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From Metal to Minds: Economic Restructuring in the Rust Belt

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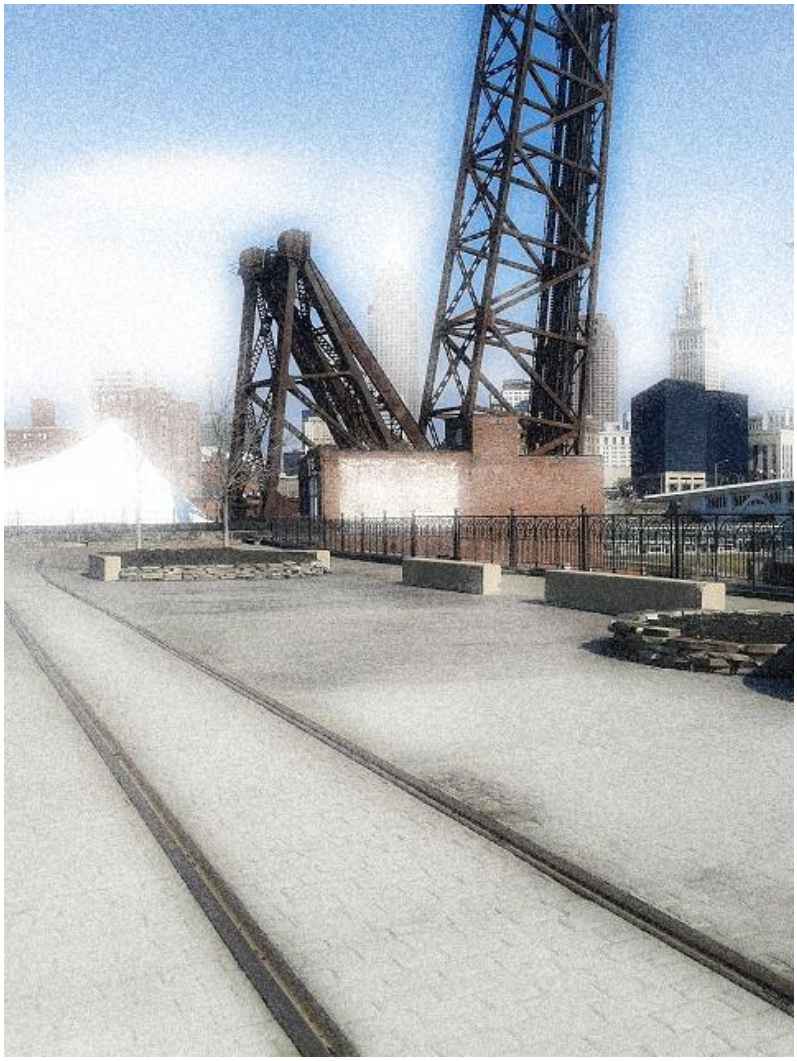

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Table of Contents

Forward Page 3

Section 1: Separated at Rebirth Page 4-6

Section 2: The Anti-Social Network

- Failing to Succeed Page 7-8
- "Forums" versus "Fountains" Page 8-9

Section 3: A Pittsburgh Story

- From the Ashes of Steel Page 9-12
- The Software City Page 12-14
- Succeeding in Failure Page 14-19

Section 4: The Rise of the Knowledge Society Page 19-23

Section 5: Cleveland's Cure

- The Kardiac Kids Page 23-26
- Moths to a Flame Page 27-29
- Keeping the "River" Burning Page 29-30

Foreword

There has been no lack of ink spilled on the effects of deindustrialization in Rust Belt cities. The narrative arc is usually the same: loss of manufacturing jobs led to depopulation and disinvestment. Intuitively, the policy prescription is to get the factory jobs back. To the extent this is doable is one thing, to the extent this is strategic is another.

Enter "Saxophone Santa".

A recent *Economist*[1] piece details the other side of globalization, looking at the Chinese city of Yiwu, dubbed the "Christmas Village". Yiwu makes 60% of the world's Christmas trinkets. One of the trinkets is a Santa Claus with a saxophone. They get made, boxed, shipped, and consumed, all of which is technically economic development. Ask people in Yiwu, though, why Santa has a saxophone "and no one quite knows why". But it doesn't matter. People are getting paid minimally to make it and people are spending marginally to buy it.

Meanwhile, making in Rust Belt Cleveland is occurring as well. "Big Data pioneer Explorys plans to expand in University Circle" reads the *Plain Dealer*[2]. Explorys does big data analytics with the reams of information pouring out of global healthcare institutions like University Hospitals and the Cleveland Clinic. The software being developed is helping reduce healthcare costs while aiding in treatment innovation. As such, Explorys makes longevity, with the aim the production of value, not simply the consumption of things. Saxophone Santa this isn't. Angry Birds this isn't.

"You can work for a cool tech company with a texting app," noted the co-founder. "Or you can work for a company that improves health for millions of people."

This contrast, then—i.e., one between making for human consumption versus making for human production—drives the heart of this paper. It is an analysis that charts the economic restructuring of Boston, Pittsburgh, and Cleveland, looking specifically at the role the "eds and meds" sector is playing in the creation of the "knowledge society", or those milieus where economic gain is driven via industries of human progress.

A further explanation of the "knowledge society" is in the pages that follow. For now, it is enough to hint at its development. "The profound global changes that we are facing today will be comparable in depth and magnitude to those which brought about the shift from the agricultural to the industrial society," writes French mathematician Michael Demazure[3]. "This change should be addressed successfully through careful and wise policies."

The current analysis attempts to do just that: inform with the intent for wise policies, particularly for regions such as Pittsburgh and Cleveland that are still "feeling" their way through economic restructuring. But one thing is for certain: the Rust Belt's future is not returning to the past. Well, at least not exactly.

Wrote poet philosopher George Santayana: "Those who do not remember the past are condemned to repeat it." Those who do, however, are not.

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[1] "Oh what fun". *Economist*, Print Edition. Dec. 2014.
[2] Smith, R. "Big Data pioneer Explorys plans to expand in University Circle". *Plain Dealer*, Jan. 2015.
[3] Michel Demazure, "New governance for a new society," Organization for Economic Cooperation and Development, The OECD Observer, Paris, July 2001, p 3.

Section 1: Separated at Rebirth

"Human history becomes more and more a race between education and catastrophe"—H.G. Wells.

Despite progress, Greater Cleveland is still in the grips of an economic restructuring into a knowledge-based economy. Employment gains are moderate. Population growth is lacking. Home values are low. These facts are known. Less known is that many of today's urban success stories had a similar Rust Belt profile not long ago.

Take Boston. The city's population dropped by nearly 200,000 from 1920 to 1980, and 75% of its housing stock was below the bricks and mortar cost of construction[4]. Today, the Boston metro has the 4th highest per capita income of big-city metros[5]. It has the 5th largest number of residents with at least a bachelor's degree[6], and its median housing value is now $363,200[7].

What happened? "The source of Boston's recent success is not unknown," wrote Harvard economist Ed Glaeser[8]. "[B]oston in 1980 had a strong skill base relative to its rustbelt peers…This skill base, which is most strongly related to the educational history of the region, enabled Boston to become a successful city in the information age."

In other words, Boston's skill base was the engine that drove the metro from seafaring, to textiles, to the likes of biotech and education technology. *But it was a skill base enabled by Boston's "educational history"*. For Rust Belt metros, this educational history has come about two ways.

First, as legacy assets of the industrial age. Put simply, the industrialist wealth amassed in Rust Belt cities seeded early-stage construction of universities and hospitals that today form the "eds and meds" sector of the economy. Yet at the time of their creation, these legacy institutions were formed for humanist purposes, not as engines of economic growth. Things changed. "In 1950, Boston's universities may have seemed like a quaint anachronism of the city's Brahmin past," noted Glaeser, but those universities would prepare Boston once America entered the knowledge economy[9].

Second, decades of manufacturing embedded regions with collective "know-hows" related to the design, finance, and manufacturing of products. The historical DNA that resulted is a competitive advantage that's translatable into newer work, such as advanced manufacturing. For instance, while steel-making collapsed in Pittsburgh, the metro knows how steel is made, and this labor expertise has allowed Pittsburgh to transition from a steel maker to a steel technology cluster[10]. As well, Cleveland's making legacy has enabled its position as a key cog in the manufacturing of medical imaging machines and other biomedical devices.

Taken together, as America's position in the global economy continues to specialize in knowledge production, the regions that can give their educational history currency will win the day. This is done by leveraging legacy institutions and labor expertise. Boston is one metro that has crossed "the valley" of economic restructuring. Increasingly, Pittsburgh is another.

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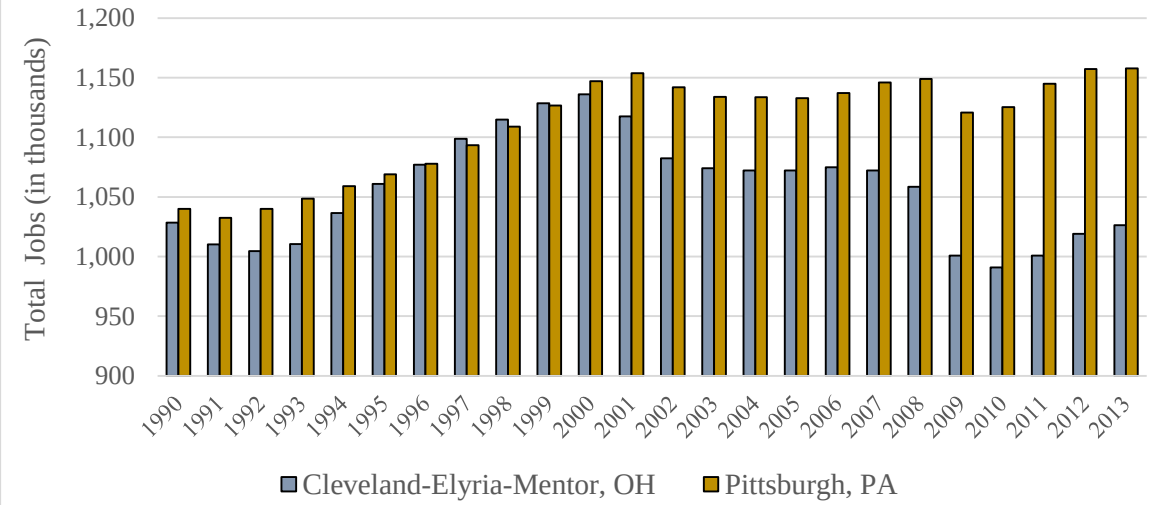
[4] Glaeser, Edward L. "Reinventing Boston: 1630–2003." Journal of Economic Geography 5.2 (2005): 119-153.
[5] Source: Bureau of Labor Statistics, 2012.
[6] Source: American Community Survey, 2013.
[7] Source: Ibid
[8] Glaeser, Edward L. "Reinventing Boston: 1630–2003." Journal of Economic Geography 5.2 (2005): 119-153.
[9] Ibid
[10] Treado, Carey Durkin. "Pittsburgh's evolving steel legacy and the steel technology cluster." Cambridge journal of regions, economy and society 3.1 (2010): 105-120.

"[B]eneath the collapse, stagnation and misery," noted a 2014 *Politico* feature, "[Pittsburgh's] core assets remained largely intact, in the form of human capital housed in the city's cultural institutions, foundations, an overlooked industrial research sector and above all its great universities—Carnegie Mellon, Pitt, Duquesne—built and endowed by the 19th century robber barons who gave the city its first golden age. Pittsburgh wasn't dead; it was just sleeping."[11]

How Pittsburgh "woke up" will be detailed below. It is first necessary to document the "Steel City's" divergence from its Rust Belt sibling Cleveland. The task is less about how Cleveland failed, rather how Pittsburgh is succeeding.

From 1990 to 2013, Greater Pittsburgh gained nearly 117,900 jobs. The region is now at an all-time high for labor force participation[12]. Conversely, Greater Cleveland lost 2,200 jobs, creating a job growth "gap" of 120,100 between the two regions. Figure 1 details where this divergence occurred. The two regions had equal total employment numbers in 1999, before separating ever since. Why?

Figure 1: Total Employment for Cleveland and Pittsburgh 1990-2013
Source: BLS



To answer this, job change by industry sector was analyzed. Over the last 23 years, Greater Cleveland lost 87,900 manufacturing jobs (see Table 1). Eighty-two percent (82%) of the job losses occurred since 2000. Pittsburgh's manufacturing job losses were less severe—a decrease of 41,300 jobs. This difference in manufacturing job loss severity (46,600) **explains 40% of the job growth "gap"** between the Cleveland and Pittsburgh metros.

The data illustrates that Pittsburgh deleveraged from its slow-growth manufacturing economy at an earlier date than Cleveland. The Federal Reserve Bank of Cleveland noted that the percentage of Pittsburghers employed in manufacturing went from 37% in 1964 to 16% in 1985[13]. This decrease has only continued. The share of Pittsburgh workers employed in manufacturing now stands at 7.7%, down from 12.6% in

[11] Thrush, G. "The Robots that Saved Pittsburgh". *Politico*, Feb. 2014.
[12] See: http://nullspace2.blogspot.com/2013/01/tale-of-two-charts.html
[13] Federal Reserve Bank of Cleveland. Annual Report. 1986.

1990 (Table 1). Greater Cleveland, however, still employed over 20% of its workforce in manufacturing in 1990. The concentration dropped to 12% by 2013. This more recent deleveraging from manufacturing explains much of Cleveland's divergence from Pittsburgh since 2000.

Table 1: Manufacturing Employment Cleveland/Pittsburgh Source: BLS

	1990	2013	Change (1990-2013)	% of Labor Force 1990	% of Labor Force 2013
Cleveland	211,700	123,900	-87,900	20.6%	12.1%
Pittsburgh	130,600	89,400	-41,200	12.6%	7.7%

Table 2: Knowledge Service Sector[1] Employment Cleveland/Pittsburgh Source: BLS

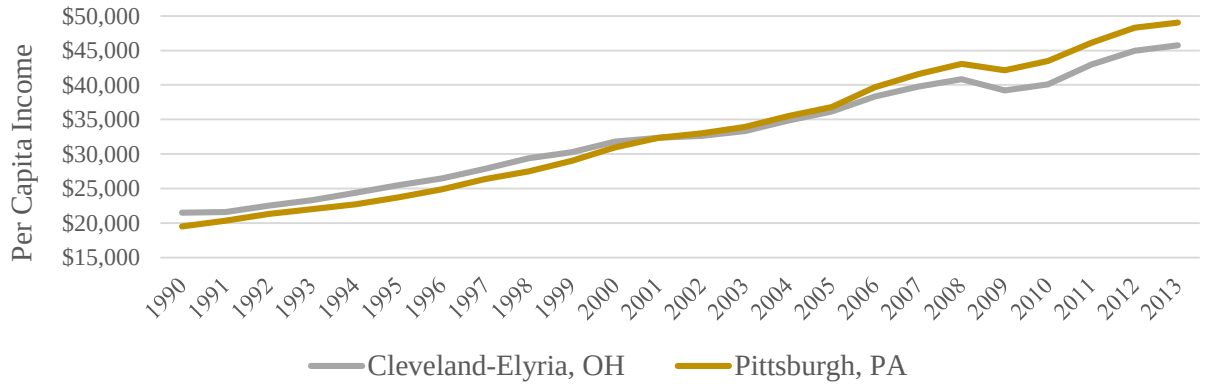
	1990	2013	Change (1990-2013)	% of Labor Force 1990	% of Labor Force 2013
Cleveland	234,100	342,100	108,000	22.8%	33.3%
Pittsburgh	286,800	415,200	128,400	27.6%	35.9%

1 Knowledge Service Sector includes Education and Health Services and Professional and Business Service sectors

As Pittsburgh deleveraged from manufacturing sooner, it restructured around knowledge industries prior to Cleveland. Table 2 shows that by 1990, Pittsburgh had 27.6% of its workforce, or 286,000 people, employed in education, health, and professional and business services. By 2013, the number of Pittsburghers employed in the knowledge service sector increased by 128,400. Greater Cleveland, too, has experienced a restructuring in its workforce, with one-third (33%) of Clevelanders employed in education, health, and professional and business services in 2013, up from 22.8% in 1990. Nonetheless, Pittsburgh has outgained Cleveland by 20,400 knowledge service sector jobs from 1990 to 2013, which accounts for approximately **18% of the job growth "gap"** between the two metros.

The divergence between the regions extends into income and educational attainment. An analysis[14] by Praxis Strategy Group analyzed the "brain gains" for America's largest 51 metros. Pittsburgh was **second** in the nation, trailing only Boston, in the increase of residents with a bachelor's degree or higher from 2000 to 2013. Greater Cleveland ranked 32nd. This rapid accumulation of human capital in Pittsburgh—a city once nicknamed "hell with the lid taken off" due to its prevalence of blast furnaces—is significant. Also, given the relationship between education and income, it follows that Pittsburgh's per capita income would increase more than Cleveland's. Figure 2 shows that this the case, with this separation occurring mainly after 2006. These numbers show that Pittsburgh is emerging from its economic restructuring. To understand why is to know how the fall was birthed in the first place.

Figure 2: Per Capita Income for Cleveland and Pittsburgh 1990-2013
Source: BEA



[14] Kotkin, J and Schill, M. "America's Smartest Cities". *New Geography*. Nov. 2014.

Section 2: The Anti-Social Network

"Go west young man, and grow up with the country"—Horace Greeley.

Failing to Succeed

The "Steel City" was nicknamed so for a reason. Pittsburgh produced more than 60% of the nation's steel by 1910[15]. This output consumed a good portion of the labor force. In 1957, 43% of the region's manufacturing sector was comprised of steel workers[16]. Yet as Pittsburgh rose with steel, it fell with steel, and it was a "body blow", notes the *Pittsburgh Quarterly*, "that no major American city had ever received"[17]. Facing stiff competition from foreign firms, the steel industry's bottom fell out in 1984, and the unemployment rate, 18%, was nearly double the national rate[18]. Fifty thousand (50,000) people on net left Pittsburgh in 1984 alone[19]. By the late 80's, 75% of the steel mills shuttered, with only a handful open today. As well, 75% of the city's corporate headquarters are now gone[20].

The tale of Pittsburgh's fall is not unique. It is the epithet for cities across the industrial heartland. The more informative story is Pittsburgh's rise from the fall. ***It is a rise preconditioned on failure, or on the need to sever a city's dependence on a few mature industries.***

"Boston's economy had to be virtually purged of its reliance on the textile industry before it was ready to nurture new, innovative firms," notes the 1986 Annual Report from the Cleveland Fed[21]. "If such a decline of a region's base industries is a necessary precondition for advancing to another wave of development, then the erosion of Pittsburgh's manufacturing base is setting the stage for Pittsburgh's renaissance".

The Fed report proved prescient. Before sketching out why it's necessary to introduce the concept of "life cycles" as they relate to economic development. Like people have life cycles, so do industries. The "birth", or research and development phase, leads to a new product or industry, one that is introduced to the market. With little competition, output grows, gaining a wide market share. After long, competitors come in, like foreign steel firms. Without further innovation, a given industry matures and eventually "dies".

The key, here, is that when a region is dominated by a few mature industries, like Pittsburgh with steel or Detroit with cars, then the region's life cycle reflects the life cycle of the dominant industry. "As established industries mature and decline," writes lead author Michael Fogarty in "Cleveland from Startup to Present,"[22], "a city eventually loses its ability to create new industries and the so-called 'incubator' or 'seed' function which creates new industries shifts to other regions". But why is that? Why did Rust Belt metros become less capable of growth?

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[15] Pittsburgh Regional Planning Association. *Economic Study of the Pittsburgh Region: Region with a future*. Vol. 3. University of Pittsburgh Press, 1964.
[16] Chinitz, Benjamin. "Contrasts in agglomeration: New York and Pittsburgh." *The American Economic Review* (1961): 279-289.
[17] Dietrich, W. "A very brief history of Pittsburgh". *The Pittsburgh Quarterly*. 2008.
[18] Pittsburgh Today. "Pittsburgh Today and Tomorrow". 2014.
[19] "Outmigration Steady in the Region". *Pittsburgh Economic Quarterly*. Vol. 1. Issue 1. 2000.
[20] Dietrich, W. "A very brief history of Pittsburgh". *The Pittsburgh Quarterly*. 2008.
[21] Federal Reserve Bank of Cleveland. Annual Report. 1986.
[22] Fogarty, Michael S., Gasper S. Garofalo, and David C. Hammack. *Cleveland from Startup to the Present: Innovation and Entrepreneurship in the 19th and Early 20th Centuries*. Center for Regional Economic Issues, Weatherhead School of Management, Case Western Reserve University, 2002.

An economic ecosystem, like any ecosystem, is dependent on flow, or a circulation of ideas via emerging networks, as well as the circulation of capital, which is usually passed down from established firms to small firms and entrepreneurs. In the case of the Rust Belt, mature industries have historically sucked the air out of a given city's ecosystem, absorbing it for themselves instead.

Initiated by Pittsburgh economist Benjamin Chinitz[23], there is a long, if unappreciated, line of research as to how this unfolded. During the 1930's, large manufacturing corporations took their research and development "in-house", shifting the locus of innovation away from entrepreneurs and small firms. Cleveland's industrial labs grew to 65 by 1930, up from 18 in 1920[24]. ***With R&D increasingly monopolized by large corporations, the focus was not on the development of new industries, but rather on the continuation of existing industries, causing crucial opportunities to be missed.***

In a 1945 speech to city leaders, former Cleveland city manager William Hopkins bemoaned a few colossal missteps in the early 1900s. The founders of General Motors and Lockheed Martin[25] wanted to put down roots in Cleveland, for instance, but couldn't get financing, so they went to Detroit and Baltimore, respectively. In retrospect, not good. At the time, however, the region's captains of industry felt newcomers and their ideas were not needed. "Indeed," writes Cleveland State's Tom Bier in the *Plain Dealer*, "newcomers could be a threat, particularly if they were to draw labor away from established companies.[26]"

Consequently, the seeds of the Rust Belt's decline were sewn early. "Most observers think of the 1970s as the decade when the Manufacturing Belt fell into its sharp industrial decline," notes Fogarty, but the Rust Belt's productivity decline began as early as the 1930s, due largely to the monopolization of research and development and an associated decline of entrepreneurship[27].

Worse, a parochial culture emerged that became one of path dependence. It was an ethos of risk-aversion and defensiveness dictated by a scarcity mentality of "holding on to what you got". Specifically, the drumbeat in industrial labs was to protect one's own technology, while reverse-engineering that of its rivals and of entrepreneurs. Knowledge networks, then, became undone in the name of competition. Though one effect was to extend the maturity stage of various slow-growth industries, another was a depletion of new ideas and new firms. The ensuing "institutional sclerosis" resulted in the shift of innovation from the Rust Belt to the Sun Belt[28]. After long, Silicon Valley was born.

"Forums" Versus "Fountains"

Industrial cities were in crisis mode by the 1980's. Mature industries were failing rapidly. Regional leaders, gripped by decline, frantically plotted strategies for economic reconstruction. Efforts were made to invigorate downtowns as entertainment districts, as well on attraction and retention of corporations, but neither addressed the need to rebuild local knowledge networks. Leaders turned to legacy institutions, particularly research hospitals and universities, as sources of new ideas. "Yet how [institutions] should go about filling this mandate," according to MIT's Sean Safford," was not made clear[29]."

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[23] Chinitz, Benjamin. "Contrasts in agglomeration: New York and Pittsburgh." *The American Economic Review* (1961): 279-289.
[24] Fogarty et al. 2002.
[25] Bier, T. "Cleveland's industrial devolution". *Plain Dealer*, Feb. 2001.
[26] Ibid
[27] Fogarty et al. 2002.
[28] Federal Reserve Bank of Cleveland. Annual Report. 1986.
[29] Safford, S. "Forums Vs. Foundations: Universities and the Evolution of Knowledge Networks in Akron and Rochester Vol. 2005. No. 1. Academy of Management, 2005.

In his analysis called "Forums vs. Fountains: Universities and the Knowledge of Networks"[30], Safford contrasted two main approaches taken to rebuild knowledge networks in the Rust Belt. Akron officials, in their attempt to partner with the likes of Goodyear in the use of polymers, used what he termed the "fountain" approach. Here, the local university tried to become the central hub of R&D—a kind of gatekeeper of knowledge, or the "life of the party"[31]—with ideas being fed into big firms for product development. Little effort, though, was spent developing relationships with small firms or entrepreneurs, connecting big firms with small firms, or more generally diffusing knowledge in the local network.

The problem with this was twofold according to Safford. One, it simply attempted to shift the monopolization of knowledge from the firm to the institution. Two, the companies never accepted the university's self-appointed role, and the insularity in the network remained. As such, cooperation, at least from the big firm perspective, was simply about employing the graduates as they came out of the university. Firms didn't need ideas, they needed labor. The fatal flaw in this logic is that the development of knowledge networks creates local job demand[32]. Consequently, the fountain approach proved ineffective and was discontinued in 1995.

The University of Rochester took a facilitator—or the "host of the party"—approach, one termed the "forum" by Safford. Rather than becoming a gatekeeper of optics-related research and development, the university's goal was to both *produce and redistribute* knowledge across the network. "What mature regions lack are institutions that can help bridge among isolated actors in communities," notes Safford. While Akron's approach was to close the gap between the university and the big firm, Rochester's institutions, through the likes of consortia and knowledge trade missions, bridged the gaps between small and large companies, and between actors inside and outside the region. Rochester's efforts, then, entailed unlocking knowledge and dispersing it back into the ecosystem through transfer efforts up and down the network's hierarchy.

"Popularity is exhausting," noted the playwright Wilson Mizner. "The life of the party almost always winds up in a corner with an overcoat over him." Delineating the role both universities and research hospitals play in the restructuring of local economies is a complex process, lest the anchor institutions become marginalized in their contradictory roles as producers of knowledge for the public good and producers of innovation for private profit. The most successful institutions navigate this paradox by knowing there is wealth in knowledge, but not necessarily knowledge in wealth.

Section 3: A Pittsburgh Story

From the Ashes of Steel

The fall of the Steel City was exceptional in its suddenness and completeness. The collapse, though fear-inducing and painful, enabled a "realization that modernization of the economy was now possible", according to Pittsburgh historian Roy Lubove[33]. The effort that followed was impressive, with nearly 400 strategic documents created between 1984 and 1994 alone[34]. While there was neither a single plan nor lone agency that can take credit for Pittsburgh's comeback, what emerged was a guiding, if implicit,

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[30] Ibid
[31] University of Chicago. "Universities and the Evolution of Knowledge Networks". *Capital Ideas*. Oct. 2009.
[32] Abel, Jaison R., and Richard Deitz. "Do colleges and universities increase their region's human capital?." *Journal of Economic Geography* (2011): lbr020.
[33] Lubove, Roy. "Twentieth century Pittsburgh, Volume Two: The post steel era." 1996.
[34] DeAngelis, J and Deitrick, S. "The Regional Economic Development Bibliography and Data Base (TRED/Biblio) Final Report". Dec. 1994.

consensus of what needed to be done: a restoration of the region's knowledge network, and more generally the economic diversification of a formerly "company" town.

Pittsburgh relied on its educational history to reconstruct. As steel was declining, the region's "eds and meds" sector was rising. Health, educational, and business support services increased by 115,000 jobs between 1960 and 1983[35]. Cultivating this knowledge service sector was crucial, noted Lubove, with the objective to create "a more self-conscious strategy" that would push Pittsburgh in a direction it was heading.

Section 3 describes how the region did this, focusing on the efforts of one individual: Richard Cyert, President of Carnegie Mellon University (CMU) from 1972 to 1990. Cyert loomed large to the extent he provided critical guidance during the 1980s. "It was a terrible time. ... People didn't see a future for themselves in Pittsburgh," noted former Pittsburgh Mayor and state legislator Tom Murphy[36]. Murphy singled out Cyert as a visionary. "[He] was the one for me who was driving this conversation. He was the first person I heard who said the universities could be the economic drivers for the region.[37]"

Before detailing Cyert's efforts, it's important to point out that not all parties were on board with a concerted aim to deleverage from manufacturing. Service professionals, whether it be a heart surgeon, professor, or sous chef, were commonly seen as part of the local, consumer economy, and not part of the tradable, productive economy. From this view, Pittsburgh's future was its past.

"A retail service economy cannot exist in a vacuum," noted one member of the Steel Valley Authority in the late 80s, "it ultimately depends upon those sectors, such as basic manufacturing, that export to the larger markets…Sophisticated medical care, chic restaurants, specialized legal services and higher education are all part of the consumer economy, not the productive economy.[38]"

This parochial, if not reactionary, view of service delivery was (and still is) pervasive in Rust Belt cities. Production meant what can be soldered, boxed, and consumed by non-locals. Conversely, knowledge and health was simply a byproduct (of) and pathway (to) simply making more things. "The conventional view of the service-producing sector," noted the Cleveland Fed in 1986, "was that it grew only as a result of healthy manufacturing, and did not generate wealth for the area"[39]. This was false. The service-producing sector was an exporting sector, according to the Fed, with "the potential to directly spur local economic expansion". This is what occurred in Pittsburgh.

Greater Pittsburgh's Education and Knowledge Creation sector—which includes employment at colleges, universities, research organizations, and training programs—currently employs 62,994 people, ranking Pittsburgh 9th in the nation in total employment, just behind San Francisco (see Table 3). The sector grew by nearly 24,000 jobs, or 61%, since 1998. Importantly, Pittsburgh developed its Education and Knowledge Creation sector without the benefit of population gains, suggesting growth is being driven exogenously, not via local demand. Moreover, Pittsburgh ranks 3rd in the nation among big-city metros in its specialization in Education and Knowledge Creation, with a location quotient of 2.16, behind Boston and Baltimore. Put simply, a higher location quotient equates to a high degree of concentration of a given industry, or a "cluster". Regions with high location quotients are generally seen as exporting that industry to regions with lower location quotients, as well as internationally.

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[35] Lubove, Roy. "Twentieth century Pittsburgh, Volume Two: The post steel era." (1996).
[36] Rotstein, G. "30 years of change: A new direction for Pittsburgh". *Pittsburgh Post-Gazette*. Oct. 2013.
[37] O'Toole, Jim. "The Political Makeover of a Rust Belt City." *Politico*. Feb. 4th, 2014.
[38] Ibid
[39] Federal Reserve Bank of Cleveland. Annual Report. 1986.

Table 3: Largest Education and Knowledge Creation Clusters[1] in the United States by Metro

Metro	Employment 2012 (National Rank)	Location Quotient	Job Creation 1998-2012	Job Creation (%)	Avg. Annual Wage 2012	Population Growth (%) 1998-2012
New York	271,015 (1)	1.38	90,997	51%	$53,482	0.46%
Boston	168,610 (2)	2.57	46,137	38%	$68,953	0.49%
Los Angeles	136,272 (3)	0.92	49,399	57%	$49,661	0.54%
Washington, DC	130,109 (4)	1.92	84,683	186%	$74,626	1.55%
Chicago	123,313 (5)	1.1	39,120	46%	$55,447	0.44%
Philadelphia	119,778 (6)	1.81	49,337	70%	$56,676	0.47%
San Jose	67,483 (7)	2.02	35,961	114%	$135,086	0.74%
San Francisco	67,189 (8)	1.27	32,986	96%	$78,789	0.69%
Pittsburgh	62,994 (9)	2.16	23,782	61%	$46,974	-0.26%
Baltimore	59,126 (10)	2.21	26,101	79%	$55,059	0.62%
Cleveland	28,967 (23)	1.2	13,894	92%	$29,424	-0.29%

1 Education and Knowledge Creation Cluster includes people employed at universities and colleges, research organizations, training programs, education support services, and professional organizations. Source: U.S. Cluster Mapping Project

Cleveland, however, has a location quotient of 1.2, signifying its educational services are more locally-driven. Too, Greater Cleveland has nearly 35,000 less jobs than Greater Pittsburgh in education and knowledge creation. The average salary in the sector is also starkly different: $29,424 in Cleveland versus $46,974 in Pittsburgh. The wage difference is a reflection of how the industry operates in each metro.

Pittsburgh has become an exporter of education. Cleveland's higher education industry is more consumer-driven; that is, educators "sell" college credits to largely regional students, and a campus service industry develops as a main multiplier, hence the low wages. This consumer model has also led to an excess of liberal arts and general studies undergraduates that are ill-equipped for Cleveland's emerging industries, according to a report commissioned by the Cleveland Foundation[40]. Moreover, the consumer model can encourage an environment in which education is relegated to being a "pipeline" to mature industries. ***Here, knowledge is consumed by the needs of traditional industries, as opposed to knowledge producing emerging industries. This issue needs to be addressed if Cleveland is to economically reconstruct.***

Still, Cleveland's "consumer university" set-up is the rule, not the exception, and Pittsburgh's "producer university" milieu is the exception, not the rule. The thinking nationally is that by making more college graduates, a city's educational attainment rates will go up and then economic development ensues, because per capita income correlates with educational attainment. Likewise, attracting college graduates vis-à-vis "creative class" methods is another stock redevelopment mindset. In this model, cities economically develop by "cooling" their way to higher educational attainment rates with job and wage increases to follow.

But a recent study from the Federal Reserve Bank of New York called "Do Colleges and Universities Increase Their Region's Human Capital?" proves that pathways to economic growth are more

[40] Perkins, O. "Cleveland Foundation pushes placing workers in "family-sustaining" jobs by closing skills gap". *Cleveland Plain Dealer*. Sept. 2014.

complicated[41]. The authors found that a region's production of college graduates has only a "small positive relationship" with its levels of educational attainment. "At the same time," the authors' conclude, "we demonstrate that the academic R&D activities…act to increase local human capital levels, suggesting that spillovers from such activities can increase the demand for human capital, creating opportunities to attract and retain skilled labor".

In other words, a dense, strategic R&D environment spurs job demand in today's knowledge economy, and the supply of educated workers fills that demand, with a rise in educational attainment the result. Simply accruing college graduates won't suffice in the revamping of a Rust Belt economic ecosystem. It's akin to adding fish to a pond that has been drained of water. Instead, leadership is needed to economically reconstruct. So is a vision. In the 1980s, CMU President Richard Cyert had both.

The Software City

"Necessity is the mother of invention"—Plato.

Necessity happened in Pittsburgh. Richard Cyert, an organizational theorist by trade, knew that first hand. Cyert operated an institution in a metro experiencing contraction. Contracting strategically meant figuring out how to do more with less. Cyert accomplished this, transforming CMU from a consumer to a producer university. More notably, his reorientation of how the university did business helped seed a broader reorientation of how Pittsburgh did business. ***That is, just as Pittsburgh's decline was reflected in the "death" of steel, so the city's emergence would be echoed in the "birth" of a new industry, namely the production of knowledge.***

By 1988, Cyert was one of a few new "power brokers" in Pittsburgh, according to the *Post-Gazette*. Ten years prior he was an academic, writing articles such as "The Management of Universities of Constant or Decreasing Size"[42]. In it, Cyert forecasted the strategic direction he'd be taking CMU, inferring that when a university cannot operate successfully in "the conventional way" (via increased enrollment), then it would need to eliminate areas where the university was losing money, while moving into areas where there was potential for growth. "Stated more succinctly," Cyert writes, "it may be possible for some private universities to operate more as a mixture of a research institute and an educational institution than is currently done."

Cyert accomplished this. When he took over in 1972, CMU received $17 million in research funding. By 1990 it grew to $123 million, an increase of 846%[43]. Today, Carnegie Mellon's R&D expenditures have increased to $243 million. The university ranks 33rd in the nation in "The Top American Research Universities" completed by the Center for University Performance. Translating this knowledge to quality education, the school's computer science program ranks 7th in the world[44], and its statistics, mathematics, and engineering programs are in the top 50 as well[45].

It wasn't always this way. Carnegie Mellon was originally Carnegie Tech, a post-high school founded in 1900 by industrialist Andrew Carnegie that was meant to serve "the needs of the great industries" in the

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[41] Abel, Jaison R., and Richard Deitz. "Do colleges and universities increase their region's human capital?." *Journal of Economic Geography* (2011): lbr020.
[42] Cyert, Richard M. "The management of universities of constant or decreasing size." *Public Administration Review* (1978): 344-349.
[43] Lubove, Roy. "Twentieth century Pittsburgh, Volume Two: The post steel era." (1996).
[44] See: http://www.shanghairanking.com/SubjectCS2014.html
[45] See: http://www.cmu.edu/about/rankings-awards/rankings/universityrankings.shtml

region[46]. By 1912, the school transformed into a post-secondary institution modeled after MIT. Well into the 1950s, the model succeeded in connecting to local firms, with innovation sustaining many of Pittsburgh's dominant industries[47].

But there were problems. According to the article "The Historical Role of Pittsburgh's Research Universities in Regional Economic Development" by Annette Giovengo, the knowledge and college graduates being produced would dwell on those industries that built Pittsburgh[48]. Meanwhile, while Carnegie Tech focused on industries that would begin declining, M.I.T. and Stanford focused their efforts on growth industries, particularly research in electronics and information technology.

By the 1960s Carnegie Tech would pivot into emerging fields as well, centered on computing, robotics, and artificial intelligence. Yet the fruits of this knowledge would bloom on the coasts, as Pittsburgh's ecosystem was still dominated by traditional industries housed in big firms. It was a set-up, according to Giovengo, that "did not expose obvious niches for entrepreneurship, unlike Silicon Valley's orchard-based, under-developed economy or Boston's depressed textile economy."

But with steel's collapse came the dawn of a new day. The effort would be driven by research in advanced technology, with a main goal being tech transfer, or the commercialization of university R&D. "New technology has got to be the leader in establishing economic development [in Pittsburgh]," noted Pennsylvania Governor Robert Casey in 1986[49]. Influencing Casey was the increasingly persuasive Cyert, who was touting Pittsburgh as the next "software capital of the world"[50].

So began the hunt for the "white whale" in the Steel City's industrial evolution. It was a hunt meant to hook the next "big" firm back.

Cyert had a right to be ambitious. CMU's rise as a computer science mecca was coalescing by the mid-80s, highlighted by the school's awarding of a five-year $103 million dollar contract via the Department of Defense that established a federal research lab called the Software Engineering Institute (SEI), which would "develop technology to aid in the transfer of software between the government and private industry"[51]. Another five-year $156 million dollar grant would follow in 1990. It was a monumental victory for the region, one providing for a deciding "revolt against the city's smokestack image[52]".

More importantly, the initial funding rethreaded Pittsburgh's knowledge network, as it was used to hire over 200 of the nation's leading software experts and engineers. Eventually, this clustering of computing expertise, predicted CMU Provost Angel Jordan, "will act as a magnet in attracting more software companies", as well as ignite a robust start-up culture, primarily with the help of the Benjamin Franklin Technology Partners initiative—a still-existent, publicly-funded venture capital entity run by the state, but lobbied for intensively by Cyert and then-state representative Tom Murphy[53].

While any economic impacts would take time, the burgeoning reputation of the region created for an immediate pipeline of ideas back into Pittsburgh from the likes of Silicon Valley. "Steve Jobs often slept on a couch in [CMU] as he worked with computer scientists…Bill Gates would visit professors and

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[46] Giovengo, Annette L. "The Historical Roles of Pittsburgh's Research Universities in Regional Economic Development." *Western Pennsylvania History*: 1918-2013 70.3 (1987): 257-278.
[47] Ibid
[48] Ibid
[49] Lubove, Roy. "Twentieth century Pittsburgh, Volume Two: The post steel era." (1996).
[50] Ibid
[51] Ibid
[52] Ibid
[53] Gannon. J. "How CMU courted, caught SEI". *Pittsburgh Business Times*. Jan. 1985.

graduate students to work through new concepts and ideas," notes the 2014 Magnet Cities' report "Pittsburgh: The city that was reinvented by universities"[54], underlying the extent the Steel City reemerged in the psychogeography of the era's great minds. "Soon," the report continued, "some of the country's most innovative companies were setting up operations in close proximity to CMU to be close to the university's world-leading researchers and computer scientists".

Today, the companies that have planted flags in Pittsburgh include Google, Apple, Microsoft, Walt Disney, Uber, Intel, Oracle, and Yahoo. This newer economy presence has politicians who have come of age in the mood and mire of steel's collapse shaking their heads. "I never thought that I would live in a city that would be a boomtown," said Pittsburgh Mayor Bill Peduto recently[55]. "I always thought it would be how well we manage decline."

Of course what Mayor Peduto is referring to is the *inevitability* of decline. The vision of Cyert, however, was far less fatalistic, instead seeing strategic opportunities in the *reality* of decline as to how to do more with less. Cyert knew that contraction doesn't have to be forever. It can lead to invention: the forebear of growth.

This growth is evident when comparing Pittsburgh's per capita income gains versus the nation's largest 52 metros from 1985 to 2013. In terms of percent gain, Pittsburgh is second in the nation in income growth, behind San Jose, but ahead of Boston[56]. By that measure, Pittsburgh has succeeding in joining the club it sought to reach.

Succeeding in Failure

With the SEI's wind at their backs, CMU's provost Angel Jordan predicted in the *Chicago Tribune* that in the coming era it will be "Silicon Valley for chips, Boston for electronics, and it's going to be Pittsburgh for software[57]". In the same article, Cyert said 25,000 jobs will spin off the SEI within five years. Neither happened.

By the 1990s the sheen was starting to wear off on the idea of Pittsburgh becoming a software hub. Put simply, tech transfer out of the SEI wasn't. For instance, a piece entitled "Hopes were too high"[58] revisited the promises of the SEI to "spawn numerous start-ups" and create "thousands of jobs". Yet the SEI failed to spin-off one start-up in its first five years, contradictory to initial projections which—admitted one CMU staffer in the piece—were "extreme" and "unrealistic".

Although the tenor at the time was to preach patience, the struggles to remake Pittsburgh into the "next Silicon Valley" persist. Pittsburgh ranks 21st in the nation in total employment in the Information Technology Cluster, one spot behind Detroit, and two spots ahead of Cleveland (see Table 4). The region's specialization, or location quotient, is also low (1.17). The agglomeration of tech jobs in Pittsburgh never came, percolating instead into Silicon Valley, Boston, and Seattle.

To understand why IT jobs failed to cluster in Pittsburgh, it's important to look at the tech industry as a whole. IT lost the most jobs out of any sector outside of manufacturing from 2000 to 2010[59]. Job growth has been contracting significantly in all major tech markets outside of Seattle, indicating that the life cycle of tech is that of a new economy growing old steadily, complete with off-shoring and automation. This

[54] Magnet Cities. "Pittsburgh: The city that was reinvented by universities". 2014.
[55] Greenblat, A. "The Progress and Promise of Pittsburgh's Turnaround". *Governing*. Nov. 2014.
[56] Source: U.S. Bureau of Economic Analysis
[57] Longworth, R.C. "Software Stepping In Where Steel Left Off." *Chicago Tribune*. August 8th, 1985.
[58] Gannon, J. "Hopes were too high". *Pittsburgh Post-Gazette*. Jan. 1990.
[59] "America's Incredible Shrinking Information Sector". *Harvard Business Review*. Nov. 2013.

bodes ill for those cities trying to "hook" the next "white whale" in software or social media, as it's hunting for the future in the near past.

Table 4: Largest Information Technology Clusters[1] in the United States by Metro

Metro	Employment 2012 (Rank)	Establishments 2012 (Rank)	Location Quotient	Job Creation (% Change 1998 to 2012)
San Jose	72,976 (1)	908 (4)	6.31	-54.52%
Boston	63,616 (2)	946 (3)	2.80	-32.39%
Seattle	63,178 (3)	480 (8)	4.18	108.06%
Los Angeles	57,694 (4)	1,325 (1)	1.12	-37.14%
San Francisco	49,235 (5)	817 (5)	2.69	-18.80%
Pittsburgh	**11,811 (21)**	**188 (21)**	**1.17**	-12.22%
Cleveland	10,011 (23)	165 (23)	1.20	1.23%

1 Information Technology Cluster includes people employed in software publishing, software reproducing, electronic components, semiconductors, computers and peripherals, audio and video equipment, laboratory instruments, and medical apparatus. Source: U.S. Cluster Mapping Project

Still, the failure of Pittsburgh's universities to create spin-offs is less about the tech sector— and less about Pittsburgh—than it is the difficulty of university-driven tech transfer in general. This failure is documented in the analysis "The False Promise of the Entrepreneurial University"[60]. In the introduction of the 129-page report, the author writes:

"Although it has become almost a cliché for entrepreneurial universities and regional leaders to boast of becoming "the next Silicon Valley," a systematic review of the historical record reveals that the celebrated success stories of university-led economic development are more the exception than the rule. Far more typically, the commercialization of academic research and investments in university technology transfer have had little discernible impact in reshaping the economic trajectory of cities or regions. Nor…have university-generated patents and licenses produced the internal returns envisioned by proponents of academic commercialism."

While an analysis of why universities struggle at tech transfer is beyond the scope this paper, it is enough to say that what was expected to drive Pittsburgh's economic restructuring—i.e., research-driven entrepreneurialism—didn't. Nor has it for the vast majority of cities. But then what did?

Becoming a global node in the production of knowledge. Instead of making metal, Pittsburgh makes minds.

Specifically, Pittsburgh's Allegheny County, home to CMU and the University of Pittsburgh (Pitt), ranks 7th (out of ≈ 3,000 counties) in post-secondary employment, just behind the county seats of Boston and Cambridge. This, coupled with a location quotient of 3.80 and a 56% job growth from 1998 to 2012, indicates that the post-secondary education industry is clustering in Pittsburgh, despite attendant population decline.

[60] Levine, Marc V. "The False Promise of the Entrepreneurial University." (2009).

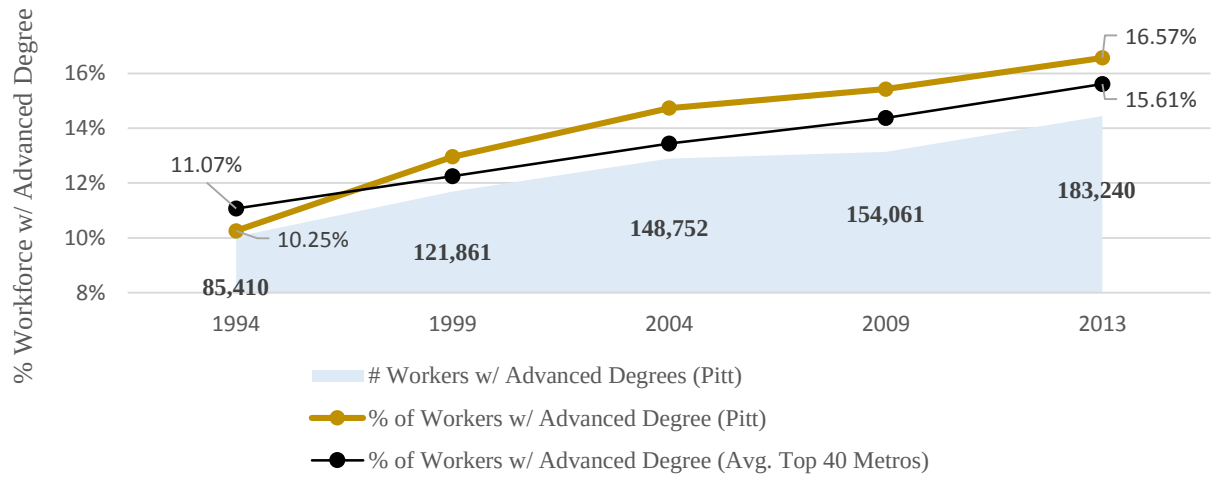
Table 5: Largest Post-Secondary Clusters[1] in the United States by County

County	Employment 2012 (Rank)	Location Quotient	Job Creation 1998-2012	Job Creation (%)	Population Growth (%) 1998-2012
New York (Manhattan)	82,183 (1)	1.92	19,304	31%	0.41%
Los Angeles	70,746 (2)	1.01	15,468	28%	0.47%
Philadelphia	64,124 (3)	6.69	25,329	65%	0.11%
Cook (Chicago)	59,410 (4)	1.54	17,663	42%	-0.16%
Middlesex (Cambridge)	55,336 (5)	3.17	11,110	25%	0.41%
Suffolk (Boston)	48,074 (6)	4.26	9,635	25%	0.64%
Allegheny (Pittsburgh)	**45,399 (7)**	**3.80**	**16,309**	**56%**	**-0.37%**
Maricopa (Phoenix)	41,071 (8)	1.72	38,044	1,257%	2.19%
St. Louis City	38,058 (9)	7.33	20,209	113%	--
Washington, D.C.	37,910 (10)	4.65	--	--	--
Cuyahoga (Cleveland)	19,490 (15)	1.83	10,082	107%	-0.74%

1 Post-secondary Cluster includes people employed at universities, colleges, and professional schools.
Source: U.S. Cluster Mapping Project

Pittsburgh's growing post-secondary sector has helped drive gains in regional educational attainment, particularly for workers with advanced degrees. Nearly 40% of Greater Pittsburghers employed in education have a graduate or professional degree[61]. Of all workers with advanced degrees, approximately 30% work in education, whereas 2% work in information[62]. Speaking to the gains in educational attainment, only 10.25% of Pittsburgh's workforce had an advanced degree in 1994, below the average for the nation's top 40 metros (See Figure 4). Today, 16.57% of the region's workforce has an advanced degree, ranking Pittsburgh 11th in the nation. Pittsburgh's rise was due to an increase from 85,410 advanced-degreed workers in 1994 to 183,240 in 2013—a gain of 115%. This outpaced the 98% gain for the nation's top 40 metros.

Figure 4: Workers with Advanced Degrees, Pittsburgh VS. Top 40 Metros.
Source: Current Population Survey (CPS)



[61] Source: PUMS 5-Year (2013)
[62] Ibid

Now, why is the region's post-secondary industry growing? And what does this mean for the regional economy?

Pittsburgh's post-secondary cluster is largely fed by two components: (1) an educational service industry that is tradable, or exportable; and (2) a research industry that is attracting R&D expenditures from outside the region. Both components are globally sourced.

"Global capital has, for the first time, heavily invested in knowledge industries worldwide, including higher education and advanced training," notes the author of the article "The internationalization of higher education: Motivations and realities."[63] "This investment reflects the emergence of the 'knowledge society'…and the dependence of many societies on knowledge products and highly educated personnel for economic growth."

Most simply, developing a tradable post-secondary industry includes bringing outside students into the region. Pennsylvania ranks second in the nation in the number of out-of-state freshman enrolled, led by Philadelphia and Pittsburgh[64]. Pittsburgh's colleges are also an international draw, according to a recent Brookings' report[65]. Pittsburgh ranks 15th out of 118 metros for the most international students, totaling 13,326. These students bring in nearly $444 million in tuition and $183 million in living expenses. CMU is driving the region's academic internationalization. The school ranks 24th in the nation in the number of foreign-born students. Forty-one percent (41%) of CMU's students are international. Importantly, the fields attracting Pittsburgh's global talent are engineering and computer and information sciences, which account for 60% of all learners who arrived internationally[66].

Why does it matter what migrants coming into Pittsburgh study? Returning to the concept of producer university, the key is not that Pittsburgh is attracting outside money from arriving students, and subsequently creating local service jobs (though this is important); rather, it's the deepening of expertise in emerging fields that's pulling in the best minds worldwide, igniting a feedback loop of knowledge production and talent attraction, all the while redeveloping the Rust Belt knowledge network from its sclerotic state.

This is where the importance of a robust research industry comes in. ***If used strategically, R&D expenditures allow for the creation of a "knowledge society", described here as a regional economy in which knowledge production does not so much create industry, but rather is industry.*** Put another way, while Pittsburgh failed in its hunt for the white whale, it succeeded in developing a white whale beneath its feet.

For instance, while CMU's Software Engineering Institute (SEI) didn't produce the next Facebook, it created a center of gravity for tech knowledge. "Ask SEI administrators what the institute has accomplished to date," notes the 1990 *Post-Gazette* piece extolling its letdowns, "and they will point to…ongoing efforts to develop a master's of software engineering degree program", one of several educational initiatives SEI undertook, including the development of a curriculum in software engineering for 43 universities across the nation[67]. The initial funding not only laid the groundwork for the subsequent tradable service industry that developed, it also sparked successive waves of federal investment, including

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[63] Altbach, Philip G., and Jane Knight. "The internationalization of higher education: Motivations and realities." *Journal of studies in international education* 11.3-4 (2007): 290-305.
[64] U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Spring 2013, Enrollment component.
[65] Ruiz, Neil G. "The geography of foreign students in US higher education: origins and destinations." (2014).
[66] Roth, M. "Pittsburgh officials put out welcome sign for immigrants". *Pittsburgh Post-Gazette*. June 2014.
[67] Gannon, J. "Hopes were too high". *Pittsburgh Post-Gazette*. Jan. 1990.

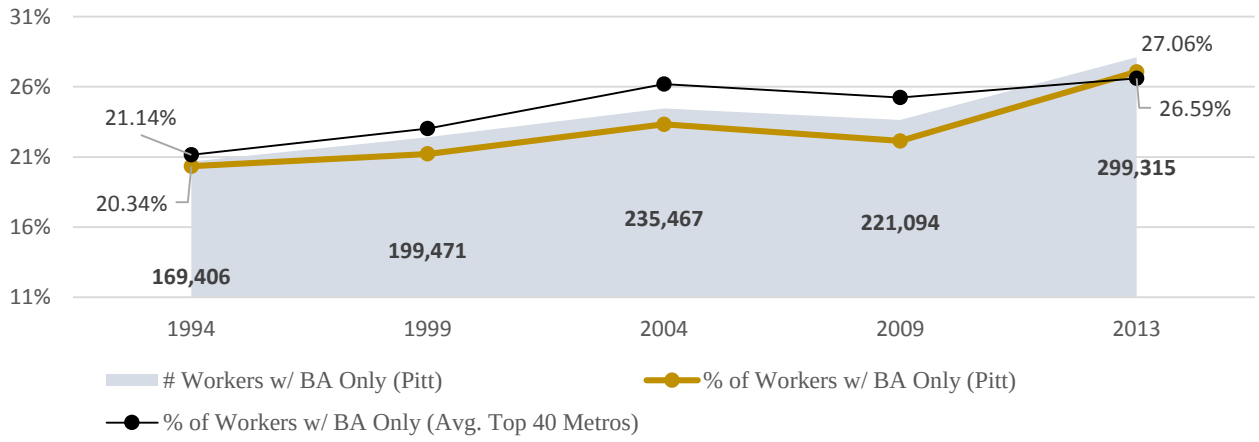
$1 billion in funding since 2005[68]. Today, CMU is second in the nation in math and computer science R&D expenditures, well ahead of MIT and Stanford[69].

A dense R&D environment means jobs. Research-intensive metros have larger shares of the most highly-skilled occupations and smaller shares of the lower-skilled occupations.[70] Highly-skilled occupations include those in life, physical, and social science; computer and math; and architecture and engineering. Intuitively, job growth in the metro corresponds to the region's area of research specialty. This is exactly what is occurring in Pittsburgh.

The University of Pittsburgh (Pitt)—which ranks 14th in the nation in total R&D expenditure, just behind MIT and Stanford—and CMU generated $1.14 billion in research dollars in 2013[71]. Eighty-three percent (83%) of CMU's research dollars were in math and computer sciences and engineering, while 84% of Pitt's funds were in life sciences. Tellingly, in a recent analysis by Pitt economist Chris Briem, the results showed that the highest concentration of workers who moved to Pittsburgh between 2008 to 2012 came for a job in life, physical, and social sciences; computers and mathematics; engineering and architecture, and education—all those sector's that thread the Pittsburgh's knowledge network.

Jobs, then, are one major "downstream" effect of Pittsburgh's knowledge industry. So is a parallel rise in educational attainment. Pittsburgh recently surpassed the average top 40 metros in the percentage of the workforce with only a bachelor's degree (see Figure 5). It is theorized that the clustering of highly-educated workers in Pittsburgh twenty years prior has created a multiplying effect down the knowledge economy hierarchy[72]. These trends will likely continue. Not because Pittsburgh is chasing tech, but because tech is chasing Pittsburgh. This will be discussed in Section 4.

Figure 5: Workers with Bachelor's Only Degrees, Pittsburgh VS. Top 40 Metros. Source: Current Population Survey (CPS)



[68] See: http://www.sei.cmu.edu/about/statisticshistory.cfm
[69] National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2013.
[70] Abel, Jaison R., and Richard Deitz. "Do colleges and universities increase their region's human capital?." *Journal of Economic Geography* (2011): lbr020.
[71] National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2013.
[72] Piiparinen, R., Russell, J., and Post, C. "Ranking America's Top Young Adult Labor Forces: A Rust Belt Rising?" *Engaged Scholarship* (2014).

Summarizing the Pittsburgh story, it is right to say no one person or event remade the Steel City. But occurrences and individuals do make impacts that cast long shadows over a city's trajectory. Writes Cleveland scholar Michael Fogarty[73]:

"We observe a discontinuity in the economic growth of a region, sometimes traceable to a particular event or person…We can think of the sources of these discontinuities as economic drivers…[defined as] a change initiated by a person, technology, event, or investment which occurs at the origin of a place or industry, triggering a lengthy, sustained sequence of events… leading to or enabling the formation of an important new industry or set of related industries driving the growth of a specific place."

Here, that person is Richard Cyert, the event the creation of CMU's Software Engineering Institute, and the industry the production of knowledge. Pittsburgh's story, though, is but part of a larger story, one reflected in "the knowledge society". It's the economic future. And it's scripting the fortunes of cities as we speak.

Section 4: The Rise of the Knowledge Society

"Human behavior flows from three main sources: desire, emotion, and knowledge"—Plato.

There is a reason cities desire the white whale. There's money in tech. "Throwing Money at Start-Ups in Frenzy to Find the Next Uber," reads a recent *New York Times* piece[74]. Figuratively, the "next Uber" is a software application ("app") that transforms older industries. For instance, the actual Uber, based in San Francisco, is a ride-sharing business made possible by an app that connects riders with drivers, bypassing the taxi industry altogether. It was recently valued at $41 billion, with the bet that Uber will make cabs obsolete.

Start-ups that succeed can also remake an "old economy" company town into a "new economy" company town. A case in point is Waterloo, Ontario. In the mid-80s, two University of Waterloo graduates started a company, Research in Motion (RIM), which eventually birthed the Blackberry, an early entry into the smart phone business. Quickly, Waterloo went from a Rust Belt town to a capital of high-tech.

"At its peak, [Blackberry] had nearly 20,000 employees, a market value of more than $80 billion, and a sanctified status in the gadget world," notes the piece "The Battle of Waterloo: The life, death, and rebirth of BlackBerry's hometown"[75]. But Blackberry collapsed as quickly as it had risen. Overtaken by Samsung and Apple, Blackberry users now comprise less than 1% of the global market. The company is valued at $5 billion and employs 7,000 workers, with recent talks that the company will be bought out by rival competitors.

There are two lessons here. First, the product life cycle in tech is short. The "life" of U.S. Steel was around 80 years, whereas Blackberry's was roughly 8—a reflection of just how fast innovation upends markets in the industry. Second, Waterloo didn't economically depress after Blackberry's decline. In fact, the region prospered. The Waterloo metro has the 3rd fastest year-over-year GDP growth in Canada, and the 5th highest median income, ahead of Toronto[76]. The region's labor force increased by nearly 23,000 from 2009 to 2013: a time period coinciding with Blackberry's lay-offs.

As Blackberry contracted, however, there were fears about a "brain drain" out of the region. It didn't happen. Instead, Silicon Valley moved in. Count Google, Square, Electronic Arts, and Intel among tech

[73] Fogarty et al. 2002.
[74] Solomon, S. "Throwing Money at Start-Ups in Frenzy to Find the Next Uber". *New York Times*. Dec. 2014.
[75] Roose, K. "The life, death, and rebirth of BlackBerry's hometown". *Fusion*. Feb. 2015.
[76] Canada's Technology Triangle. "Waterloo Region: Community Profile" (2014).

firms now located in Greater Waterloo. Why? Computer scientists are desirable in today's labor market, explains one industry correspondent, and Silicon Valley firms are so hungry for talent that they are willing "to trek up to Waterloo" to find it[77]. "The future of high-end labor might look like small clusters of programmers spread across the globe," the correspondent continues, "with billion-dollar corporations chasing them around."

Yet why wouldn't firms just attract the talent to California? After all, Waterloo isn't exactly replete with amenities that allure the "creative class". The short answer: because big tech is not after the Blackberry's talent, but rather the knowledge network that spawned Blackberry in the first place. This network is centered at the University of Waterloo: Canada's equivalent to CMU. It is the top research university in the nation, pulling in nearly $200 million in R&D expenditures annually[78]. The school's computer and science programs are ranked top-25 globally as well[79]. "[There] is an amazing amount of technical talent in Canada, and University of Waterloo is the center of that," asserts one Google exec[80].

Not coincidentally, Google has invested heavily in Pittsburgh too. The company employs several hundred workers in a converted Nabisco factory in the inner city. While the jobs are welcome, the main benefit is the two-way pipeline of investment and intellectual capital that connects Silicon Valley with Pittsburgh. This is illustrated by the recent appointment of former Google VP Andrew Moore as the dean of CMU's School of Computer Science. Upon taking the assignment, Moore said there are a few "really important hotspots for the future of technology"—one is Google, one Carnegie Mellon. "Look at Google—or any of the major Internet and startup companies around the world," says Moore. "You can often trace the birthplace of their technologies right back to CMU.[81]"

This dynamic is currently happening with Uber. The company recently announced it was partnering with CMU's Robotics Institute to create the Uber Advanced Technologies Center with the goal to "kickstart autonomous taxi fleet development", aka driverless cars[82]. Uber will be hiring 50 scientists from CMU, but also investing heavily into the university's research and development capabilities.

Put simply, Pittsburgh's research institutions have become the de facto R&D labs for the world's richest tech firms. In the region's innovation ecosystem, they are the "host of the party" (revisiting Sean Safford's term), rather than the "life of the party". While this can be construed as "giving the milk away for free", the key to the knowledge society is less about the commercialization of knowledge than it is the creation of knowledge. ***Elite knowledge is fashioned through open networks in the pursuit of progress. Commercialized knowledge is created through patenting in the pursuit of profit. This distinction is important. The world economy is shifting its valuation from things made and consumed to knowledge produced and diffused. Making widgets for a livelihood was yesterday. Making ideas for lives is today.***

Enter the rise of the "intangible economy". From the paper "An Introduction to the Economy of the Knowledge Society", it is described this way[83]:

"Intangible capital largely falls into two main categories: on the one hand, investment geared to the production and dissemination of knowledge (i.e. in training, education, R&D, information and

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[77] Roose, K. "The life, death, and rebirth of BlackBerry's hometown". *Fusion*. Feb. 2015.
[78] See: http://www.tcu.gov.on.ca/pepg/publications/vision/WaterlooAgreement.pdf
[79] Ibid
[80] Martinez, M. "University of Waterloo: Google's top choice for recruitment". *Canada Business Review*. Oct. 2014.
[81] Silmore, M. "One Moore Milestone". *Carnegie Mellon Today*. Jan. 2015.
[82] Biggs, J. "Uber Opening Robotics Research Facility In Pittsburgh To Build Self-Driving Cars". TechCrunch. Feb. 2015.
[83] David, Paul A., and Dominique Foray. "An introduction to the economy of the knowledge society." *International social science journal* 54.171 (2002): 9-23.

coordination); on the other, investment geared to sustaining the physical state of human capital (health expenditure). In the United States, the current value of the stock of intangible capital (devoted to knowledge creation and human capital) began to outweigh that of tangible capital (physical infrastructure and equipment, inventories, natural resources) at the end of the 1960s."

So the intangible economy drives the "eds and meds" sector. But there's a catch. Until 2013, the intangible economy didn't count—literally.

"On July 31, the U.S. Bureau of Economic Analysis will rewrite history on a grand scale by restating the size and composition of the gross domestic product," begins a *Bloomberg* piece entitled "The Rise of the Intangible Economy: U.S. GDP Counts R&D, Artistic Creation"[84]. The article notes that throughout the 20th century, R&D, the "lifeblood of the 21st century economy", will be reclassified from an expense that ate into profit, like energy costs, to an investment that produced profit, like building a factory.

That fact brings pause, or should. For roughly 80 years, R&D spending—*the* driver of innovation and valuation—was equated to cafeteria costs. What counted, then, was what can touched, boxed, shipped, and consumed (i.e., the Blackberry widget), but not what can be conceived and how it aided progress (i.e., the ideas behind the Blackberry and the ideas spawned by its use). Such practice has led the Federal Reserve Board to conclude that up to $1 trillion has been left out of GDP since its onset until the late 90s. "That intangibles, and more generally, knowledge capital should be such an important driver of modern economic growth is hardly surprising…," the economists conclude. "What is surprising is that intangibles have been ignored for so long."

Echoes Federal Reserve Chairman Ben Bernanke: "We will be more likely to promote innovative activity if we are able to measure it more effectively and document its role in economic growth.[85]"

The omission has had consequences. There's persistent underfunding of R&D at both the state and national level. Slashing college and university budgets is seen as smart business, or a cost to be cut, when in fact it's just the opposite. ***Also, economic restructuring is stubbornly believed not to be the result of knowledge production, but knowledge commercialization. This is also incorrect. R&D means jobs, both directly and indirectly. In fact, knowledge is the growth industry of the future.*** The remainder of this section illustrates how.

First, a question: What happens to a city when the barons of information technology team with institutions of knowledge within its borders? To answer this, it's important to delineate information from knowledge. Information is exactly that: data points, text, etc. that is packaged yet passive and inert. Technology has made information readily available like never before. Knowledge, on the other hand, is the organization of information in a way that "empowers [people] with the capacity for intellectual or physical action"[86]. Becoming a heart surgeon is knowledge. Information fills the student text.

The key, here, is that when information technology, or the innovative ways to access information, co-exists with centers of knowledge production, then a cyclical effect takes hold. That is, better access to information enables better knowledge creation, and advancement in education leads to better information. This is the knowledge society in a nutshell. And it has the capacity to evolve cities like Pittsburgh—and yes, Cleveland—profoundly, with longstanding economic and community impacts.

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[84] Coy, P. "The Rise of the Intangible Economy: U.S. GDP Counts R&D, Artistic Creation". *Bloomberg*. July 2013.
[85] Ibid
[86] David, Paul A., and Dominique Foray. "An introduction to the economy of the knowledge society." *International social science journal* 54.171 (2002): 9-23.

For instance, the confluence of tech and education has proven to be a boon in Beantown. Boston is America's leading knowledge society. The region educates and researches like none other. With the widespread practice of R&D and education has come not only a wealth of knowledge, but also a wealth of information on how to best educate. This has led to Boston's emergence as a global force in educational technology, or "edtech". Again, better information leads to best practice which leads to better technology. If a firm is in the business of edtech, Boston is a place to be.

"Houghton Mifflin Harcourt has long been headquartered here in Boston, Cengage recently moved its corporate headquarters here, and McGraw Hill has opened up its R&D here," notes the recent *Boston Globe* piece asking "Will education technology be the next growth sector?[87]" "Scholastic's development site is here," continues the author. "Pearson and MacMillan both have major operations here."

Beyond established education firms clustering in Boston, the ecosystem is fruitful for start-ups as well. Boston's edtech scene has sprouted 250 start-ups and dozens of venture-funded and growth stage companies. Moreover, unlike with R&D, the region's edtech scene has been mostly privately funded. Education technology will be a driving force in Boston's economy going forward.

What's more, edtech isn't just about money and job growth, but about productivity, or how to educate society more efficiently and successfully, be it a preschooler, college student, or lifelong learner. In other words, the success of a knowledge society is not just in the labs, classrooms, or boardrooms, but ultimately in the societal "downstream" effects. Such effects are materializing in Pittsburgh.

"Pittsburgh is absolutely a leader when it comes to building a learning ecosystem for the 21st century," said Constance M. Yowell, director of education at the John D. and Catherine T. MacArthur Foundation, to *Education Week* recently[88].

Yowell was speaking to a number of innovations that are spinning out of the universities related to early childhood education. Much of Pittsburgh's early edtech scene is organized under the umbrella of Kids+Creativity Network, a collaboration between for- and non-profit organizations, which has received extensive philanthropic support. For instance, Pittsburgh has joined New York and Chicago as MacArthur "hive learning networks", and it also became the first city in the nation to receive a Tribeca Disruptive Innovation Award, given to groups that "have broken the mold to create significant impact" in education[89].

Then there's the story of Louis von Ahn, who is a Pittsburgh-based academic and entrepreneur who builds "systems that combine humans and computers to solve large-scale problems that neither can solve alone"[90]. Von Ahn, a 35-year-old native of Guatemala and faculty member at CMU in computer science, has created a new way to learn a language called Duolingo[91].

Duolingo is web-based, free, and more effective than traditional classroom techniques. A recent study found that 34 hours of using Duolingo is equivalent to 1 semester of university coursework[92]. Its efficacy is derived from Von Ahn's ability to extract information on how people best learn a language—Pittsburgh's schools are world-renowned for teaching English as a second language—and then developing software that takes this information into account. Also, the program is free because of the unique funding

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[87] Rudden, E. "Will education technology be the next growth sector?" *The Boston Globe*. Oct. 2014.
[88] Herold, B. "Community Network Eyed as Model for Supporting Digital Learning". *Education Week*. Jan. 2015.
[89] Ibid
[90] See: https://www.cs.cmu.edu/~biglou/
[91] See: https://www.duolingo.com/
[92] Vesselinov, Roumen, and John Grego. "Duolingo effectiveness study." City University of New York, USA (2012).

model: students learn while translating text for media companies, such as CNN, who are looking to spread their content globally. In other words, individuals and societies progress, while companies pay a fee for service.

Such an evolution from a basic consumerist model is a hallmark of the knowledge society—its arc of progress harkening back to the words of Ralph Waldo Emerson who famously wrote: "Every man is a consumer, and ought to be a producer. He is by constitution expensive, and needs to be rich." Perhaps it's no coincidence that those Rust Belt cities who had their economies collapse first are drivers of this new economic paradigm. Cleveland is no exception.

Section 5: Cleveland's Cure

"Healing is a matter of time, but it is sometimes also a matter of opportunity"—Hippocrates.

The Kardiac Kids

"Cleveland is a historical accident, a child of the industrial revolution" writes former Cleveland State researcher Richard Knight in his 1980 analysis "The Region's Economy: Transition to What?"[93]. Knight was discussing Cleveland's rise at the confluence of its geographic advantages. But as the world flattened, those advantages eroded. The solution would not be found in chance. Cleveland had to work for it. The remedy?

"Cleveland's comparative advantage now takes the form of human and cultural resources…that can be matched in very few other places," concludes Knight. But to take advantage of these assets meant getting over projecting the decline of manufacturing onto the decline of a populace, as such "acceptance of the inevitable demise of a once proud city…" wrote Knight, "…does not reflect the growth dynamics associated with the development of the knowledge sector".

Today, this "transition to what?" question has been partially answered. The heart of Greater Cleveland's emerging economy is the Health Tech Corridor (heretofore called the "Corridor"), which runs along a 3-mile stretch of Euclid Ave. and is anchored by Cleveland State University, Case Western Reserve University, the Cleveland Clinic, and University Hospitals. It is along this street where Cleveland is making the intangible tangible.

Tellingly, the Corridor has a new firm, the Beauty Shoppe. The first Beauty Shoppe, a co-working space for knowledge workers, opened in Pittsburgh. The second is in Cleveland. Why Cleveland? "It has similar demographics," noted the co-owner[94]. "We saw similar urban trends playing out here that played out back home. Four or five years ago in Pittsburgh feels like Cleveland now."

The sentiment is nice: Cleveland is rejoining its sister city in a Rust Belt revival. But there's more to the notion than emotion. There's data. As of 2013, the Cleveland metro ranks 10th in the nation in the concentration of workers with an advanced or professional degree (17%), one spot ahead of Pittsburgh (16.57%), and above the average of the top-40 metros (15.61%) (See Figure 6). While Cleveland's rise was due to a significant inflection point since 2009, Cleveland's advanced degree job "pop" occurred between 1994 and 2004 (no. of workers with advanced degrees increased by 96%, from 64,875 to 136,944). Now, what's driving this growth?

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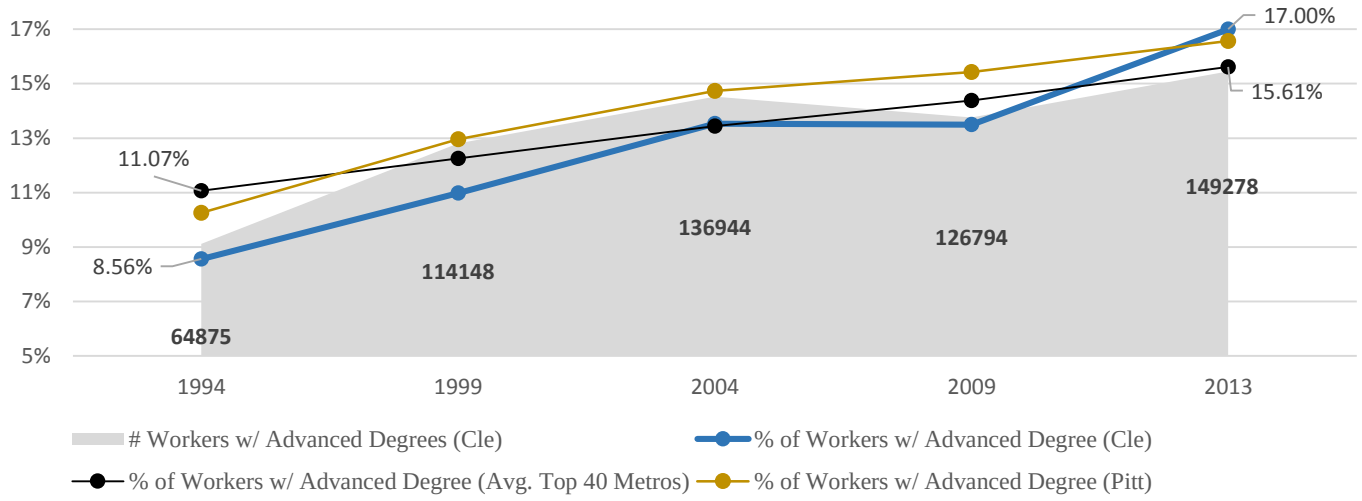
[93] Knight, Richard V. The Region's Economy: Transition to What?. Cleveland State University, College of Urban Affairs, 1981.

[94] McFee, MJ. "Coworking craze hits Cleveland's Midtown, as Beauty Shoppe inks deal at Victory Center". Cleveland Plain Dealer. Feb. 2015.

Figure 6: Workers with Advanced Degrees, Cleveland VS. Top 40 Metros
Source: Current Population Survey



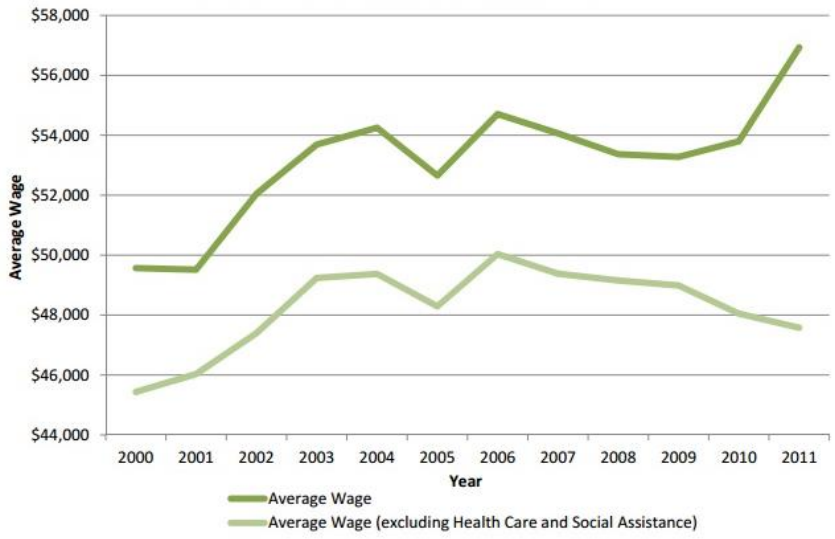
Fifty percent (50%) of Clevelanders with graduate or professional degrees work in the "eds and meds"[95]. The region has approximately 33,600 advanced degree workers employed in education and 27,800 in healthcare[96], with a significant proportion housed along the Corridor.

Job growth in the Corridor has significantly outpaced metro-level growth. According to a recent Cleveland State study by the Center for Economic Development called "The Cleveland Health Tech Corridor: An Analysis of Economic Trends, 2000-2011", employment in the Corridor increased by 21.2%[97], whereas jobs decreased by 11.9% for the metro as a whole[98]. Growth in the Corridor was mostly in healthcare, which gained 13,502 jobs—an increase of 55%. Education added only 526 jobs.

It is imperative to illustrate the wealth healthcare is generating in terms of payroll. The Cleveland State study found that healthcare worker income in the Corridor increased by **$1.05 billion** from 2000 and 2011[99], whereas gains in educational service income were only $27 million. Also, Figure 7 details average wages in the Corridor of all jobs versus non-healthcare jobs. The trends mirror each other until 2009. Then, wages including healthcare jobs diverge rapidly from non-healthcare jobs, which means payroll in healthcare along the Corridor is diverging from local industry constraints. Healthcare in Cleveland is globalizing.

[95] Source: PUMS 5-Year 2013
[96] Ibid
[97] Hrubey, Matthew, Ziona Austrian, and Joe Andre. "The Cleveland Health Tech Corridor: An Analysis of Economic Trends, 2000-2011." (2012).
[98] Source: Bureau of Labor Statistics, 2000, 2011
[99] Hrubey et al. 2012.

Figure 7: Wages in the Health Tech Corridor, 2000 to 2011 (Source: Center for Economic Development, CSU)



Source: Quarterly Census of Employment and Wages (QCEW)

Elaborating, Table 6 details the largest hospital employment clusters by county. Cuyahoga County has the 6th most hospital jobs in the nation, behind the county seats of Los Angeles, Chicago, Houston, Manhattan, and Boston. Too, Cuyahoga County has the 3rd largest specialization (location quotient of 2.18) and the 3rd largest job growth rate (58%) out of the top hospital employment cities, doing so with attendant population decline. In other words, as "eds" has become an export industry in Pittsburgh, "meds" has done likewise in Cleveland.

Table 6: Largest Hospital Employment in the United States by County

County	Employment 2012 (National Rank)	Location Quotient	Job Creation 1998-2012	Job Creation (%)	Annual Wage 2012	Population Growth (%) 1998-2012
Los Angeles	150,291 (1)	0.90	21,287	17%	$66,719	0.47%
Cook (Chicago)	122,697 (2)	1.12	-5,933	-5%	$57,356	-0.16%
Harris (Houston)	99,160 (3)	1.12	41,627	72%	$56,295	1.84%
New York (Manhattan)	91,705 (4)	1.04	9,277	11%	$80,711	0.41%
Suffolk (Boston)	85,344 (5)	3.20	30,765	56%	$69,215	0.53%
Cuyahoga (Cleveland)	75,767 (6)	2.18	27,851	58%	$42,641	-0.74%
Maricopa (Phoenix)	63,548 (7)	0.85	25,796	68%	$68,934	2.19%
Philadelphia	62,197 (8)	2.03	2,166	4%	$55,574	0.11%
Dallas	48,538 (9)	0.79	6,038	14%	$57,029	0.91%
Baltimore City	47,637 (10)	3.27	10,947	30%	$58,553	-0.50%
Allegheny (Pittsburgh)	41,426 (14)	1.18	-5,345	-11%	$47,553	-0.37%

Source: U.S. Cluster Mapping Project

"In this 21st century world," notes Kathleen Sebelius, the former Secretary of Health and Human Services, "some of our country's most significant exports and imports extend beyond goods and services: They also include innovation, knowledge, discovery, and healing."

Cleveland is elite in healing. Cleveland Clinic is ranked first nationally in cardiology and urology; second in diabetes, gastroenterology, nephrology, and rheumatology; and third in orthopedics, gynecology, and

pulmonology[100]. In terms of cancer care, both University Hospitals and the Cleveland Clinic were ranked in the top 20. It is no surprise, then, that patients come to Cleveland to get high-quality care.

But there are larger forces at play as to why some cities, like Cleveland, are becoming exporters in health. These forces were discussed in a recent *New York Times* op-ed[101] by Duke University's Aaron K. Chatterji, a former senior economist in the White House. Chatterji wrote that for most cities, banking on the "eds and meds" is risky when it comes to long-term economic planning, because "the same forces that led other industries to cluster in specific regions (think technology in Silicon Valley or banking in New York) are now sweeping through education and healthcare."

Why the clustering? Costs to a large extent. Rising healthcare expenditures for the nation, the firm, or the person means less investment elsewhere. Efficiency gains are needed, which means scaling. So, while localities will need emergency rooms and obstetricians, specialized healthcare, such as cardiology—which powers the high-margin services that bring significant sums into local economies—will bunch to geographies of expertise, driven by efficacy.

Wal-Mart, for instance, recently announced it would send employees in need of transplants or heart or spine surgery to one of six leading medical centers around the country, including the Cleveland Clinic. Count Boeing[102] and Lowe's[103] as two other national firms who have engaged in "bundled packaging" contracts with the Clinic related to cardiac care. In fact, nearly half of the more complex heart surgeries the Clinic does each year are on individuals from outside the state[104].

Such emerging shifts, according to Chatterji, will lead to a freeing of capital and higher GDP for the nation, all the while carving out a newer geography of jobs in the "eds and meds" that will see the same "dynamic of winners and losers observed in other industrial sectors, as top universities and hospitals become larger and absorb most of the increase in students and patients from across the nation."

The stakes for Cleveland in such a scenario cannot be overemphasized. If the city indeed becomes an outpost in longevity, then Cleveland's more recent landscape of loss will be no more alive than the memory of its manufacturing prowess. But this is not inevitable. Collective understanding is needed to ensure the vision becomes reality. ***This entails recognizing that Cleveland's advantage as a healthcare hub isn't driven by the demand to consume services, but rather on the production of knowledge that presages it. Cleveland's identity as a knowledge society needs to be uncloaked, and its knowledge network strategically addressed.***

Moths to a Flame

It was December 2011. Ohio Governor John Kasich was merry. "This is really big news," began the Governor[105]. "This is fantastic. This is just a gangbuster day." He later took to Twitter, tweeting[106]: "Silicon Valley is coming to Cleveland. Phillips is moving new jobs from California." The Governor was referring to Phillips Healthcare's decision to move its nuclear medical headquarters from San Jose to Cleveland. The jobs were high paying, about $115,000 a year, but the moment was bigger than the direct effect: the innovation that for years went west was coming back.

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[100] See: http://health.usnews.com/best-hospitals
[101] Chatterji, A. "The Bad News for Local Job Markets". *The New York Times*. Oct. 2013.
[102] "Boeing, Cleveland Clinic strike bundled-payment deal". *The Advisory Daily Briefing*. Oct. 2012.
[103] Chen, C. "Cheaper Surgery Sends Lowe's Flying to Cleveland Clinic". *Bloomberg Business*. March 2014.
[104] "Trending Developments: Out of State Care for a Flat Fee: Boeing Contracts with Cleveland Clinic". *The O'Connor Report*. March 2013.
[105] Frolik, J. "Ohio Gov. John Kasich re-introduces himself as a job-creator". *Cleveland Plain Dealer*. Dec. 2011.
[106] See: https://twitter.com/johnkasich/status/149223295567396865

The movement extends to investment. According to a 2014 report by Bioenterprise[107], Ohio ($499.3 million) bested Minnesota ($406.3 million) in attracting the most healthcare venture capital in the Midwest. The industries included health IT, medical devices, and biopharmaceuticals. Leading the way was Minneapolis and Cleveland, with $402.7 and $398.3 million, respectively.

Returning to Phillips, the firm's relocation strategy was about the access to knowledge stemming from Cleveland's anchor institutions, particularly Case Western, Cleveland Clinic, and University Hospital. "There is such an advantage to be in the Cleveland area, and being close to world leading research sites," said Richard Fabian, Vice President & General Manager of Nuclear Medicine for Philips[108]. "If you take a look at big imaging hubs that exist in the world, Cleveland ranks at the top of the list."

Today, the hub goes beyond Philips to include Siemens, Toshiba, Hitachi, and GE, as well as more than 50 imaging start-up companies[109]. The industry employment in Cleveland tops 3,000[110]. That Cleveland became a "magnet for the magnetic imaging industry"[111] is illustrative of the tangible economic impacts of knowledge production in healthcare.

Still, while the region's knowledge is drawing the "moths", what exactly *sustains* the "flame"?

Again, insight can be gleaned from America's premier knowledge society, Boston, except switch out medical imaging for pharmaceuticals. A recent *Boston Globe* piece[112] noted that the region has benefited from an "unexpected positive development" over the last decade. "Where we used to be simply the Hub of Biotech," noted the piece, "we have suddenly turned into the Hub of the (Big) Pharma Universe."

GlaxoSmithKline is developing an innovation center in Boston. Novartis relocated its entire research function to the region. Merck built a sleek research center in the Harvard Medical School campus, while Pfizer recently moved over 1,000 researchers and drug developers to the heart of Cambridge. Beyond research headquarter relocations, "Big Pharma" is buying up local biotech start-ups, most of which have strong ties to area universities and hospitals. "Those sounds you hear reverberating through the local biotech [start-up] industry are the heavy footsteps of Big Pharma," writes one industry correspondent[113].

Meanwhile, over in New Jersey, a different, albeit recognizable, scene has developed. "Downsizing, consolidation, relocation take toll on New Jersey's pharmaceutical sector," reads the subtitle of a piece detailing a report that showed New Jersey/New York City has slipped from 2nd to 7th in life science clusters[114]. Boston ranked 1st.

The issue for New Jersey is one of ecosystem. The corporate R&D model still predominates the region. This is a problem. "There is very little innovative research in the modern pharmaceutical industry, despite its claims to the contrary," notes Marcia Angell, Senior Lecturer in Social Medicine at Harvard Medical

[107]"Midwest Healthcare Companies Raise $1.8 Billion in 2014". Bioenterprise Final Report. Jan. 2015.
[108] Microh Scope. "Northeast Ohio offers ideal setting for Philips Healthcare growth". Bio Ohio. 2011.
[109] Tribble, S. "Quality Electrodynamics helps expand Cleveland's medical imaging industry," *Cleveland Plain Dealer*. Jan. 2009.
[110] Ibid
[111] Piorkowksi, J. "Philips Healthcare in Highland Heights to add 100 high-paying jobs; Governor John Kasich speaks at announcement". *Cleveland Plain Dealer*. Dec. 2011.
[112] Westphal, C. "Boston's biotech, pharma success will breed more success". *The Boston Globe*. July 2014.
[113] Weisman, R. "Could Big Pharma's appetite for local biotechs hurt independents?" *The Boston Globe*. Dec. 2014.
[114] Silverman, E. "As NJ Sheds Pharma Jobs, Other Major Metro Areas Emerge as New Hubs for Life Sciences". *NJ Spotlight*. Feb. 2013.

School[115]. Instead, according to Angell, Big Pharma increasingly relies on universities, research hospitals, and start-up companies for "creative, early-stage research".

The outsourcing of R&D to the "eds and meds" sector is not industry specific. Be it Google to Pittsburgh, Philips to Cleveland, or Pfizer to Cambridge, the shift is tectonic, in line with the revaluation of the intangible economy in macroeconomic policy. Still, the reality that knowledge isn't cheap does mean it isn't increasingly cheapened—a trend detailed elegantly in a recent speech by the University of North Carolina President Tom Ross called "The real value of higher education"[116]. In it, Ross laments a public sector that has "forgotten the real value of higher education – both to our economy and to our society", saying:

How do we continue to finance what has become the nation's primary research engine…? Historically, industry in America conducted its own R&D in its own facilities. About a quarter century ago, however, a transition began. Industry realized it could shift some of its R&D capacity – and the associated costs – to the nation's universities. Roughly 75 percent of research in America now takes place on university campuses.

From a public sector standpoint, cuts in "eds and meds" funding is a question of whether or not there is a "bang for the buck". Which brings us back to the issue of what role universities and hospitals play in regional economic development. Returning to Section 2, should research in the "eds and meds" be a "fountain" to tech transfer, beholden to the pursuit of profit? Or should it be a "forum", networked in a system of innovation? The answer is less a moral one than it is an issue of what works, not only economically, but societally.

There has long been tension in academe between knowledge for public good and knowledge for private gain. It's a duality between secrecy and openness. Between owning and sharing. This tension has been playing out in Boston with the arrival of Big Pharma. "Harvard Medical School is under fire from critics for its ties to Big Pharma," reads the *Boston Magazine*[117]. "While the school tries to sort it all out, two professors battle for its soul."

One on side of the debate is the aforementioned Marcia Angell, who thinks quality research in healthcare has been pilfered by the biases inherent in commercialization. Think doctors running clinical trials while on the dole of drug companies whose products they are studying. Or professors tailoring lectures toward drug interventions they are paid to represent. Such practices, according to Angell, "puts the medical schools and teaching hospitals in the role of junior partner of Big Pharma"[118].

On the other side is Harvard hematologist Tom Stossel, who argues that limiting doctors' interactions with the pharmaceutical industry will limit the power of the market to drive innovation. "We have to tolerate some bad behavior if we want progress," believes Stossel[119].

While the battle for Harvard Medical's soul continues to play out, the existential plight is broader, particularly in the context of the value a given knowledge society produces. "Are we just becoming New Jersey north?" questions Harvard business professor Gary Pisano in a piece entitled "Could Big Pharma's appetite for local biotechs hurt independents?" The question is the right one, touching on the notion of the paradoxes of success.

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[115] Angell, M. "Big Pharma, Bad Medicine". *Boston Review*. May 2010.
[116] Ross, T. "Tom Ross: The real value of higher education". *The News and Observer*. March 2015.
[117] Carmichael, M. "Bitter Pills". *Boston Magazine*. Nov. 2009.
[118] "Angell on Big Pharma". EconTalk Episode with Marcia Angell. Library Economics and Liberty. Nov. 2012.
[119] Carmichael, M. "Bitter Pills". *Boston Magazine*. Nov. 2009.

Simply, the presence of Big Pharma, Big Manufacturing, or Big Tech can devalue the "long-game" of open innovation for the want of short-term profit—in effect "freezing up" a regional knowledge network. This story has been written. A knowledge network beholden to big firms made the Rust Belt. That's the danger of attracting "the moths"—they can put out "the flame".

Keeping the "River" Burning

They were called the "fab five"[120], but instead of basketballs they handled beakers. They are experts in physiology, biophysics, cardiovascular medicine, hematology, and oncology, and all were recruited to Ohio's largest medical institution, Case Western Reserve School of Medicine, between 2005 and 2007. The medical researchers came from the likes of Harvard and Yale—brought their staffs with them—and between the five of them brought in $60 million dollars in research grants in three years, adding to a medical school that is ranked top-25 nationally in federal research funding[121].

"They are entrepreneurs -- researchers who know how to pitch the National Institutes of Health [NIH] for multi-million-dollar grants…" describes the *Plain Dealer*. Their economic impact is direct: the researchers they hire make between $50,000 to $100,000 a year; indirect: every $1 in NIH funding in Ohio has a $2.29 multiplier effect in the local economy[122], translating to an $801.4 million dollar impact from Case life science research in 2013 alone[123]; and long-term: the knowledge being produced further centers Cleveland as a node in global healthcare.

"This city has become quite a hub for the healthcare industry", affirmed CEO of Siemens Eric Spiegel on a tour of Case Western Reserve recently[124]. "We want to get more involved with leading universities," he continued, noting his late autumn campus tour included MIT, Georgia Tech, Cal Tech and Carnegie Mellon, in addition to Case.

Still, while these economic impacts of research are real, wide-ranging, and long-lasting, the tech transfer temptation is still the barometer of success, despite the well-documented difficulty of tech transfer from academe.

Does this mean application of knowledge is unimportant? Or that public and non-profit R&D should be untied to private growth? Obviously not. In the end, knowledge without application is akin to water that can't be drunk. Moreover, it is likely that start-ups and entrepreneurial activity emanating from the knowledge society is key to its longevity. They are a "buffer" of sorts between the "moths" and "the flame". ***Or perhaps more aptly, in the knowledge society small firms can turn "fire" into "light", in effect routinizing the source of economic and societal progress in a manner that the likes of Big Pharma and Big Tech—who are indebted to short-term demands of shareholders—simply can't.***

"We find that successful small firms recognize the value of developing symbiotic relationships that do not necessarily deliver 'quick-wins'," notes one recent study[125]. Meanwhile, Google is feeling the pinch.

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[120] Vanac, M. "Case Western Reserve's new medical researchers pump millions into Northeast Ohio economy". *Cleveland Plain Dealer*. July 2008.
[121] See: http://casemed.case.edu/research/
[122] Families USA. "In Your Own Backyard: How NIH Funding Helps Your State's Economy". Families USA Foundation. 2008.
[123] Vanac, M. "Case Western Reserve's new medical researchers pump millions into Northeast Ohio economy". *Cleveland Plain Dealer*. July 2008.
[124] Smith, R. "Siemens displays fresh interest in Cleveland as a tech center and "healthcare hub". *Cleveland Plain Dealer*. Nov. 2014.
[125] Clifton, Nick, and Robert Huggins. "Knowledge Sourcing by Small Firms The Internationalization of Networks."

"Wall Street chafes as it waits for Google's projects to pay off," reads the headline of a recent *Boston Globe* piece[126].

That said, effectively managing and strategizing around a regional knowledge society can only be done if a city understands *how* it is economically restructuring, or its cause and effect. Simply, the commercialization of knowledge is not the cause of economic growth, but rather the effect that comes when the best knowledge is being produced.

"The skeleton of the whale furnishes but little clue to the shape of his fully invested body", noted Herman Melville.

Hunting for the white whale when it is with you is a chancy endeavor. You risk eroding the essence with uninformed want. That is, then, the beauty of knowledge. It allows for progress.

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[126] Dougherty, C. "Wall Street chafes as it waits for Google's projects to pay off". *The Boston Globe*. Feb. 2015.