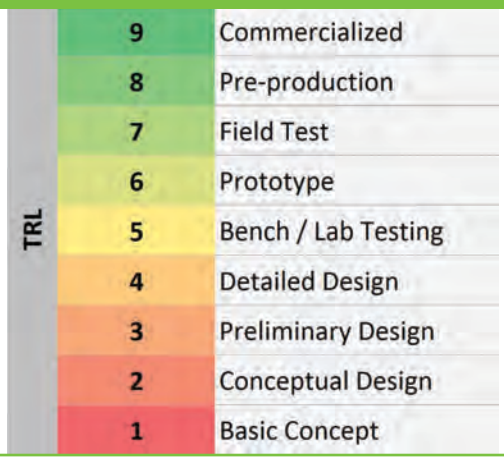
A second impact is through start-up formation, as R&D is the seed corn of innovation. In fact, today's "holy grail" of economic development is job creation—as opposed to "smokestack chasing," or job attraction via subsidies given to companies—and this is increasingly in the purview of academic institutions via the commercialization of knowledge, or "technology transfer."

Start-up formation, though, is associated with a third impact of regional knowledge production, one less understood and discussed: the attraction of high-tech firms. Here, "smokestacks" chase the city instead of the city chasing "smokestacks," if only because high-tech firms want to be in earshot of those institutions where the best "upstream" knowledge is produced. "We find that scientific capability continues to be important for innovation but that large firms face lower incentives to develop significant new products and processes internally, and have reduced their investments in science," concludes Ashish Aurora, the author of "Killing the Golden Goose." "[T]hey rely upon startups to develop new inventions…[S]uch startups themselves rely…upon university research."

Pittsburgh is illustrative of a Rust Belt city the "smokestacks" are chasing, and associated metrics are telling: the region ranks sixth out of the top 40 metros in per capita income gains since 1985, just after Seattle.[33] As Cleveland doubled down on manufacturing R&D in the 70s and 80s, Pittsburgh built an emergent knowledge infrastructure at Carnegie Mellon University (CMU) in computer science and robotics. Today, that R&D groundwork has blossomed, placing the region as a node in the world's fastest-evolving industries, particularly artificial intelligence (AI), or "the science of making computers do things that require intelligence when done by humans."[34]

A brief, if necessarily simplified, look at the evolution of Pittsburgh's robotics industry can elucidate. In 1979, CMU founded its Robotic Institute: a site of basic research that tackled fundamental questions in the still-nascent field. By 1995, the region had amassed enough knowledge capital to extend the line of inquiry from basic to applied, at which point CMU opened the industry-backed National Robotics Engineering Center. A useful concept called the Technology Readiness Level (TRL), developed by NASA to gauge the maturity of a given field of science, is helpful in explaining the relationship between the basic and applied arms of CMU's robotic research. At Level 1, an area is so new that no one understands its basic principles. At Level 9, technology is ready to be used in commercial products. "In effect," notes a recent *New York Times* magazine piece, "Carnegie Mellon used the NASA scale to carve up its robotics research. The Robotics Institute would handle research from Levels 1 to 3 or 4, while the center would take technology from there and move it to 7."[35] It was after Level 7, then, that "smokestacks" begin chasing.

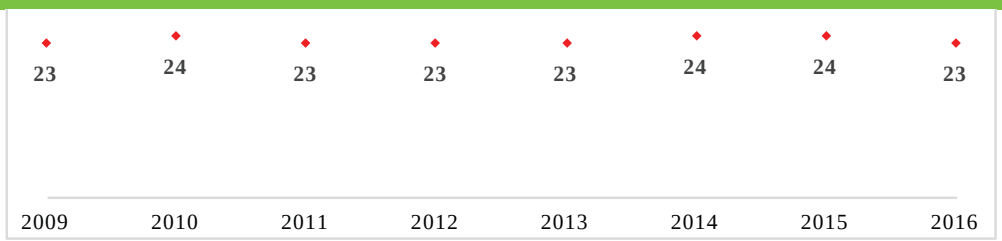
**Image 3:Technology Readiness Level**




[30] T. Ross, "The Real Value of Higher Education," *Raleigh (NC) News and Observer*, March 2015.
[31] B. Weinberg et al., "Science Funding and Short-Term Economic Activity," *Science*, 344 (2014): p. 41-43.
[32] Ibid
[33] Bureau of Economic Analysis, 1985, 2015.
[34] J. Copeland, "What is Artificial Intelligence?" AlanTuring.net, May 2000.
[35] C. Thompson, "Uber Would Like to Buy Your Robotics Department." *New York Times*, September 11, 2015.

**Figure 11: City of Cleveland Ranking by NIH Funding, 2009-2016**

*Source: Blue Ridge Institute for Medical Research*




In 2015 the tech firm Uber—in its race to operationalize autonomous vehicles—established an R&D center in Pittsburgh, the Uber Advanced Technologies Group, in partnership with CMU's National Robotics Engineering Center. More recently, some of Uber's top engineers—who were poached from CMU's robotics center—created Argo AI: a start-up that Ford recently invested $1 billion in their commitment to have autonomous vehicles on the road by 2021.[36] Not to be outdone is Intel, which was recently propelled to the forefront of autonomous vehicle technology with its $15 billion-dollar purchase of Jerusalem-based Mobileye which, in turn, has partnered with Pittsburgh-based Delphi, who itself purchased a Carnegie Mellon University spin-out company, Ottomatika, in 2015.[37]

In all, the knowledge hub Pittsburgh built decades back paid off, with a cluster of high-tech firms evolving. "Since 2011, artificial intelligence has become a mainstream industry in its own right...," explained Andrew Moore, the dean of CMU's School of Computer Science. "Suddenly, Pittsburgh finds itself as one of only five significant cities in the world with massive capital around this. We're up there with the Bay Area, Boston, Zurich and Beijing."[38]

Cleveland's position as a clinical care cluster is undeniable. Health professionals come to Cleveland to learn care and patients come to receive it. Yet America's most productive knowledge economies aren't only "hands on" but "eyes up," the latter tied to the extent a region is engaged in "blue sky" research. Cleveland has the basic infrastructure from which to build a knowledge hub as evidenced by its top 25 ranking in NIH funding since 2009 (see Figure 11). But approaching the likes of Boston and Philadelphia will require a cohesive, far-reaching strategy, one largely aimed at targeting and endowing researchers, ideally in emergent fields. This would in part entail methodically supplementing publicly-funded "downstream" innovation (start-up formation and tech transfer) with investing in "upstream" innovation (funding R&D).

Texas, for example, has recently invested $250 million in attracting the top cancer researchers to its universities. "It is part of a strategy to make Texas a clear leader in studying cancer," with the goal not only to attack one of humanity's most devastating diseases, but also bolster the state's economy. In some respects, this is nothing new: the poaching of star scientists. "What is new," said C. Michael Cassidy, president and chief executive officer of the Georgia Research Alliance, "is doing it as a broad economic-development strategy."[39]

This strategy basically involves the funding of R&D as a requisite front-end investment, with the end product a regional ecosystem that acts as a "black hole" for talent and capital. In the nascent days of biotech, for instance, it was found those regions with star scientists in the field emerged as industry cluster winners, if only because "knowledge…at least when it is new, is embodied in particular individuals; [and so] it cannot diffuse rapidly."[40]

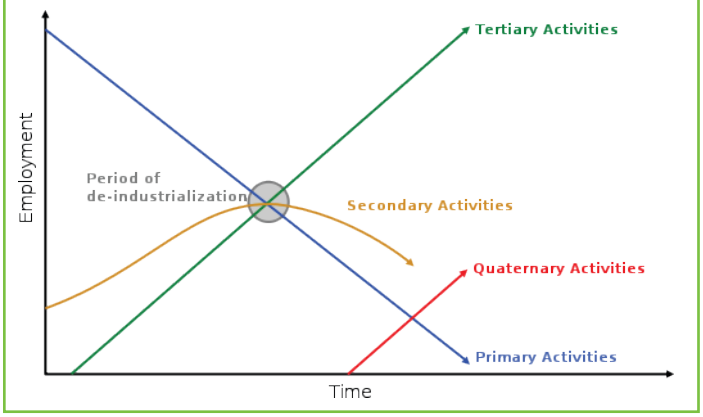
That said, there's considerable uncertainty as to what areas of R&D Cleveland should focus on. That is, biotech, pharmaceuticals, medical devices, and other product-oriented fields are well situated in other locales, making a play on such areas ill-advised from a strategic standpoint. "Pursuing a traditional tradable model in devices, drugs, and products might be too costly and too late," explains one local industry insider. "We must set new models, a new future."[41] Which brings to mind a quote by the hockey great Wayne Gretzky, who said: "I skate to where the puck is going to be, not where it has been."

[36] A. Auperlee, "Pittsburgh Self-Driving Car Startup Argo to be Based in Strip District." *Pittsburgh Tribune,* February 23, 2017
[37] Associated Press. "Intel Drops $15B on Mobileye in Race for a Driverless Future." March, 2017.
[38] T. Schooley, "Pittsburgh Lauded as One of World's Great Robotics Centers," *Pittsburgh Business Times,* January 12, 2016.
[39] P. Basken, "Boom in Academic Poaching Is Fueled by Visions of Economic Development," *Chronicle of Higher Education,* July 23, 2015.
[40] L. Zucker, and R. Darby, "Entrepreneurs, Star Scientists, and Biotechnology," NBER Working Paper Series (1998).
[41] Personal interview, Request of anonymity, May 2016.

# Where the Puck is Going

Having a long view forward means having a long view back. A nation's—and region's—economy can be divided into four sectors,[42] with the proportion of employment in each tied to where it's at on its continuum of economic restructuring. There is the *primary sector*, which is resource-extraction based and associated with pre-industrialization (See Image 4). America's agrarian economy, for instance, employed upwards of 70% of people before the Industrial Revolution. That revolution produced the goods-producing *secondary sector*, which itself employed upwards of 40% of Americans at its peak. Then came the *tertiary sector*, or the area of service provision that employs the bulk of the U.S today. This is where most of the healthcare industry fits. Lastly is the *quaternary sector*: a breakoff of the tertiary sector devoted to knowledge production, aka the "information economy." At the most basic level analysis, then, the quaternary sector is where the puck is going.

**Image 4: The Four Sectors of the Ecomony**




But there's more to it than that, because the puck is now going faster into places it has never before been, all due to the fact that technology has gotten so good. Specifically, data used to be a byproduct of the tertiary service sector: you bought a t-shirt and the credit card company recorded the transaction, you went to the doctor and the insurance company recorded the transaction, and so on. With advances in data collection, storage, and analysis, however, the data of the transaction itself is the source of much of the added value in the world.

Explains Peter Sondergaard, senior V.P. of the insight analyst firm Gartner Research: "Information is the oil of the 21st century, and analytics is the combustion engine." [43]

"The most important…technology of our era is artificial intelligence, particularly machine learning," echoes MIT's Erik Brynjolfsson and Andrew McAfee, noting artificial intelligence (AI) will change the way we live and the forms our cities take, not unlike how the combustion engine gave "rise to cars, trucks, airplanes, chain saws, and lawnmowers, along with big-box retailers, shopping centers, cross-docking warehouses, new supply chains, and, when you think about it, suburbs."[44]

Cities that have economically restructured beyond the secondary economy—or the production of a good for consumption's sake—and beyond the tertiary economy—or the provision of service for service's sake—and into the quaternary economy—or the mining of data capital from a good or a service for innovation's sake—are the ones that will be tomorrow's economic powerhouses.

Why AI and why now? One reason is that the basic science of AI is maturing, meaning the technology itself is readying for launch. With that, AI has changed the rules of the game, particularly how information is processed and knowledge is made. Simply, the old way involved programming computers with codified knowledge, or knowledge that can be broken down into steps. Yet this codified approach had "a fundamental weakness" notes Brynjolfsson and McAfee, because much of the knowledge people have is tacit, meaning that we can't fully explain it.[45] The fact we know more than we can tell not only limits how humans learn, it has also restricted the ability of machines to learn, which has limited the activities machines could perform.

[42] The four sector model is a revision to the original Three-Sector Theory developed by theorists Allan Fisher, Colin Clark, and Jean Fourastié.
[43] Gartner Press Release. "Gartner Says Worldwide Enterprise IT Spending to Reach $2.7 Trillion in 2012." October 17, 2011.
[44] E. Brynjolfsson, A. McAfee, "The Business of Artificial Intelligence." *Harvard Business Review.* July 2017.
[45] Ibid.

But things have changed. "Machine Learning represents a fundamentally different approach to creating software," explains Brynjolfsson and McAfee. "The machine learns from examples, rather than being explicitly programmed for a particular outcome."[46] Think of machine learning, then, as a machine that can learn, absent some constraints of human input.

Now, which industries have seen the largest advances in digitization and are most primed for adding value? According to a 2015 McKinsey report, the most digitized industries include information technology, media, and finance, while areas of "medium digitization" include advanced manufacturing, wholesale trade, and retail trade. The laggard sectors of digitization are hospitality, construction, and—you guessed it—health care.[47]

In the case of healthcare, why is that? Insight can be found in the "cost disease theory" developed by William Baumol, an NYU economist. Historically, hospital productivity has grown more slowly than the overall economy, which helps explain why the nation's health care costs have taken up ever-larger shares of overall spending. This lack of productivity is associated with the low-levels of digitization in the sector. As to why, the cost disease theory "asserts that productivity growth in health care is inherently low for the same reason it is in education: Productivity-enhancing technologies cannot easily replace human doctors or teachers."[48] In contrast with, say, manufacturing, there are far fewer machines that can step in and outperform doctors and other healthcare professionals, given that these industries are flush with tacit knowledge, (e.g., you don't learn to be a heart surgeon or nurse by reading a manual, but by observing a great heart surgeon or skilled nurse).

Nonetheless, there are various ways hospital systems can "trim fat." The Cleveland Clinic's "care path," assembly-line strategy is an example that achieves efficiency gains via coordinated care. Consider it a service-based, process approach, one the Clinic aims to scale. Yet the biggest gains in healthcare productivity will arise from technology, despite the longstanding difficulties in digitizing the sector. This is occurring in component parts, beginning with the process of digitizing health information via electronic medical records. Here, Cleveland has a toehold with Explorys, a Cleveland Clinic spin-off purchased by IBM. Their software is now used in over 400 hospitals, encompassing a data set of fifty million lives.

That data, aka "big data," is raw material for IBM's supercomputer Watson of *Jeopardy* fame. IBM Watson creator John Kelly explained the cognitive-computing[49]—Watson had no "inherent intelligence" to start with and was essentially "a child." "But as it's given data and given outcomes, it learns," Kelly continued, "which is dramatically different than all computing systems in the past, which really learned nothing. And as it interacts with humans, it gets even smarter. And it never forgets."[50]

This brings us to the other component in the digitization of healthcare for productivity sake: making knowledge out of information, largely through the feeding of data into algorithmically-constructed learning machines.

To recap: the means to the end is productivity in healthcare, with the end better health care for people at lower cost. To get there requires better data via health information technology, which fuels better knowledge via artificial intelligence. Where does Cleveland fit into this productivity-big data-artificial intelligence landscape? Mapping this can inform where the region should invest when it comes to developing its R&D capacity.

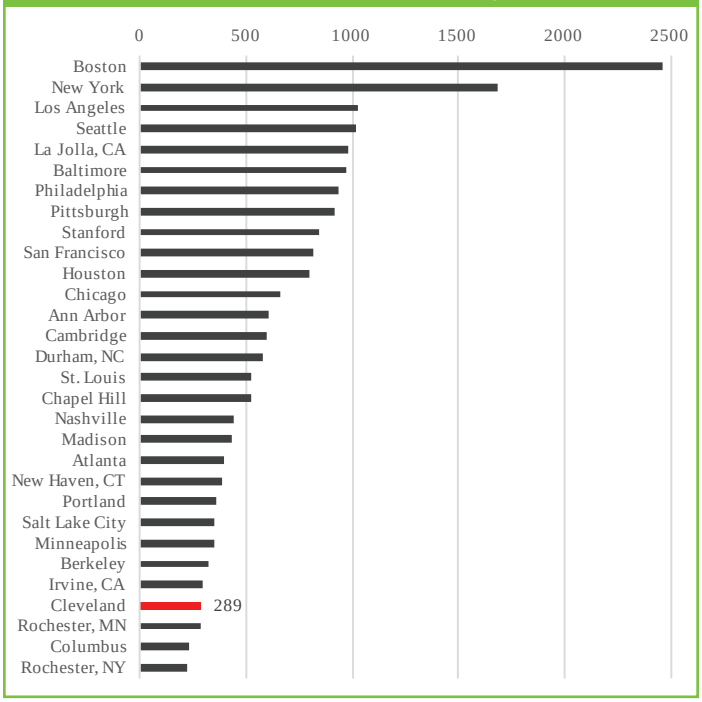
Generally, there are a few basic areas in play, starting with the two components just discussed: health information technology and artificial intelligence. To find what areas of the nation are consolidating life science-related R&D funding in these fields, the current analysis ranks cities by the frequency of grants received

[46] Ibid.
[47] J. Manyika, et al., "Digital America: A Tale of the Haves and Have-Mores," McKinsey Global Institute Report, (2015).
[48] A. Frakt, "Obamacare's Big Gamble on Hospital Productivity," *New York Times*, May 25, 2015.
[49] The basic differences between AI and cloud computing are that in an artificial intelligence system, the system would have told the doctor which course of action to take; whereas in cognitive computing, the system provides information to help the doctor decide.
[50] CBS News, "Artificial Intelligence Positioned to be a Game-Changer," *60 Minutes*, (aired October 9, 2016).

from Department of Health and Human Services (HHS) using two search terms: "big data" and "algorithms."[51] Between 2008 and 2016, there were approximately 32,000 "big data"/"algorithm" projects funded by HHS, representing only 4.5% of the agency's grants during that period. In other words, the lack of digitization in healthcare services is also prevalent in the field of healthcare research. Which locales are filling the void? Boston was 1st with 2,500 projects funded, and neighboring Cambridge was 14th. Also accumulating knowledge capital in healthcare analytics were: New York City, Los Angeles, Seattle, La Jolla, Baltimore, Philadelphia, Pittsburgh, and the Bay Area, particularly San Francisco and Stanford. Cleveland garnered 289 grants, tying the Mayo Clinic-based Rochester, MN for 27th nationally (see Figure 12).

**Figure 12: City Ranking of "Big Data"/ "Algorithm" Projects Funded by Department of Health and Human Services, 2008 to 2016**

*Source: Star Metrics via Federal Reporter*




Determining the likelihood of Cleveland moving up these rankings entails inferring why the likes of Boston, Pittsburgh, and the Bay Area are there in the first place. Recall the case of Pittsburgh. In the late 1970s the region invested in a research infrastructure centered on robotics. Boston's and the Bay Area's infrastructure predates that, with the advent of computer science arising in the 1950s. Hence, the cities accumulating computer science capital in healthcare are places that have amassed industry-agnostic capital over the last half century, which—in the case of Cleveland—means running a race where the opponents have a vast head start. To that end, investing in Cleveland to become a computer science hub in health—or any sector for that matter—isn't necessarily strategic, given the computer science R&D cemented elsewhere. This doesn't mean Cleveland has no strategic play in healthcare analytics. It just means the region must pinpoint where exactly its assets fit in the quickly-evolving field.

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In terms of assets, Cleveland has historically been a place of doing, or of taking basic knowledge and applying it. For example, a recent study called "Emerging robotic regions in the United States: insights for regional economic evolution" categorized the nation's robotics industry between those region's that research and design (i.e., knowledge hubs), and those regions that retrofit and deploy robots (i.e., knowledge cluster).[50] Expectedly, Pittsburgh's place was as a robotics hub, described as "an analytically dominant environment in robotics…where researchers are developing a novel AI algorithm or neural network architecture." By contrast, Cleveland—which the study found had the 2nd most jobs in the robotics sector nationally—was a cluster, described as a region that's "integrating robots into a production system on the shop floor."[53]

Is that good or bad? In terms of employment, it's good for Cleveland, as the region has ten times the employees in robotics as Pittsburgh. In terms of value add, however, it's less ideal. Returning to the analogy of where the puck is going, Pittsburgh's place in robotics is in the knowledge-producing quaternary sector, which

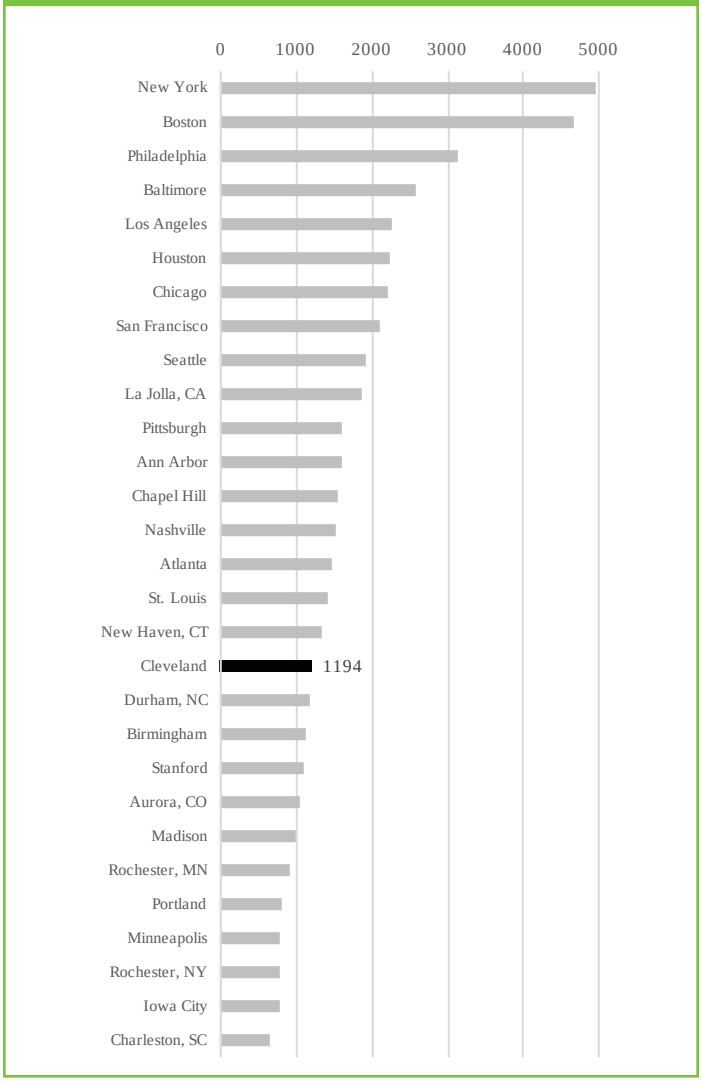
[51] "Big data" is a common term that's the proxy for modern large-scale data sets, or the digitization part of health IT. "Algorithms" is a common term used to analyze these data sets, or the basic science component of AI/machine learning.
[52] N. Leigh and B. Kraft, "Emerging Robotic Regions in the United States: Insights for Regional Economic Evolution." *Regional Studies* (2017), doi : 10.1080/00343404.2016.1269158
[53] Ibid.

has upward trajectory. Cleveland's place is in the goods-producing secondary sector, which has a declining trajectory. Combine this with the fact that centers of knowledge production act as a magnet for new economy firms, the advantages between the cities are clear.

The differences in the regions' robotic sectors largely play out in the healthcare sector: Cleveland excels in healthcare service provision, while Pittsburgh leads in life science R&D. Yet there is an inter-medium in healthcare that historically gets short shrift called "translational research," described as a "bench-to-bedside" process which entails "translating research into practice…[or] ensuring that new treatments and research knowledge actually reach the patients or populations for whom they are intended and are implemented correctly."[54] It's arguably here that Cleveland excels from an R&D capacity standpoint, as evidenced by the city's 18th-place ranking in "translational research" projects funded from HHS—just ahead of Duke University-based Durham, NC (see Figure 13). The question becomes: Is translational research an area the region should strategically invest? The short answer is "yes." But the short answer isn't enough.

**Figure 13: City Ranking of "Translational Research" Projects Funded by Department of Health and Human Services, 2008 to 2016**

*Source: Star Metrics via Federal Reporter*

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In 2011, IBM's Watson began a stint as a medical student at the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University.[55] While describing how Watson learns is beyond the scope of this paper, it's enough to say that Watson trained like any medical student. Watson reads medical studies and pours over patient notes, medical images, and electronic medical records, with several IBM-acquired health IT firms, including Explorys, feeding it data on 300 million patient lives. The endgame is to make Watson a very smart assistant to aid in diagnosis and treatment, yet this assistant would have the information of millions of experts in numerous fields, and its knowledge would be current. The amount of medical data doctors can use to impact care will double every 73 days by 2020. "By allowing Watson to crunch and cross-reference data and patient information," notes the Cleveland Clinic's Toby Cosgrove, "human doctors will have more time to spend with patients – talking to them, listening to them, understanding them." This freeing of time will lead to an industry that is not only more productive, but also "less robotic and more human," explains Cosgrove.[56]

[54] E. Wehling. *Principles of Translational Science in Medicine: From Bench to Bedside.* (Cambridge, UK: Cambridge University Press, 2009).
[55] S. Lohr, "I.B.M.'s Watson Goes to Medical School." *New York Times.* October 30, 2012.
[56] T. Cosgrove, "A Computer that Allows Doctors to be More Human." Consult QD, July 2016.

Progress on this front is slow, however. In the recent MIT Technology Review piece "A Reality Check for IBM's AI Ambitions,"[57] the author explains that the current problem holding Watson and other AI systems back is that certain types of data are needed for machines to learn. But healthcare data commonly doesn't exist in the right format. "Health care has been an embarrassingly late adopter of technology," affirms Manish Kohli, a physician and healthcare informatics expert. The solution lies in close partnerships with large health-care organizations, "or getting Watson inside a wide range of medical centers…which are positioned to provide the critical data needed to shape AI's future in medicine."[58]

Enter the recent announcement of a 5-year agreement between the Cleveland Clinic and IBM aimed at expanding the Clinic's IT capabilities. It effectively embeds IBM into the hospital so as to create a health IT process that plugs the data gap. The agreement is a two-way street: data scientists will translate their needs to healthcare professionals regarding the data needed, while healthcare professionals will translate the tacit knowledge they have to enliven that data. Importantly, just like Cleveland deploys the industrial robots Pittsburgh designs on the shop floor, it's in the process of translating the basic science of AI in its hospital settings.

What do these developments mean for the future of Cleveland's economy? Finding the answer entails examining the extent health IT work in Cleveland produces knowledge or facilitates a service. That is, is the health IT landscape in Cleveland tertiary ("puck been") or quaternary ("puck going")? And if it's the former how do we leverage it into the latter?

# Innovation Through Disparity

Headlines abound that this or that city is the "next Silicon Valley," with the stories invariably discussing the number of start-ups or tech jobs a geography is producing. But tech in itself is less an industry than a tool deployed in other industries to better a good or service. Think tech in journalism that makes online what was once in print. Here, the "new economy" isn't new, rather just decreasing the cost of pretty old work. That frequently happens in healthcare, as tech is being used to better healthcare services. That's not unwelcome. Better healthcare services means healthier people and less waste for the populace. It's also advantageous for a given hospital system: a better product means a better brand and thus wider customer base.

Recall, though, that it's not the good or service that provides the value add, but the data capital derived from that good or service. For example, people think of Uber as a taxi business, but its drivers are actually data collectors of road conditions, with that data then used to feed its autonomous vehicle research in Pittsburgh. IBM, too, is no longer a firm that makes business machines and then services them. It's an aspiring data capital company that makes "data plays" in given industries, including health. One big data play is in Cleveland, and while that has created the potential for a health IT cluster locally—with hundreds of healthcare analytics jobs in the offing—the data mined here is being "pipelined" to the world-class research hub that's Cambridge: home of IBM Watson Health. In other words, the knowledge produced in Cambridge is off the backs of services rendered in Cleveland.

Cleveland can do better. It must find a way to keep the added value of the data mined "in house" so as to evolve from a largely secondary and tertiary economy to quaternary one. The main way to do this is leverage the fact that Cleveland is a node in a network of cities advancing one of the most important fields in the world: healthcare analytics, with the goal to grow a R&D hub off its healthcare and health IT clusters. To get there means strategizing around assets like translational research, but doing so in a field capable of rendering first mover advantages. The field proposed in the current analysis—which is by no means exhaustive—is the artificial intelligence (AI) of population health, particularly the AI of disparities.

[57] D. Freedman, "A Reality Check for IBM's AI Ambitions." *MIT Technology Review* (June, 2017).
[58] Ibid.

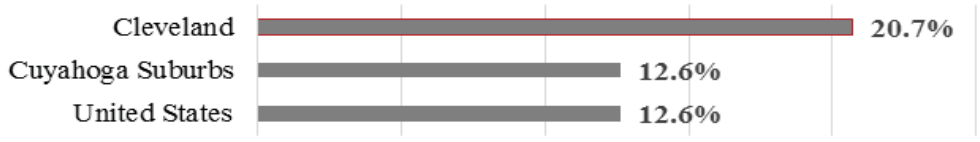
Why healthcare disparities? A nation's and region's gross domestic product (GDP) is a function of two forms of capital: intangible capital (as measured by knowledge creation and human potential) and tangible capital (as measured by physical infrastructure and equipment, inventories, and natural resources). By the 1970s, the stock of America's intangible capital overtook tangible capital as the main driver of GDP growth.[59] Intangible capital itself is created two ways: (1) investments in knowledge production via education and R&D and (2) investments geared to people's physical state, or one's health. Peoples' physical state, though, has been overlooked as a determinant of productivity, despite research showing that increased life expectancy has a pronounced positive effect on economic development, even relative to education.[60] In fact, estimates project that the effects of chronic diseases will cost the U.S. $794 billion per year in lost productivity between 2016 and 2030,[61] whereas premature death due to health inequalities will cost another $309.3 billion.[62] These figures are staggering (over $1 trillion lost annually), yet efforts to fix the issue—particularly through the lens of economic development—have been limited.

Put another way: economic development jargon has continually harped on the notion of "brain gain" and "brain drain," e.g., what can cities do to attract and retain talent—yet little thinking has been on "brain waste," particularly related to the limited capacity of those in poorer health. This has been a massive oversight, if only because those with health concerns have been viewed as a liability rather than a potentiality. Cleveland—with disability rates of 20.7% in the core city compared to 12.6% nationally—can be the proving ground to correct this oversight. The region should do this by using one form of intangible capital—knowledge production—to generate the other form of intangible capital—physical health—creating for a positive feedback loop that essentially uses technology to innovate through disparity. To date, technology has been a driver of disparity—i.e., its access bends toward affluence[63]—not a corrector of it. The region can help create a model to change that.

There is a need. It is estimated that only 20% of a community's health outcomes are the effect of clinical care, with the remainder a function of social determinants, including health behaviors, the environment, and social and economic factors.[64] And while there is a will to change the other 80%, the industry lacks capability. "Contrary to popular belief, the majority of health care professionals know that social determinants of health profoundly impact health outcomes. The desire is there but the capacity is not. Fragmented systems leave health care professionals without the time, resources, and support needed to help vulnerable populations become and remain healthy."[65]

**Figure 14: Percent of Adults w/Mental or Physical Disability**

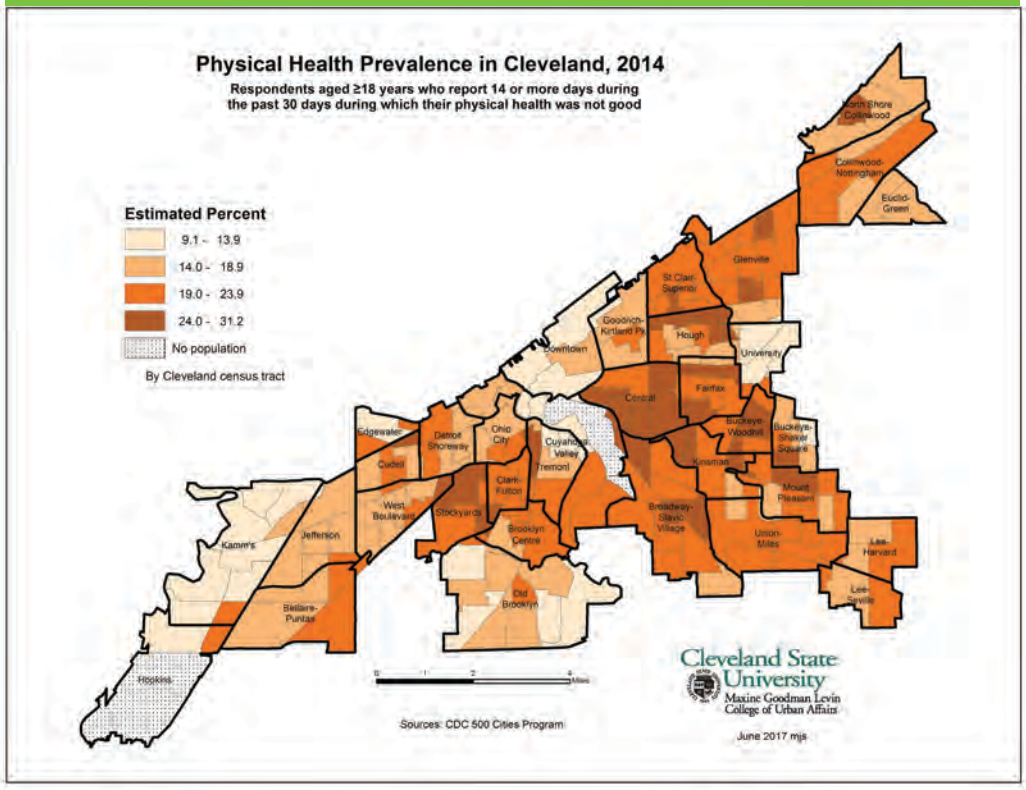
*Source: ACS 1-Year, 2015*




[59] P. David and D. Foray, "An Introduction to the Economy of the Knowledge Society." MERIT-Infonomics Research Memorandum Series (2002).
[60] K. Thorpe, "The United States Can Reduce Socioeconomic Disparities By Focusing On Chronic Diseases" Health Affairs Blog, August 2017.
[61] Ibid.
[62] T. LaVeist, D. Gaskin, and P. Richard, "The Economic Burden of Health Inequalities in the United States," Joint Center Political and Economic Studies Fact Sheet, September 2009.
[63] D. Rotman, "Technology and Inequality," *MIT Technology Review* (October 2014).
[64] K. Handmaker, "Incorporating Social Determinants into Population Health Management" (Healthcare Financial Management Association, March 2017).
[65] V. Mason, "More than Healthcare: Innovation and the Social Determinants of Health." *Medium* (September 2016).

**Image 5. Physical Health Complaints in City of Cleveland**

*Source: CD 500 Cities Program*




How can Cleveland lead the way to fill this void? The first step is collective awareness, or knowing the unique position Cleveland is in regarding thought leadership in the field of health disparities. That's because Cleveland has healthcare institutions and medical schools—University Hospitals, Case Western Reserve University, the Cleveland Clinic, Cleveland State University's Center for Innovation in Health Professionals, and MetroHealth Hospital—neighboring communities where health disparities are rampant. Life expectancies in the neighborhoods of Glenville and St. Clair Superior, for instance, are ten to twelve years less than nearby suburbs.[66] Again, this landscape is one of potentiality not liability, as services rendered to neighborhood residents are a source of data capital that can be used to create knowledge.

Developing strategies to build this knowledge will follow this initial step. This involves two tasks: understanding the data architecture that comprises the "other 80% of health" i.e., the social determinants. The other involves the development of algorithms that evolve as information is fed into them. That is, the context feeds the algorithms in order that the algorithms inform the context. The goal here is not so much preventative medicine via a change in individual behavior, rather a systemic change in population health that prevents disparities by predicting them in advance of their occurring.

Importantly, once that process is in place, it can be exported as a service to produce productivity in communities worldwide. "Interestingly, healthcare is a unique industry which can provide both tradable and nontradable output," explains one industry insider, "therefore creating a potential positive feedback loop that can provide sustainable growth to a region in terms of economic development. Cleveland is well positioned to become the model of a hybrid tradable and nontradable healthcare industry, particularly in modern products such as knowledge, services, and intelligence that have higher premiums compared to pharmaceuticals and devices, which inevitably faces commoditization and potential cycle decline."[67]

"Now, 'health' might not be our best industry. We have an industry to treat the sick - it is disease, not health management," notes the insider, explaining that the region's health export model is centered on diagnosis and treatment. "What we miss is to add technology to our model to make it expandable and to focus and develop the 'health' part of healthcare — here comes commitment to eliminate health disparity."

If successful, Cleveland can move up the knowledge hierarchy with the likes of Cambridge and Pittsburgh by entering the quater-

[66] See: https://societyhealth.vcu.edu/work/the-projects/mapping-life-expectancy.html
[67] Personal Interview. Request anonymity, May 2016.

nary sector of the world economy. Here, services rendered worldwide create a flow of data capital that's "pipelined" back into the region so as to deepen the knowledge base. Then, smokestacks will be chasing Cleveland instead of Cleveland chasing smokestacks.

The alternative, of course, is to do what we have been doing. Building buildings, chasing yesterdays. But then we will be asking the same question—"What's wrong with Cleveland?"—thirty years hence as Rabbi Silver did some thirty years back. Yet the fix then is still the fix now. "The future of Cleveland rests first on a revived economy," observed Rabbi Silver. "A revived economy depends upon bright people and new ideas. People do not get ideas out of the air. Ideas begin in our schools, universities and laboratories… The future for Cleveland cannot be bought cheaply."[68]

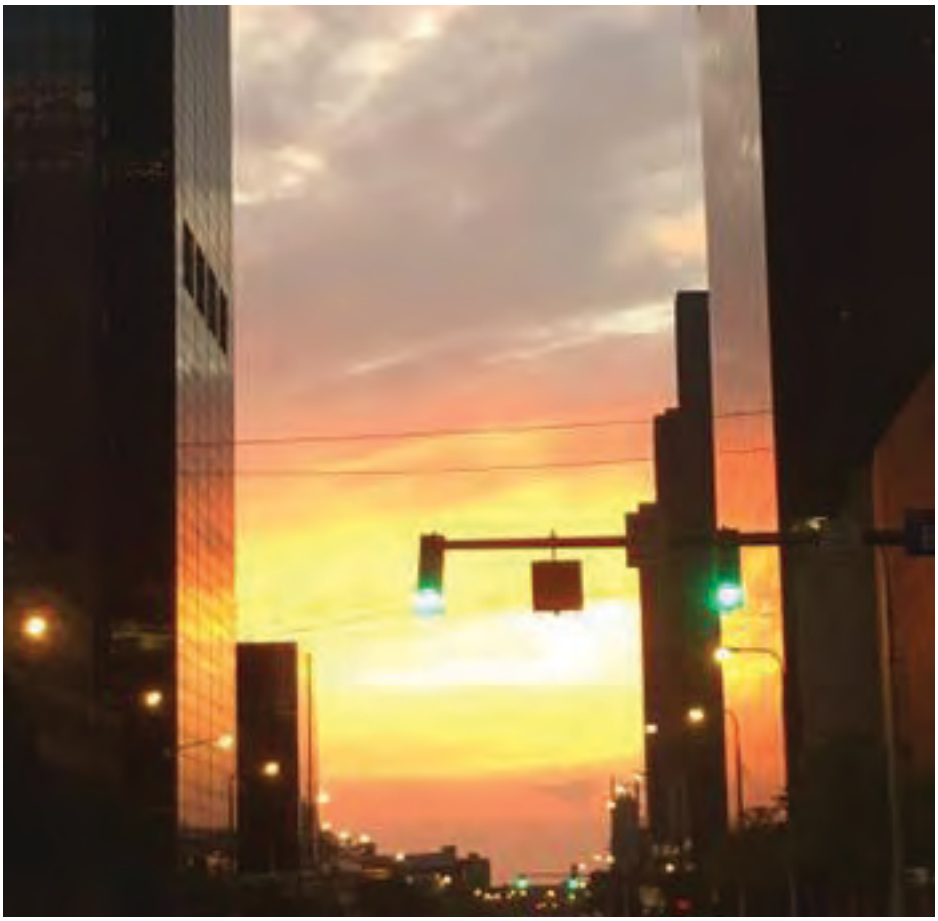


*Image 6: Courtesy of Healthy Cleveland*

[68] Rabbi Daniel Jeremy Silver, "What's Wrong with Cleveland" (sermon, 1985).

Levin.

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