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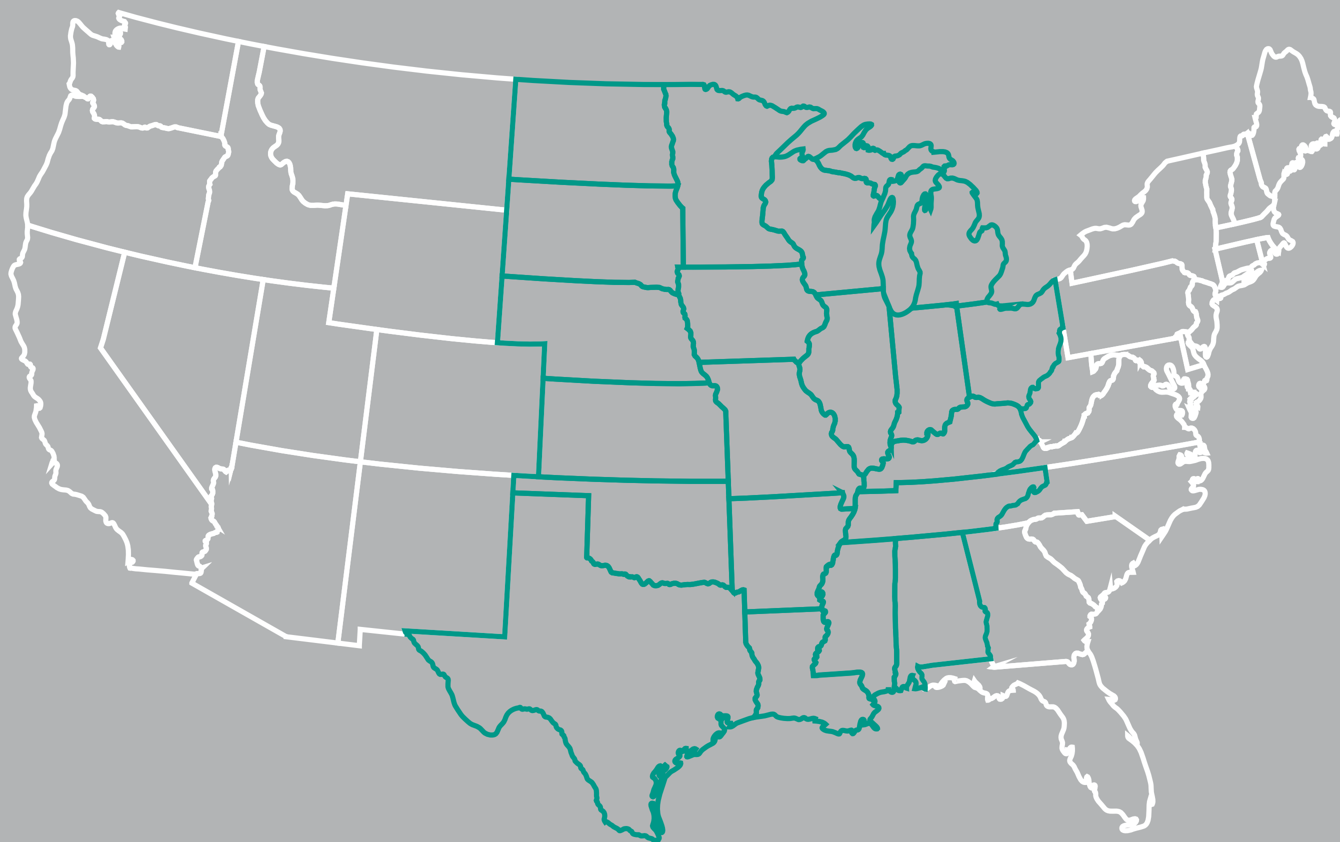

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How Do Research Universities Contribute to Regional Economies?

Measuring Research University Contributions to Regional Economies

ABOUT THE AUTHOR

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Abstract

There are multiple channels through which research universities impact regional and national economies. These channels are growing in importance and scale as the fundamental output of research universities becomes ever more valuable to an economy that is fueled by innovative endeavors. Ultimately, the impact of research universities is determined by the degree to which they embed themselves and their graduates in the local business and economic milieu and contribute to the social capital building across numerous dimensions.

Research universities fulfill their mission by creating new knowledge and disseminating it. Universities achieve this by instilling new knowledge in the human capital they develop and through research and discovery that is translated to existing firms or commercialized by startups. This paper explores the processes and metrics to measure the contributions of research universities through their ***(1)*** *operations,* ***(2)*** *human capital creation,* ***(3)*** *licensing and academic startup activity,* ***(4)*** *business and economic engagement pathways and* ***(5)*** *enhancing quality of place through social capital building and interactions with their communities. How do universities produce knowledge and transfer it by codified and tacit exchange with the private sector? The American research university may be one of the greatest inventions this nation has ever produced.*

Research university leadership and economic development officials must understand the multifaceted dimensions to create jobs and economic opportunity in their communities. Monitoring metrics such as those contains in this report could improve focus and positively impact outcomes.

(1) OPERATIONS

Background

In the process of creating new graduates and conducting research, similar to private-sector firms, research universities generate a substantial amount of economic impact from their operations. Many universities are among the largest employers and generate significant payroll in their metropolitan areas. Research universities purchase a variety of goods and services, such as equipment, office supplies, and professional services from local businesses.

Additionally, university capital investments give a boost to construction and a variety of other locally-produced capital equipment. University research expenditures pulse through the local and statewide economies and have a substantial effect, too. University employees spend money, as well as existing and prospective students, and inject further funds into the local economy. Travel and tourism increase through parents and visitors that desire to immerse themselves in the unique atmosphere of learning, openness, and culture of university campuses, especially in university towns. These are the direct economic impacts of a university.

But these figures represent only a partial snapshot of a research university's effect on a regional economy as it creates a broader economic ripple effect across many sectors. The extent of such an impact is typically determined by analyzing the length and characteristics of the supply chain throughout the region. A research university requires an extensive production infrastructure and a large proportion of highly skilled and specialized labor, including many researchers, scientists and professors. These are considered the indirect economic impacts.

The supply chain activity generates yet more income for the region's residents, who in turn recycle it back into the economy. For example, in addition to consumer spending by scientists, researchers and other university faculty, one should also consider spending by other business professionals, restaurant workers, retail clerks, real estate agents, and many others who are impacted by university operations. These consumption effects are termed induced economic impacts.

Based on a survey of the literature, the majority of university "impact" studies utilize some form of input/output studies. Regional economists typically think of two primary groups of activities. Economic base activities satisfy purchases (demand) coming from outside the region and generate export earnings that can permit purchases of goods and services from outside the region (imports).[i] The economic base of a community determines the vibrancy of the region. Nonbase activities of a region are a derived demand for goods and services that are dependent upon those exported outside of a region.

These input/output models must be used with caution because they are subject to the rule of garbage in/garbage out. Many times inexperienced users of the models will include expenditures as an input that should be excluded. Double counting economic impacts can result in estimates that vastly exceed a reasonable assessment and cause many to question the credibility of such studies. For example, a common error is to include state appropriations to a university in addition to the university's spending. Those state appropriations would be double counting as they are captured by the spending of the university. Other times mistakes are made in interpreting the findings of an input/output economic impact study. This can be attributable to attempting to demonstrate a cost-benefit or return on investment.[ii] Please see Zoe Ambargis et al. for an extensive review of best practices on common mistakes in input/output analysis.[iii]

Metrics

To capture both the direct and the broader effects (indirect and induced) of research universities on their regional economy, economists apply unique coefficients, known as "multipliers," developed by the Bureau of Economic Analysis (BEA). These multipliers (input/output system) capture and quantify the additional jobs, earnings, and output created beyond the university. Private firms such as IMPLAN (IMpact Analysis for PLANing)[iv] and REMI (Regional Econometric Models Inc.)[v] have similar estimating tools. Capturing these multiple research university operating activities provides us with the total current economic impact or a snapshot in time.

This methodology uses the input-output structure of industries at the national and regional levels, otherwise known as RIMS II (Regional Input-Output Modeling System),[vi] to estimate the total impact one industry has on the wider economy. Based on the final-demand multiplier concept from RIMS II, one can calculate total economic impacts for output, earnings, and employment. For example, the final-demand employment multiplier would indicate the total number of jobs per $1 million change in final demand stemming from research university operations. In other words, applying this multiplier to the appropriate university expenditure figures quantifies the total number of jobs in a region that are supported through university spending.

Likewise, using similar final-demand multipliers for wages and output, one can estimate the amount of total wages and output which were supported through university spending. Based on the direct-effect multiplier concept from RIMS II, one can separate the direct portion of these impacts. The difference between the total and direct impacts comprise the indirect and induced portions of the impact. Additionally, you can obtain the distribution of economic activity across all industries once multiplicative dynamics are accounted. For example, through "input-output" analysis one can estimate how much manufacturing, trade, and financial services might be affected by direct university spending.

Table 1 is an example of the economic impact of a proposed College of Medicine (COM) at the University of Central Florida.[vii]

> "The economic impact analysis of a medical school at UCF captures the total impact generated from the creation of a medical school. It also accounts for additional R&D dollars that would be awarded as a result of the school presence. These impacts specifically reflect the construction and operating phases of the medical school. The construction phase accounts for the first two planning years; the operating phase includes the next 10 years. During this latter period, we assume that the presence of the medical school will generate a great deal of research and development, particularly with National Institutes of Health (NIH) and other types of R&D funding. The total impacts under COM scenario are summarized in the table below."

Table 1: Economic Impact of College of Medicine

Impacts on Orlando Economy: End of Yr. 10

	Baseline	COM
Government Cost	N/A	+ $194.3 million
Number of Jobs	1.4 million	+ 6,470
Average Wage for Additional Jobs	$62,570	$79,895
Total Wages	$86 billion	+ $517 million
Tax Revenue	N/A	+ $81.4 million
Total Economic Impact	$239 billion	+ $1.4 billion

Source: Wong & Bedroussian, 2006

"The "baseline" column projects Orlando's economy at the end of the operational phase — in other words, what is expected to occur, independent of the existence of a medical school. Even without a college of medicine, Orlando's employment base is projected to reach 1.4 million by the end of 2017. Similarly, the total wage and salary disbursements are expected to reach $86 billion, producing a total economic impact of $239 billion.

A college of medicine alone could be responsible for:

• 6,470 additional jobs

• $517 million in increased wages

• $81.4 million in additional tax revenue

• $1.4 billion in increased economic impact

By the end of 2017 (the end of the 10th year of the operational phase), the presence of a medical school would generate direct employment within the university and produce economic benefits for Orlando. The additional jobs would be primarily in the educational services and construction industries. The bulk of jobs generated in education services, however, would consist of more than medical school faculty - namely scientists, lab technicians and contract specialists, as well as general support and administrative positions. More important, these jobs would be created as a result of incremental funding from the NIH and other private sources.

The following table 2 provides an industry breakdown of the estimated employment gains by the end of 2017."

Table 2: Additional Jobs Created in COM Scenario

Industry Breakdown

Industry	Total Impact
Agriculture, forestry, fishing, and hunting	18
Mining	0
Utilities	10
Construction	1026
Manufacturing	63
Wholesale trade	69
Retail trade	258
Transportation and warehousing	91
Information	82
Finance and insurance	92
Real estate and rental and leasing	222
Professional, scientific, and technical services	142
Management of companies and enterprises	25
Administrative and waste management services	228
Educational services	3396
Health care and social assistance	240
Arts, entertainment, and recreation	60
Accomodation and food services	273
Other services	173
Total Additional Jobs	**6468**

Source: Wong & Bedroussian, 2006

"With the COM overall wage per employee and income per capita would reach $62,651 and $56,737, respectively, by the end of 2017. As previously indicated, the additional jobs would yield an average wage-per-employee total of $79,895. The proposed college of medicine would generate total economic activities valued at $1.4 billion in the Orlando metropolitan area.

The estimated economic impact includes:

• wages and salaries provided to employees at the proposed medical school

• additional goods and services provided to the region because of new economic activity added to the local economy

• intra-regional purchases that will elevate Orlando's economic production"

Universities should update their economic impact assessment at least every five years to provide a current estimate of how their operations affect the local economy.

(2) HUMAN CAPITAL

Background

Research universities, through training graduates, expose them to the boundaries of scientific advances and are formidable mechanism for transferring knowledge and technological acumen to local businesses, if they can be retained in the geography after completion of studies.

Discoveries in the economy are aided by the transfer of knowledge and skills out of universities through their graduates, independent of the licensing and academic startup channel.

This concept—that the accumulation of skills over many years builds the stock of human capital, forms the source of innovative capacities, and drives the trajectory of regional economic performance—is behind a perceived economic shift to a knowledge-based economy. Today, the workforce talent determines economic performance, while historically capital and land were the critical factors of production. The most fundamental determinants of regional economic growth are the skills and productivity of the workforce. Education—from industry certifications and vocational training to Associate's, Bachelor's, Master's and Ph.D. degree programs—is the key to a high-performing workforce.

Numerous studies have documented the returns to investing in human capital for individuals. The wage premium to investing in higher education has risen in recent decades. In 1979, the median earnings of individuals with a Bachelor's Degree or higher were 63.9 percent higher than those without a high school degree. In 2014, the premium had jumped to 144.4 percent.[viii] An important study on the college premium was conducted by Daron Acemoglu and David Autor.[ix] They concluded that in 2008, the average college graduate earned 97 percent more than the average high school graduate with no college. In other words, college graduates on average earned twice as much as those who didn't attend college.

Less conventional is the idea that just occupying the same geographic space as those skilled workers can benefit the less-educated workforce. A study that I led demonstrated for each additional year of post-secondary schooling a region's workforce obtains, real GDP per capita and real wages per worker jump by more than 17 percent. In other words, the wages of less educated workers are boosted by being located in a region with more highly educated workers.[x]

A population with a high level of advanced education attainment in a geographic area helps create more rapid and higher value-added regional economic growth.[xi] The percentage of adults with a Bachelor's Degree is the single most decisive factor for explaining regional variations in income per capita.[xii] Residents benefit from the compendium of spillovers emerging from others with the requisite skills. Economists define this as increasing returns to scale. As greater quantities of a product or service are produced, the marginal returns rise at a faster pace than the incremental inputs.

Business success and regional economic prosperity are determined by factors other than skilled workers alone, but here is another source of spillovers. Deep pools of high-skilled labor attract business investment and create more demand for professional and personal services, so they stimulate local job creation and salary growth across the broader economy.

Perhaps Enrico Moretti put it best in his 2012 book, The New Geography of Jobs:[xiii]

"Cities with a high percentage of skilled workers offer high wages not just because they have many college-educated residents and these residents earn high wages. This would be interesting but hardly surprising. But something deeper is going on. A worker's education has an effect not just on his own salary but on the entire community around him. The presence of many college-educated residents changes the local economy in profound ways, affecting both the kinds of jobs available and the productivity of every worker who lives there, including the less skilled. This results in high wages not just for skilled workers but for most workers.

Extensive literature demonstrates that productivity is enhanced by having higher concentrations of human capital. Ed Glaeser has performed far-reaching work on this topic over the years. A study from 2013[xiv] found a strong association between regional output per capita (a measure of productivity) and average educational attainment. The study is noteworthy as it analyzed 1,500 regions across 105 nations, finding that education levels explain 38 percent of the variation in regional output per capita within nations. This finding is significant because economic theory would not propose that regions within a country would have fixed factor endowments of human capital.

Metrics

Research universities compete for the highest quality students matriculating from high schools, community colleges and non-traditional students. Universities must monitor the quality of students applying, admitted and attending. Universities are obliged to encourage a diverse student population while maintaining high academic standards. However, public universities receiving state funding have a unique obligation to maximize in-state student admissions while adhering to minimum academic enrollment standards. Public universities should monitor the balance of admitting out-of-state students with higher academic accomplishments against the desire of affording access to qualified in-state students.

The grade point averages (GPAs) of those applying are often a good indicator of ultimate outcome measures such as graduation rates. Standardized test scores like Scholastic Aptitude Test (SAT) and American College Testing (ACT) scores can reveal additional insights on the academic potential of students. Other special award designations such as on Advanced Placement courses (AP) and adjusted GPAs through the AP system, National Honor Society, National Merit Scholarship Program, Presidential Scholar, National Honor Roll and a variety of similar programs should be recorded. Prestigious awards like the Truman, Marshall and Fulbright Scholars can serve as indicators of how competitive a university has become and improve the stature of future applicants.

Universities should develop better tracking systems to identify matriculation rates with patterns and causes of dropouts. Intervention protocols should be established and implemented to minimize the obstacles to degree completion. Governments should promote the best practices of colleges and universities with high completion rates to establish guidelines for increasing student success.

The collaborations between educational institutions and local industries help develop programs and career pathways to assist students' transition into careers. Institutions should develop paid internship programs through business-education partnerships and establish industry-led curriculum committees. Additional industry-specific certificate programs to promote skill development for specific jobs should be encouraged, even at the most elite universities. Offering career services, workshops and job shadowing can also increase students' workforce readiness and result in higher job-placement rates.

Ultimately, universities must evaluate themselves on the number of undergraduate, graduate and professional degrees bestowed on their students. Academic credentials serve as essential signals of implied success in the workforce. Research universities need to track the number of Bachelor's Degrees awarded along with completion rates. It is especially important for research universities to monitor the number of science, technology, engineering and mathematics (STEM) degrees awarded. Producing a highly-trained workforce with the requisite technical abilities is essential to delivering a core mission of a university. In addition to monitoring graduate-placement rates, research universities should scrutinize how many are enrolling in graduate school programs and complete Advanced Degrees.

Table 3: Human Capital Creation Metrics

Topic	Metrics	Sample	Unit	Source
Secondary School Grade Point Average (GPA)	Mean, Median, Distribution	Applying, Accepted, Enrolled Students	Four-point Scale	University Fact Sheets, US News College Compass
Advanced Placement Course-adjusted GPA	Mean, Median, Distribution	Applying, Accepted, Enrolled Students	Five-point Scale	University Fact Sheets, US News College Compass
Scholastic Aptitude Test (SAT) Score	Mean, Median, Distribution	Applying, Accepted, Enrolled Students	Score, Score Percentile	University Fact Sheets, Compass Education Group
American College Testing (ACT) Score	Mean, Median, Distribution	Applying, Accepted, Enrolled Students	Score, Score Percentile	University Fact Sheets, Compass Education Group
Advanced Placement (AP) Course Test Scores	Mean, Median, Distribution by AP Course	Applying, Accepted, Enrolled Students	Score, Score Percentile	University Fact Sheets
National Honor Society Membership	Share of Students	Applying, Accepted, Enrolled Students	Percent	University Fact Sheets
National Merit Scholarship Program Semifinalists, Finalists, Recipients	Share of Students	Applying, Accepted, Enrolled Students	Percent	University Fact Sheets, National Merit Scholarship Corporation
Presidential Scholars Program Scholars	Number of Students	Applying, Accepted, Enrolled Students	Count	University Fact Sheets
Truman Scholarship Recipients	Number of Students	Current Students and Alumni	Count	University Fact Sheets, Harry S. Truman Scholarship Foundation
Marshall Scholarship Recipients	Number of Students	Current Students and Alumni	Count	University Fact Sheets, Marshall Aid Commemoration Commission
Fulbright Student Scholarship Recipients	Number of Students	Current Students and Alumni	Count	University Fact Sheets, Fulbright U.S. Student Program
Matriculation of Accepted Students	Share of Accepted Students	Accepted Students	Percent	University Fact Sheets, National Center for Education Statistics
Dropout of Current Students	Share of Current Students	Current Students	Percent	University Fact Sheets, National Center for Education Statistics
Industrial Involvement in Curriculums	Share of Curriculum Committee from Outside Academia	Curriculum Committee Members	Percent	N/A
Internships at Local Organizations	Share of Current Students	Current Students	Percent	N/A
Internships	Share of Current Students	Current Students	Percent	University Fact Sheets, US News College Compass
Job Shadowing	Share of Current Students	Current Students	Percent	N/A
Industry-Specific Certificate Programs	Number of Certificate Programs, Number of Certificates Awarded	University Programs, Alumni	Count	University Websites, National Center for Education Statistics
Career Services Centers	Number of Centers, Number of Career Services Staff	University Centers, University Staff	Count	University Websites
Career Workshops	Number of Workshops	University Activities	Count	University Websites
Degrees Awarded	Numbers of Undergraduate, Graduate, and Professional Degrees Awarded	Current Students	Count	University Fact Sheets, National Center for Education Statistics
Science, Technology, Engineering, and Mathematics (STEM) Degrees Awarded	Number of STEM Degrees Awarded, STEM Share of Degrees Awarded	Current Students	Count, Percent	University Fact Sheets, National Center for Education Statistics
Graduate Employment	Share of Alumni	Alumni	Percent	University Fact Sheets, US News College Compass
Graduate School Placement	Share of Undergraduate Alumni Attending/Completing Graduate School	Undergraduate Alumni	Percent	University Fact Sheets, US News College Compass
Continuing Education Programs	Number of Students, Number of Programs, Number of STEM Programs	Current Students, University Programs	Count	University Fact Sheets
Graduates Remaining in Region/State	Share of Alumni	Alumni	Percent	University Fact Sheets, Emsi, Payscale
Graduate Compensation Overall, by Degree, and by Region of Employment	Mean, Median, Distribution	Alumni	US Dollars	University Fact Sheets, Payscale

Source: Walton Family Foundation

Given how some studies demonstrate there are higher marginal financial returns to regional economies from Advanced Degrees - Master's, Doctorates, and other professional degrees such as Doctor Jurisprudence - research universities must capture how many graduate degrees are awarded. At the graduate level, the number of awarded STEM degrees becomes even more critical. Degrees granted in other areas such as the arts and humanities are important, but most communities find it difficult to retain and attract STEM graduates because they are in high demand. Another criterion vital to measuring contributions in regional economies is the number and composition of continuing education programs offered to those in the workforce where flexible arrangements are necessary for nighttime and weekend classes.

The proportion of graduates retained in a region or state are important indicators for economic contributions to be realized. If graduates leave for other states, the benefits of their human capital will accrue to them. If a disproportion number of in-state graduates, especially for public universities, leave the state, returns to public investments will be harmed. Additionally, while attracting students from out of state can be seen as an export while they are in school, if they return to their host states or accept a position in other locations, another important opportunity for investment returns is lost.

Universities should continually survey their graduates' compensation information. The information provides important metrics for determining how the marketplace values the human capital they create. Monitoring compensation of graduates in their community and states relative to industry averages provides a measure of perceived value-added in their education credentials. Perhaps an even more critical evaluation metric is to capture the compensation of their graduates residing outside the state relative to the prevailing wage for their degree and field of study. Particular emphasis should be placed on their graduates in business and STEM occupations.

(3) LICENSING AND ACADEMIC STARTUP

Background

The second major piece of a university fulfilling its mission is capitalizing on research by converting it for private-sector application.[xv] Scientific and technology-based economic development is fueled increasingly by public and private research universities through research and discovery. Many university faculty members pursue basic research that is for the advancement of public knowledge without an eye for the marketplace. Academic inquiry is to explore developing solutions to interesting problems and not only to pursue research activities with potential commercial value associated with them. However, university research often results in new innovations or discoveries of technology, creative content or "works of the mind" with potential market value.[xvi]

Karl Compton was President of MIT in the 1930s and 1940s and initiated the focus on technology transfer and commercialization at American research universities. Stanford electrical engineer Fred Terman prodded his students to start their own enterprises or work for local companies rather than return back East in the 1930s. Some founding students are part of the Silicon Valley ancestral tree and include William Hewlett and David Packard, who decided to start their own firm in a garage between the fruit orchards.[xvii]

The modern era of university technology transfer began with the passage of the Bayh-Dole Act, which came into law in 1981. It enabled universities to claim the intellectual property generated by research funded by the U.S. government.[xviii] Retaining intellectual property (IP) ownership created a more considerable incentive for universities and research centers to pursue patents, licensing and startup activities. Bayh-Dole explicitly encouraged collaboration with the private sector. Moreover, the Act aimed to limit administrative costs of pursuing commercialization by removing control from government bureaucracy. Under U.S. IP laws, the inventors are granted exclusive rights and can assign those rights to another entity.

University-derived research is transformed into IP and disseminated to the private sector through a variety of complex channels. Typically, the first step in the process is to file an invention disclosure with the university. The university office of technology transfer (TTO) will make a determination as to whether a patent should be filed on the IP or if other formal protection should be pursued. Additionally, the office advises when it is appropriate for the discovery to be disclosed as a paper in an academic journal. High professionalism is required during this labor-intensive process. TTO staff must be sensitive to the needs of the researchers, university, licensing firms and financiers and balance them with the requirements of government entities and the public that support—and ultimately benefit from—the products and services created.[xix]

The primary channels of research conversion to IP are measured by patenting and licensing activity, which, in turn, leads to either academic startups or externally-formed entrepreneurial entities, along with the income that accrues to a university from licensing its IP to an existing firm. Measures are available from the Association of University Technology Managers (AUTM), who has collected the information through member surveys for nearly three decades[xx]

The culture of research universities toward academic entrepreneurship can influence the extent of participation in these activities. Researchers have explored whether university incentives impact faculty participation and performance in entrepreneurship. Economists have known for generations: incentives nudge and change human behaviors. The social and cultural capital in a university builds trust and permits more impactful IP transfer. Maryann Feldman and co-authors have made significant contributions to literature in the field of how incentives impact faculty and student participation in entrepreneurial pursuits. A 2008 paper demonstrated statistical significance in how norms and the social environment (as exhibited by peers and leaders) influence whether academics choose to engage in commercialization.[xxi]

Extensive literature is available validating the degree of local capture of university-derived IP. The diverse papers reveal localized capture of paper citations[xxii] the extent of university patent citations by local firms vis-à-vis those external,[xxiii] indicating benefits to company growth based upon proximity to a research university.[xxiv] Audretsch and Aldridge performed far-reaching research on the competitive advantages that access to knowledge provide. They establish a clear connection between proximity to research universities and innovative outcomes at the regional level and individual firms.[xxv]

One paper applies statistical controls and normalizations to separate university influences from other effects on firm earnings growth. Most importantly, it finds that firms in small and medium-sized metropolitan areas experience greater gains in earning from the presence of research universities than in large metropolitan areas.[xxvi] Another study finds that the efficacy of university technology transfer diminishes with increasing distance from the center of a metropolitan area. Those impacts are negligible at distances beyond 70 miles.[xxvii]

In a recent paper, former colleagues at the Milken Institute isolate the impact of academic R&D expenditures on high-tech employment in metropolitan areas over the long run. Using a longitudinal data set, controlling for other effects, they find that for each one percent increase in academic R&D, high-tech jobs rise by 0.06 percent.[xxviii] The paper demonstrates a robust and highly significant relationship. Another study isolates the influence of academic R&D expenditures of the physical and engineering sciences. These fields are likely to produce intellectual property that is most applicable to industry activity. The study, controlling for numerous variables, does discern a higher explanatory power across multiple outcome measures such as earnings (dependent variable) for R&D in physical and engineering than for patents or total R&D expenditures.[xxix]

Metrics

The discovery and commercialization process begins with raw material—research funding. Research expenditures at universities commence the process of scientific inquiry which can result in intellectual property with commercial viability. The National Science Foundation (NSF) collects information from the universities.

Additionally, university TTO's offices report similar information to AUTM as part of their licensing survey. It is important to monitor the sources of research funding: federal, state and local, foundation or from industry sources. Research universities with a higher proportion of funding from industry tend to have better commercialization outcomes, holding other factors constant. Industry involvement can provide timelier vetting of university research. Additionally, it is important to monitor the research and development expenditures by academic field. For example, R&D in the physical sciences, engineering, life sciences and medical fields will have more applicability for commercial operations.

Tenure and promotion policies can play a significant role in incentivizing academics in pursuing commercialization. Many universities fail to provide incentives that encourage graduate students and younger faculty to think like entrepreneurs. This situation is acute particularly at research universities in the American Heartland. The coin of the realm for most young faculty members is tied to publishing in academic journals and securing research grants. Obtaining patents, licenses and activity in other commercial activities have little if any bearing. Starting a business is often a negative in the eyes of tenure committee members.[xxx] The importance for promotion and tenure of faculty should be codified in the review process.

Providing clear conflict of interest policies to faculty and administrators is important. University staff feel conflicted at times without agreeable, codified guidelines on policy and procedures. Many would-be entrepreneurs are discouraged from engaging due to the real or perceived red-tape involved. The University of Utah's policies in this area provide an innovative, transparent model. Utah creates a community of interest rather than a conflict of interest environment. University leave of absence policies are critical to encouraging or discouraging faculty involvement in startups. If a member of the faculty is at risk of losing tenure by taking a leave of absence to engage in a startup, let alone a non-tenured faculty member, then the institution has a weak commitment to commercialization. They do not fundamentally recognize it as part of their mission.

The size and professionalism of the TTO can enhance or limit the degree of success of converting IP to use in the marketplace. Investments in TTO's also offer high returns. For every $1 invested in TTO staff, the university receives a little more than $6 of licensing income, ceteris paribus.

[xxxi] Additionally, the years that a formal TTO has been in existence plays a role in transferring IP to the private sector. It provides a crude measure for the extent of commercialization networks that have formed.

As discussed in the Licensing and Startup Activity Background section, the process begins when a faculty member or student approach's the TTO office and a decision is made on filing an invention disclosure with the university. A university must then decide whether to advance the protection of the IP by submitting a patent application and pursue the legal fees and process in obtaining a patent. Tracking the number of patents granted is an early measure of potential commercial interest in intellectual property. Patent protection for intellectual property incentivizes entrepreneurs and firms to pursue development funding to bring a product or service to the market.[xxxii] Many forms of IP require significant financial investment to prepare them for a commercial application. Without forms of strong IP protection like patents, fewer inventions would result in products and services in the broader economy to provide societal benefits.

After university intellectual property is protected, the university TTO office and inventors must determine the most advantageous route to bring the IP to the market. The process is accomplished by licensing the IP to an academic inventor/inventors in a startup that they found. They may choose to hire a management team to run the new enterprise or take the reins themselves. Another more passive, alternative role is taken when the university licenses the IP to a startup without a direct role for the university inventors. The third route consists of licensing to an existing firm that can commercialize the IP. Many times an existing firm will purchase an option that gives them the right to acquire the use of the university IP. Another important indicator is how many startups have received equity financing. This provides a measure of whether financiers place value on the IP and business plan of the commercial entity. Many universities are establishing their own pre-seed and venture capital funds to validate the business plan and acquire external capital commitments.

Research universities receive income from the licenses they grant. Licensing income includes running royalties (representing the ongoing stream of income) and one-time payments, such as milestone payments, up-front payments and cashed-in equity which a university receives for its IP. Because this measure includes one-time-only payments, it can have large movements in a particular year and is apt to be a cyclical stream. Licensing income is split between the university, academic researchers and departments, in many cases.

My former Milken Institute colleagues and I introduced the term "university innovation pipeline" in the 2006 publication *Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization.* The writings look at the progression from research expenditures, invention disclosure, all the way through startups and licensing income, and then evaluate how efficient a university is in advancing IP to the next phase.

"The phrase university innovation pipeline refers to the support and process infrastructures that enable a university to convert its research and creativity into intellectual property that is commercialized. A rich innovation pipeline plays a pivotal role in a university's ability to commercialize its overall and biotech-specific research."[xxxiii]

A total of 1,024 startup firms were launched in 2016 on university-registered intellectual property, with over 73 percent of them located in the research institution's home state. Nearly 500 of these startups received equity capital and 800 new products were introduced into the marketplace. Licensing income rose to almost $3.0 billion in 2016, a 17.5 percent jump from 2015. From 1996 to 2015, academic licensing contributed $1.3 trillion in industrial output and 4.3 million jobs to the U.S. economy.[xxxiv]

If universities are not measuring outcome performance, key objectives are unlikely to be achieved. In 2017 while at the Milken Institute, we updated the University Technology and Transfer and Commercialization Index, which is considered to be among the best assessments of university commercialization.[xxxv] Below is a section from the study.

"Development of an aggregate ranking across research universities with multiple disciplines is fraught with challenges; nevertheless, the University Technology Transfer and Commercial Index (Index) is a metrics-based benchmark that is helpful in assessing the relative position among peers and in recognizing best practices.

The Index is based on data collected by the Association of University Technology Managers (AUTM) via the AUTM's Annual Licensing Activity Survey, with one exception, the University of California System.

The Index is measured using four-year averages (2012-15) for four key indicators of technology transfer success: patents issued, licenses issued, licensing income, and start-ups formed. These are normalized based on a four-year average of research dollars received by each university to yield four additional variables, for a total of eight.

Each university has distinctive – sometimes subtle – differences in structure, culture, and institutional factors (including whether it is a public or private institution) that necessitate alternative strategies on IP commercialization. For example, a university with scientific expertise in the life sciences will develop a commercialization approach different from a university with an advantage in engineering.

When ranking and scoring the Index, a primary consideration is to determine the appropriate balance between absolute and relative measures of commercialization. We would expect that a large research university that attracts substantial public funding to achieve larger commercialization outcomes relative to a smaller university.

Scale is important in assessing the impact of research universities. However, absolute outcome measures don't address the productivity or efficiency of commercialization activity. For this reason, we include the outcome metrics normalized by research expenditures.

The weights in Table 4 are applied to these eight variables to generate a score, and research institutions are ranked from highest to lowest score. The final score is generated by indexing all raw scores to the highest performer, yielding a top score of 100 for the first place institution. The result is an index that identifies universities with consistent performances across the metrics.

This index is designed to evaluate the relative position of university research quality, its market applicability, and TTO performance in the U.S. The purpose is to provide an easy to understand measure of the commercialization output of the U.S.'s higher education institutions. The potential impact on economic development from commercialization of university research is large, and is important to maintaining innovation in the U.S."

Table 4: University Technology Transfer and Commercialization Index

Rank	Institution	Patents Issued Score	Licenses Issued Score	Licensing Income Score	Startup Score	Index Score
1	University of Utah	88.27	89.38	94.04	93.90	100.00
2	Columbia University	85.86	84.54	97.08	88.50	97.93
3	University of Florida	88.60	95.37	91.60	87.84	97.81
4	Brigham Young University	85.59	85.83	86.76	94.95	96.63
5	Stanford University	96.28	85.43	94.57	81.94	96.33
6	University of Pennsylvania	83.30	86.52	91.62	87.66	95.45
7	Univ. of Washington	79.56	100.00	93.73	79.30	94.66
8	Massachusetts Inst. of Tech. (MIT)	96.76	77.92	92.91	82.00	94.58
9	California Inst. of Tech.	100.00	76.07	91.53	81.14	93.96
10	Carnegie Mellon University	75.57	92.29	88.50	87.05	93.72
11	New York University	84.48	78.27	98.60	77.76	93.20
12	Purdue Research Foundation	85.58	86.56	85.45	86.87	93.19
13	University of Texas System	87.02	82.90	89.75	81.91	92.58
14	University of Minnesota	76.71	91.99	90.75	80.80	92.34
15	Univ. of California, Los Angeles	93.32	77.37	68.43	100.00	91.48
16	University of Michigan	86.03	84.96	89.98	75.03	90.23
17	Cornell University	84.49	91.52	86.42	74.32	89.44
18	Univ. of Illinois Chicago Urbana	84.66	78.16	89.83	75.87	89.17
19	University of South Florida	89.25	83.45	81.23	79.65	88.95
20	Univ. of California, San Diego	89.14	83.65	65.76	93.53	88.36
21	Arizona State University	79.29	79.87	82.32	82.67	88.31
22	University of Central Florida	91.93	69.34	79.69	83.75	88.06
23	Northwestern University	84.88	69.32	88.85	77.44	87.99
24	Cleveland Clinic	85.51	76.51	90.86	71.88	87.92
25	University of Pittsburgh	78.31	91.48	87.84	71.37	87.84

Source: Milken Institute

Table 5: Licensing and Academic Startup

Metric	Unit	Source
Research Expenditures Overall, by Field of Study, and by Source of Funding	US Dollars	National Science Foundation (NSF), Association of University Technology Managers (AUTM), University Fact Sheets
Usage of Commercialization Work in Faculty Tenure Positions	Dummy (Used, Unused)	University Websites
University Policies Regarding Faculty Commercialization Work	Dummy (Supportive, Unsupportive)	University Websites
Technology Transfer Office (TTO) Staff Size and Budget	Count, US Dollars	AUTM
TTO Age	Years	AUTM
Invention Disclosures by University Researchers	Count	AUTM
Patents Granted to University Researchers	Count	AUTM, US Patent and Trademark Office (USPTO)
University Licensing Income, Overall and by Payment Type	US Dollars	AUTM
University Licenses Granted to Startups/Existing Firms	Count	AUTM
University IP-based Startups Receiving Equity Financing	Count	N/A
Jobs Created by University-created Intellectual Property	Count	Individual University Reports
Total Wages Generated by University-created Intellectual Property	US Dollars	Individual University Reports
Sales of Products Based upon University-created Intellectual Property	US Dollars	Individual University Reports
Market Capitalization of Firms Licensing University-created Intellectual Property	US Dollars	Individual University Reports
Donations from Firms and Entrepreneurs Connected to the University	US Dollars	N/A
Number of Entrepreneurial Programs Overall, by For-credit Entrepreneurial Courses, and by Entrepreneurial Focus of Capstone	Count	University Websites
Existence of University Business Plan Competition	Dummy (Yes, No)	University Websites
Number of Startups by University Graduates	Count	NSF (STEM Degree Graduates Only)

Source: Walton Family Foundation

The AUTM licensing survey is a beneficial evaluation mechanism. However, there are much longer term, post-market metrics of technology transfer and commercialization performance that are not included.

Measures such as job creation, employee wages, sales, and market capitalization of academic-derived enterprises and firms which licensed IP are not captured. If data were more readily available, a comprehensive and longer-term series of impact metrics could be developed.

Several universities have undertaken comprehensive, longer-term evaluation of their commercialization impacts. A study of living alumni of the Massachusetts Institute of Technology documented that they had started nearly 26,000 active firms and 6,900 of those firms were based in Massachusetts. These companies employ 3.3 million and are responsible for worldwide revenues of approximately $2 trillion.[xxxvi]

Another study conducted by Stanford found that alumni created 18,000 firms that were headquartered in California and produced annual worldwide sales of $1.27 trillion. [xxxvii] Google created over 40,000 jobs after search engine algorithms found their way out of Stanford. The majority of those jobs are based in the San Jose metropolitan area close to Palo Alto, the home of Stanford.[xxxviii]

Nevertheless, these measures do not include another vital source of university remuneration: the millions of dollars that alumni and former students donate back to their universities. For example, Google co-founders Sergey Brin and Larry Page at Stanford or Michael Dell to the University of Texas, Austin have donated millions back to their universities. Michael Dell was motivated to give back after the UT-Austin provided Dell with a dormitory room to start his computer-retailing firm, convincing him to give back. Dell donated millions to start a new medical school at UT-Austin.

Universities are setting students up for success by providing centers for entrepreneurship and training. This permits deeper engagement and sources of future income. Many of the course offerings are non-credit, but formalized entrepreneurial programs are proliferating at universities. These programs should be evaluated by the number of credited courses and whetherhey are part of a formal entrepreneurship program requiring a capstone project (business plan or elevator pitch).

Business plan competitions are a new format for students to acquire experience while developing their idea and winning financial commitments to advance it. A prospective student should not determine their future institution based on a business plan competition; however, schools offering these programs tend to be more progressive and are open to the exchange of ideas.[xxxix]

Most previous entrepreneurial studies explore the role of faculty and staff in facilitating university spinoffs and startups. A recent study involving university graduates, their faculty and entrepreneurship reached some counterintuitive conclusions.[xl] It provides some general evidence based upon U.S. data displaying that the "gross flow of start-ups by recently graduated students with an undergraduate degree in science or engineering is at least an order of magnitude larger than the spin-offs by their faculty, that a recent graduate is twice as likely as her Professor to start a business within three years of graduation, and that the graduates' spin-offs are not of low quality."

(4) BUSINESS AND ECONOMIC ENGAGEMENT

Background

There are many pathways other than licensing and academic startups for evaluating the success of university knowledge dissemination to the marketplace. For example, the engagement between academic and industry researchers across geographies can lead to broader dispersion of knowledge and commercial impact, even across international borders. However, the preponderance of these knowledge spillovers are captured in the local economy.[xli] Collaborative research with private sector firms is a critical avenue for knowledge assimilation to occur outside the traditional TTO route.

Research university faculty are often sought out to provide their expertise through institutional arrangements other than papers, patents and licensed IP from their university. This synergetic interaction serves as a critical source of knowledge exchange between universities and government, non-governmental organizations and the business sector as networks of expertise are formed. Research universities are unique institutions as they can create knowledge discoveries that other institutions do not have the capacity to accomplish and disseminate them more broadly. This allows for more rapid and contextually complex knowledge transfer into a market economy permitting a rapid and more diverse formulation of how knowledge can be applied to goods and services. This process can enhance the reputational prestige of the university faculty, and implicitly, of the university itself. Moreover, the gratitude of private sector benefactors can be bestowed upon the university through substantial gifts.

Significant business and economic growth channels include research faculty who engage in contract research/consulting. Further, researchers available for ad-hoc council or networking on an informal basis with applied practitioners are another pathway.[xlii] Publications of joint research with industry-based researchers, staff exchange, and even graduate student supervision are supplementary methods of knowledge swapping.[xliii] Repeated interaction leads to informal, tacit transfers of knowledge that may generate significant commercial value.[xliv] The output from university research may enter an ecosystem and "ping-pong" for decades before yielding a viable commercial application.

Transmission of innovations between universities, federal laboratories, firm research, and development facilities highlights the various communication channels regarding how industries value these relationships. A comprehensive study identified and prioritized these relationships.[xlv] The analysis revealed biopharmaceutical senior management placed higher value on patents and license agreements with universities than executives from other industries. Nevertheless, those surveyed from other industries found research publications, conferences, seminars, consulting, and other ad-hoc contact to have the greatest value. The evolutionary engagement between universities and industries is portrayed as unidirectional: from the university to industry. However, this linear model of innovation is too simplistic and inaccurate. Industry experts can supply advances from their research to universities which leads to unlocking desired pathways or leading to new ones.[xlvi]

The successful transfer of IP to new products and services can be impended by a knowledge filter. New or incumbent firms in close proximity minimize the severity of knowledge filters as they can better visualize the application of the knowledge.[xlvii] Universities are a platform that assists in the capture of non-codified, tacit information through proximity and repeated engagement. Knowledge spillovers diminish with distance from a university.[xlviii]

At the heart of an innovative local ecosystem is its capacity to absorb new knowledge for industrial use.[xlix] Industrial innovation is defined by the capability and propensity to engage, translate, absorb and exploit new knowledge and the active participation of a university, including facilities, faculty, staff and students who can aid this process. This provides a distinct advantage for those private firms immersed in a university's many operations. Absorptive capacity is essentially the ability to process, and ultimately, exploit knowledge from external sources.[l]

The UK government might best understand that investment in research must be matched with the capability to exploit it in a study by the U.K. Department for Business, Innovation, and Skills:

"Through investment in the knowledge base and by building our national absorptive capacity, participation in research enhances the UK's ability to exploit knowledge generated both internally and internationally; if a country cannot understand new ideas, it cannot convert them into economic and social success."[li]

Regions with weak innovation outcomes tend to be those that are organizationally and institutionally "thin." Regions must encourage/demand that their universities participate in the network-based relationships and contribute to the institutional arrangements to promote innovation outcomes that can be deployed in the marketplace.[lii]

Metrics

Perhaps the most direct pathway linking universities to their local business ecosystem is through sponsored research activities. This is the number and dollar value of private-sector entities including firms, consortia and trade associations. Tracking should be conducted by industry sector based upon the North American Industry Classification System (NAICS) to monitor the alignment between the leading local clusters and the research and knowledge competencies of the university. Sponsored research activities should exclude pass-through funds from federal entities.

Another essential engagement opportunity is through research parks and university-industry research centers operated by many universities and other real estate-based facilities. This would include operations such as business incubators, accelerators, innovation districts or maker spaces. Research parks are designed to conjoin research facilities of the university with innovative-driven companies. Battelle has commented on these collaborative arrangements: "university research parks are a successful way to advance innovation and create economic growth in regions across North America."[liii] Studies demonstrate that companies formed or located in science parks experience stronger growth rates, report fewer challenges in attracting early-stage financing and launch more new services than firms located outside of a research park.[liv]

Table 6: Business and Economic Engagement Metrics

Topic	Metrics	Sample	Unit	Source
Sponsored Research Activity	Number of Agreements, Value of Agreements	University Research Activity	Count, US Dollars	National Science Foundation (NSF), University Fact Sheets
Research Parks	Number of Parks, Number of Companies per Park, Market Capitalization of Park Companies	University-Related Entities	Count, US Dollars	University Websites, Association of University Research Parks
University-industry Research Centers	Number of Research Centers, Number of Involved Companies per Center, External Funding per Center	University-Related Entities	Count	University Websites
Business Incubators	Number of Incubators, Startup Capacity per Incubator, Budget per Incubator, Startup Funding Rate per Incubator	University-Related Entities	Count, US Dollars, Percent	University Websites
Business Accelerators	Number of Accelerators, Startup Capacity per Accelerator, Budget per Accelerator, Startup Funding Rate per Accelerator	University-Related Entities	Count, US Dollars, Percent	University Websites
Innovation Districts	Number of Districts, Startups per District	University-Related Entities	Count	University Websites
Maker Spaces	Number of Maker Spaces, Number of Staff per Space, Square Footage per Space	University-Related Entities	Count	MakeSchools, University Websites
Equipment Cost-sharing Agreements	Number of Agreements, Value of Cost-shared Equipment	University Research Capital	Count, US Dollars	N/A
Faculty Consulting	Number of Faculty Consulting, Faculty Consulting Income	University Faculty Activity	Count, US Dollars	National Study of Postsecondary Faculty (Data through 2004)
Research Conferences and Seminars	Number of Events, Invitation of Local Professionals	University Events	Count, Dummy (Invited, Not Invited)	Inside Higher Ed, University Websites, Academic Society Websites
Clinical Trial Activity	Number of Clinical Trials for Internally Developed Medical Products, Number of Clinical Trials for Externally Developed Products	University Medical Staff Activity	Count	University Websites, US National Library of Medicine
Agricultural Field Trial Activity	Number of Field Trials Conducted	University Faculty Activity	Count	University Websites
General Economic Development Activity	Responses to Stakeholder Input Surveys (Stakeholders Include Local Business Owners and Others Perceptive of University Activity)	General University Activity	Varied	University Websites, Innovation & Economic Prosperity Universities Designation Program (Designation Process Involves Stakeholder Engagement)

Source: Walton Family Foundation

University-industry research centers are typically "Centers of Excellence" and may not have the same substantial physical footprint as a research park, but provide a multi-disciplinary, multi-institutional alternative to promote technology-based economic development.[lv] Industry involvement can range from serving on Boards of Directors to providing financial support. Experience has demonstrated that research centers where industry financial support was direct rather than an in-kind arrangement were more impactful. Many universities found that research centers where in-kind contributions were the primary financial support mechanism were chronically underfunded. Successful research centers focus on specific areas of technology where industry clusters either previously existed or where emerging or nascent industry sectors were developing.

A university may not be able to justify the purchase of highly specialized research equipment or facilities. Scientific advancement may be improved with access to such equipment. However, by partnering with local industry, a cost-efficient, cost-sharing arrangement can be developed. A firm or group of firms might fund part of the purchase of such equipment if its use can be shared. These firms may not feel the cost to benefit ratio would support them purchasing the equipment on their own, but through a university purchase, where more advantageous pricing arrangements are sometimes available, it can be justified.

Research universities candemonstrate their commitment to local businesses through encouraging faculty and administrative staff to engage in consulting arrangements.Tracking the number of faculty engagements and revenues from such a consulting arrangement can provide a measure of university embeddedness in the local business ecosystem. This provides local firms early access to information that may not be available in a peer-reviewed academic journal for three to five years. Contract work is engagement, not tied to a specific short-term need, but is ongoing in a particular research field.This is sometimes resembles a retainer-type relationship. Efficiently operating ecosystems boost regional economic performance, and faculty consulting and contract work can improve connectivity and network density.

Conferences and seminars are another accessible pathway to non-codified university research breakthroughs. Research universities, as centers of creativity and innovation, provide platforms for non-rivalrous, pre-market exchange of research findings. Most of the research findings presented will be from academic sources, but some will be joint university/industry collaborations. An important advantage of university conferences and seminars is that they offer exposure to information across the geographic spectrum allowing the firms and the regional economy to absorb this information before others.[lvi]

For universities with a college of medicine or affiliated teaching hospitals, medical discoveries may have commercial applicability or may conduct clinical trials which can aid in demonstrating safety and efficacy of vaccines, diagnostics, drugs and medical devices. Many medical research breakthroughs will be commercialized through the university technology transfer office. However, before medical products can be introduced into human use, they must clear rigorous clinical trials and be approved through the Federal Drug and Food Administration (FDA). The medical and clinical platforms afforded by academic colleges of medicine are unique. Universities have the skilled personnel to oversee and conduct clinical trials. Additionally, academic medical faculty are often a leading source of consulting arrangements and revenue for universities. Another spillover effect from clinical trials at academic medical hospitals is that the local patient population gains early access to potentially life-saving drugs and medical devices.

Affiliated university agricultural or plant life science research can serve as valuable research centers to conduct field trials. Similar to products tested for efficacy in humans, novel plant varieties must undergo extensive trials to demonstrate non-toxicity and improved crop yields. America's unique system of land-grant universities were created, in part, to advance research aiding agricultural productivity and the quality of plant varieties. By using field trials, greenhouses, and laboratory bench research, universities can spread use of advanced agricultural and environmentally sustainable products.[lvii]

A key monitoring and reporting tool for regional economic growth and development is a stakeholder input survey. More universities have been using this tool as a qualitative assessment mechanism in recent years. The goal is to survey a broad range of university stakeholders: small business owners, corporate leaders, community agencies (Chambers of Commerce, Workforce Development, etc.), not-for-profits, foundations or charitable organizations, government (local, regional, state and federal) and other education organizations. The surveys generally ask questions on the type of relationships that exist and how many.

(5) QUALITY OF PLACE/SOCIAL CAPITAL BUILDING

Background

Universities can enhance the quality-of-place and build social capital through interactions with their communities. As firms try to retain or attract top-level managers, scientists, engineers, other technicians and members of the Creative Class[lviii] , quality-of-place is crucial to their success. Quality-of-place (arts, entertainment, recreational amenities, other lifestyle amenities and cultural attributes, health care access and quality, good K-12 education, transportation mobility, crime rates, air quality, along with climatic conditions and other geographical characteristics) increasingly affects location decisions.[lix]

In a knowledge-based economy, human capital is a location's most valuable factor of production. Firms merely lease knowledge assets, and location decisions are increasingly based upon quality-of-place factors that are important to attracting and retaining this most vital economic asset. Locations that are attractive to knowledge assets will have a distinct advantage over those that are not.[lx] Universities that take their role in elevating quality-of-place and community building seriously provide a unique contribution to their economies.

A growing body of research provides an empirical basis for the role of arts and culture in promoting the prosperity of place. Additionally, there are higher densities of art organizations and prevalence of art in communities with universities. Community Arts is a collaboration between community members and professional artists with collective experience and public expression as an outcome. Firms attempting to attract technical and creative class talent consider art and cultural offerings in relocation and location decisions.[lxi] When combined with tax and other relocation incentives, the presence of arts improves the image of a region and assists in making a stronger case for attraction.[lxii]

There is some statistical evidence demonstrating that concentrations of artists produce agglomeration effects for creative industries and spill over into attracting high-skilled talent.[lxiii] Urbanist Richard Florida has taken the role of arts to new heights with his "creativity index" and making each city feel that, whatever its shortcomings, it has the potential to move up the ladder. There is diverse literature on how the arts assist communities in other ways: they improve academic performance and student discipline,[lxiv] and participation in the arts can enhance psychological and physical wellbeing.[lxv]

The arts can catalyze the creation of social capital and achieve other community goals, and a university presence makes this process more inclusive. Universities are drivers of innovation in other fields like healthcare (universities with medical schools and affiliated teaching hospitals can significantly improve the quality of healthcare delivered to communities), law, K-12 education and open political discourse, although this role is in jeopardy as many college campuses are becoming closed to opposing viewpoints.[lxvi] Universities that receive public funding have a social contract to support community engagement, and indirectly improve the quality-of-place. A social contract is fulfilled by delivering improved public goods to community stakeholders.

I participated in a project to create a "Best Cities for Successful Aging Index"[lxvii] which identified categories most critical to aging Americans and placed weights on them. This includes community engagement, general livability, health care, wellness, financial security, education, transportation and convenience, employment and living arrangements. There are 83 individual indicators included in the index. We quickly discovered that this index was just not applicable to aging Americans, but to the young as well. The index looked at successful aging over the life cycle. In essence, we created a quasi quality-of-place index. On the Large Metro list, 14 of the top 20 were university dominated, and all but one of them had a significant university presence. On the Small Metro list, 18 out of the top 20 were "university towns," led by Iowa City, Iowa and followed by Manhattan, Kansas; Ames, Iowa; and Columbia, Missouri.

Social and cultural capital are ingredients for cohesive and sustainable communities. Social capital defined by Robert Putnam in his book *Bowling Alone: The Collapse and Revival of American Community:* "features of social organizations, such as networks, norms, and trust, that facilitate action and co-operation for mutual benefit." Specific elements defined by Mike Milken: "Social capital includes educational, cultural, religious and medical institutions and other intangibles."[lxviii]

Linking, bridging, and bonding of social capital augments the building of trust between individuals and institutions, and contributes to a vibrant social network. Social capital plays an instrumental role in facilitating the economic performance of organizations and individuals through minimizing friction in information flows and transaction costs.[lxix] Universities can be the conduit by which social capital is maximized in a region.

Susan Ostrander raises a concern that civic engagement by a university can be under-appreciated.

"To define the civically engaged university solely in ethical and educational terms will, according to people with whom I spoke and materials I read, likely mean that engagement will continue to be a marginalized activity (especially at top research universities) in which only a few community-minded faculty and students will choose to be involved as service added on to their normal activities."[lxx]

There is a risk that the important role of universities in community support engagement could be lost in the "university like a business" approach. However, they should not be viewed as mutually exclusive, rather as complementary and non-competitive as they will enhance a university's productivity in creating human capital, licensing and academic startup activity and business and economic engagement.

Metrics

Measurement of quality-of-place and social capital building attributes of research universities is more qualitative in nature, some might say "when you see it, you will know it." However, we are discussing arts and cultural amenities, sports and recreational amenities, programs boosting quality in Pre-K-12 schools, healthcare facilities, wellness programs, and environmental sustainability efforts. Community development engagement programs, service learning programs, community leadership development, participation in regional government and economic development organizations, urban development/redevelopment efforts, rural engagement, employment opportunities in the community (jobs for residents), local government training, and public policy analysis are all important.[lxxi]

Table 7: Quality of Place/Social Capital Building Metrics

Topic	Metrics	Sample	Source
Museums	Number of Museums, Attendance per Museum	University Facilities	Association of Academic Museums and Galleries, University Websites
Athletics	Athletics Revenue, Athletics Expenditures	University Finances	USA Today, University Websites
Childhood Education Centers	Number of Centers, Number of Staff per Center, Expenditures per Center	University Centers, University Staff, University Finances	University Websites
Health Centers	Number of Centers, Number of Staff per Center, Expenditures per Center	University Centers, University Staff, University Finances	Association of Academic Health Centers, University Websites
Wellness Centers	Number of Centers, Number of Staff per Center, Expenditures per Center	University Centers, University Staff, University Finances	University Websites
Sustainability Initiatives	Existence of Initiatives	University Initiatives	Association for the Advancement of Sustainability in Higher Education, University Websites
Community Development Programs	Existence of Programs	University Programs	University Websites
Service Learning Programs	Existence of Programs	University Programs	US News, University Websites
Community Leadership Development Programs	Existence of Programs	University Programs	University Websites
Partnerships with Local Government and Economic Developers	Existence of Partnerships	University Partnerships	University Websites
Urban Development Initiatives	Existence of Initiatives	University Initiatives	Coalition of Urban Serving Universities, University Websites
Rural Engagement Initiatives	Existence of Initiatives	University Initiatives	National Institute of Food and Agriculture (List of Land-Grant Universities), University Websites
Community Employment Opportunities	Number of University Staff	University Staff	University Fact Sheets
Local Government Training	Existence of Training Program	University Programs	University Websites
Public Policy Analysis	Existence of Public Policy Programs	University Academic Programs	Network of Schools of Public Policy, Affairs, and Administration; University Websites
Broadband Internet Access	Share of Regional Population with Access	Regional Population	Federal Communications Commission
Alternative Energy Access	Number of Alternative Energy Sources Available to Region	Regional Energy Sources	US Department of Energy
Internships at Local Community-based Organizations	Number of Internships	Regional Internships	University Websites
Student Community Service Activity	Hours of Service per Student	Student Community Service	University Websites

Source: Walton Family Foundation

Other areas to monitor include infrastructure such as broadband, alternative energy and public transportation, student learning programs, local government training institutes, internships at community-based organizations, student engagement in community health and wellness programs.

The Best Cities for Successful Aging has been used by a number of organizations to monitor where they stand on important quality-of-place characteristics. For example, the index includes a component on arts, entertainment and recreational facilities (the number of museums, dance companies, movie theaters, performing arts and other measures on a per capita basis. Adjacent is table 8, the top 20 small metros. Note the university towns.

Table 8: Metros for Successful Aging Small Metros

Metro	Rank	Score
Iowa City, IA	1	80.44
Manhattan, KS	2	79.47
Ames, IA	3	79.04
Columbia, MO	4	79.03
Sioux Falls, SD	5	78.58
Ann Arbor, MI	6	74.77
Ithaca, NY	7	74.70
Lawrence, KS	8	74.64
Logan, UT-ID	9	74.59
Fairbanks, AK	10	74.09
Boulder, CO	11	74.05
Champaign-Urbana, IL	12	73.93
Gainesville, FL	13	73.72
Fargo, ND-MN	14	73.41
Midland, TX	15	73.39
State College, PA	16	73.27
Cheyenne, WY	17	73.26
Morgantown, WV	18	72.95
Lubbock, TX	19	72.62
Burlington-South Burlington, VT	20	72.56

Source: Milken Institute

Conclusions

No set of metrics can capture the full extent of the intricate and complex relationships that exist between a university and the local economy where it is embedded. When one examines the numerous interactions, it becomes apparent that even local economic development officials fail to comprehend the full contributions of research universities and vast potential for further engagement. The American research university may be one of the greatest inventions this nation has ever produced. It is clear that other nations and localities recognize the economic potential of the American version of a research university since they are trying to copy it. Places throughout China, the rest of Asia, Europe, Russia, South America and Canada are attempting to replicate it.

The American research university is this nation's best defense against economic competition from the rest of world. If universities are not funded appropriately, we risk ceding the innovation advantage that America maintains. The regions where universities reside have a remarkable comparative advantage. Places must do a better job of supporting and exploiting the research universities in their midst. Most communities with research universities have an understanding of the economic development potential of the human capital they create. However, not enough communities fully comprehend the importance of entrepreneurship in retaining a higher share of the graduates created in their geography. If those graduates move somewhere else, their economic development potential will leave the region. The forgone growth opportunity is substantial. While not all communities should expect to have a university's graduates create the next Google or Genentech, aiming to have a few mid-cap companies within a decade or two is a realistic objective.

Research universities can enhance their involvement in regional economic development. It is central to their mission of dissemination of the knowledge that they create. Many research universities can improve upon their participation in the local economy and spur stronger growth for the nation as well. Measuring university economic contributions and providing the proper financial incentives to their leadership and faculty will improve performance in the future.

Endnotes

i Hill, Kent, and Dennis Hoffman. The Contribution of Universities to Regional Economies, Productivity and Prosperity Project. W.P. Carey School of Business, Arizona State University, May 2009, wpcarey.asu.edu/sites/default/files/univ-contribution5-09.pdf. pp. 3-4

ii Salter, Ammon, and Ben Martin. "The Economic Benefits of Publicly Funded Basic Research: a Critical Review." Egyptian Journal of Medical Human Genetics, Elsevier, 28 Feb. 2001, www.sciencedirect.com/science/article/pii/S0048733300000913. pp. 509-532

iii Ambargis, Zoe, et al. "University Contribution Studies Using Input-Output Analysis in Economic Impact Guidelines." Association of Public and Land-Grant Universities. https://www.aau.edu/sites/default/files/AAU Files/Key Issues/Research Administration & Regulation/AAU-APLU-Economic-Impact-Guidelines.pdf. Chapter 3, pp 20-33

iv "Gain Powerful Insightinto Your Local Economy." IMPLAN, www.implan.com/

v "What Does REMI Say?" » PI , www.remi.com/

vi "An Essential Tool for Regional Developers and Planners." e Bureau of Economic Analysis (BEA), Dec. 2013. https://www.bea.gov/regional/pdf/rims/RIMSII_User_Guide.pdf

vii Wong, Perry, and Armen Bedroussian. "Economic Benefits of Proposed University ofCentral ..." Milkeninstitute.org, Milken Institute, 3AD, 2006, assets1c.milkeninstitute.org/assets/Publication/ResearchReport/PDF/cfu_study_2006.pdf. pp. 7-8

viii "More Education Still Means More Pay in 2014." U.S. Bureau of Labor Statistics, U.S. Bureau of Labor Statistics, 2 Sept. 2015, www.bls.gov/opub/ted/2015/more-education-still-means-more-pay-in-2014.htm.

ix Acemoglu, et al. "Skills, Tasks and Technologies: Implications for Employment and Earnings." NBER, University of Chicago Press, June 2010, www.nber.org/papers/w16082. p. 7

x DeVol, Ross, et al. "A Matter of Degrees: The Effect of Educational Attainment on Regional Economic Prosperity." Milken Institute, 27 Feb. 2013, www.milkeninstitute.org/publications/view/564. pp.15-16

xi Gottlieb, Paul, and Michael Fogarty. "Educational Attainment and Metropolitan Growth - Paul D ..." Sagepub.com, Economic Development Quarterly, 1 Nov. 2003, journals.sagepub.com/doi/10.1177/0891242403257274. 17: 325-336

xii DeVol, Ross. "Economics of Place." Economics of Place, Milken Institute Review, 2001, www.economicsofplace.com/.

xiii Moretti, Enrico. "Enrico Moretti: The Geography of Jobs." Stanford Graduate School of Business, Mariner Books, Canada, 2013, www.gsb.stanford.edu/insights/enrico-moretti-geography-jobs. p. 23

xiv Gennaioli, Nicola, et al. "Nicola Gennaioli Rafael La Porta Florencio Lopez-De ..." Scholar.harvard, 2011, scholar.harvard.edu/files/shleifer/files/human_capital_qje_final.pdf. 128(1): pp.105-164N.

xv DeVol, Ross, et al. "A Matter of Degrees: The Effect of Educational Attainment on Regional Economic Prosperity." Milken Institute, 27 Feb. 2013, www.milkeninstitute.org/publications/view/564. pp. 2-6.

xvi Tripp, Simon, et al. "The Importance of Research Universities." TEConomy, Sept. 2017, www.cicpindiana.com/wp-content/uploads/2017/11/Indiana-Research-Universities-Report-Executive-Summary.pdf. pp. 15-16

xvii DeVol, Ross. "Technology Clusters: A New Paradigm for Southern California's Economy." Zone Magazine, Oct. 1999.

xviii "Bayh-Dole Act." AUTM - Bayh-Dole Act, www.autm.net/advocacy-topics/government-issues/bayh-dole-act/. Bayh-Dole Act."

xix DeVol, Ross, and Armen Bedroussian, et al. "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization." Milken Institute, Sept. 2006, www.milkeninstitute.org/publications/view/289. pp. 36-39

xx See http://www.autm.net/AUTMMain/media/SurveyReportsPDF/AUTM_FY2016_ Highlights_US_no_appendix_FINAL.pdf.

xxi Feller, Irwin, Maryann Feldman and Janet Bercovitz, "The State of Practices of University Technology Transfer Activities," Research Management Review, 12(2), pp.8-16.

xxii Arundel, and A. Geuna, "Proximity and the Use of Public Science by Innovative European Firms," Economics of Innovation and New Technology 13, 2004, pp. 559-580.

xxiii Jaffe, Adam, et al. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. Oxford University Press, Aug. 1993, www.jstor.org/stable/2118401. pp. 577-598

xxiv Audretsch, D.B, and E Lehmann. Mansfields Missing Link: The Impact of Knowledge ...2005, www.researchgate.net/publication/5152775_Mansfield's_Missing_Link_The_Impact_of_Knowledge_Spillovers_on_Firm_Growth. pp. 207-210.

xxv Audretsch, D, and E Aldride. "Handbook of Regional Growth and Development Theories." Edward Elgar Publishing, www.e-elgar.com/shop/handbook-of-regional-growth-and-development-theories?___website=uk_warehouse. pp. 201-211
xxvi Goldstein, Harvey, and Joshua Drucker. "The Economic Development Impacts of Universities on Regions: Do Size and Distance Matter?" Philosophy of the Social Sciences, Economic Development Quarterly, 1 Feb. 2006, journals.sagepub.com/doi/10.1177/0891242405283387. 20, pp.22-43
xxvii Warren, et al. "Models for University Technology Transfer: Resolving Conflicts between Mission and Methods and the Dependency on Geographic Location." By John Cigno :: SSRN, ," Cambridge Journal of Regions, Economy and Society, 17 Mar. 2009, papers.ssrn.com/sol3/papers.cfm?abstract_id=1361412. pp. 219-232.
xxviii Lee, Joe, and Minoli Ratnatunga. "Building a Knowledge Economy: How Academic R&D Supports ..." Milkeninstitute.org, Milken Institute , Aug. 2018, www.researchgate.net/publication/326782755_Building_a_Knowledge_Economy_How_Academic_RD_Supports_High-Tech_Employment. pp. 15-22.
xxix Drucker, Joshua. Reconsidering the Regional Economic Development Impacts of ...Regional Studies, 7 Jan. 2015, works.bepress.com/jdrucker/16/download/.DOI: 10.1080/00343404.2014.986083, 50:7, 1185-1202.
xxx DeVol, Ross. "Incentivize Entrepreneurial Behaviors at Universities – Especially in the Heartland." Walton Family Foundation, Mar. 2018, https://8ce82b94a8c4fdc3ea6db1d233e3bc3cb10858bea65ff05e18f2.ssl.cf2.rackcdn.com/dd/b9/4ce75b9a42a79dd935feb7e35e47/incentivize-entrepreneurial-behaviors-at-universities.pdf.
xxxi DeVol, Ross, and Armen Bedroussian. "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization." Milken Institute, Sept. 2006, www.milkeninstitute.org/publications/view/289. pp. 39-65.
xxxii Lan, George, et al. "America's Knowledge Economy: A State-by-State Review." Top 5 Issues for 2018: Transportation & Infrastructure: The Precarious Condition of U.S. Infrastructure | CSG Knowledge Center, knowledgecenter.csg.org/kc/content/americas-knowledge-economy-state-state-review. p.37
xxxiii DeVol, Ross, and Armen Bedroussian. "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization." Milken Institute, Sept. 2006, www.milkeninstitute.org/publications/view/289. pp. 75-1185.
xxxiv "FY2016 Licensing Survey." AUTM - Bayh-Dole Act, Association of University Technology Managers, June 2018, www.autm.net/resources-surveys/research-reports-databases/licensing-surveys/fy2016-licensing-survey/. pp. 12-14
xxxv Greene, Patricia G., and Mark P. Rice. "The Experience in the United States: A University Perspective : Global Perspectives on Technology Transfer and Commercialization Building Innovative Ecosystems." Journal of Human Rights and the Environment, Edward Elgar Publishing Ltd, 17 Aug. 2018, www.elgaronline.com/view/9781849809771.00020.xml. pp. 364-380.
xxxvi Roberts, E., & Eesley, C. E., "Entrepreneurial Impact: The Role of MIT," Foundations and Trends in Entrepreneurship, 2001, 7(1-2), 1–149.http://www.nowpublishers.com/articles/foundations-and-trends-in-entrepreneurship/ENT-030.
xxxvii Eesley, Charles, and William Miller. "Stanford University's Economic Impact via Innovation and ..." SSRNEl Electronic Journal, 30 Oct. 2017, engineering.stanford.edu/sites/default/files/stanford_innovation_survey_exec_summary_updatedmarch2013.pdf.
xxxviii Audretsch, David. Everything in Its Place: Entrepreneurship and the Strategic Management of Cities, Regions, and States: David B. Audretsch: 9780199351251: Amazon.com: Books. Oxford University Press, 2015, www.amazon.com/Everything-Its-Place-Entrepreneurship-Management/dp/0199351252. pp. 36-37.
xxxix "The 15 Largest College Business Plan Competitions." Under30CEO, 21 Nov. 2011, under30ceo.com/the-15-largest-college-business-plan-competitions/.
xl Astebro, Thomas, et al. "Startups by Recent University Graduates and Their Faculty ..." Papers.ssrn.com, Implications for University Entrepreneurship Policy , 30 July 2011, www.isihome.ir/freearticle/ISIHome.ir-23025.pdf.
xli Meagher, Kieron, and Mark Rogers. "Network Density and R&D Spillovers." Journal of Economic Behavior & Organization, vol. 53, no. 2, Feb. 2004, pp. 237–260. Journal of Economic Behavior and Organization, doi:10.1016/j.jebo.2002.10.004. Also C. Beaudry, S. Breschi, and G.M.P. Swann, "Clusters, Innovation and Growth: A Comparative Study of Two European Countries," in J.H. Dunning and J.L. Mucchielli (editors
Multinational Firms: The Global-Local Dilemma, (London: Routledge 2001) pp. 190214, and R. Baptista and G.M.P. Swann, "The Dynamics of Firm Growth and Entry in Industrial Clusters: A Comparison of the U.S. and U.K. Computer Industries," Journal of Evolutionary Economics, 9(3), 1999, pp. 373-99. For a broader review of the literature, please see Thomas Döring and Jan Schnellebach, "What Do We Know About Geographic Knowledge Spillovers and Regional Growth? A Sur-

vey of the Literature," Deutsche Bank Research Notes, Working Paper Series, October 2004, No. 14, pp. 1-33
xlii Perkmann, Markus, and Kathryn Walsh. "Engaging the Scholar: Three Types of Academic Consulting and Their Impact on Universities and Industry." Research Policy, vol. 37, no. 10, 2008, pp. 1884–1891., doi:10.1016/j.respol.2008.07.009.
xliii Schartinger, D., et al. "Knowledge Interactions between Universities and Industry in Austria: Sectoral Patterns and Determinants." Innovation, Networks, and Knowledge Spillovers, vol. 31, no. 3, Mar. 2002, pp. 135–166., doi:10.1007/3-540-35981-8_7.
xliv Link, Albert N., et al. "An Empirical Analysis of the Propensity of Academics to Engage in Informal University Technology Transfer." SSRN Electronic Journal, vol. 16, no. 4, 24 June 2007, pp. 641–655., doi:10.2139/ssrn.902207.
xlv Cohen, Wesley M., et al. "Links and Impacts: The Influence of Public Research on Industrial R&D." Science and Innovation, vol. 48, no. 1, pp. 1–23. JStor, doi:10.4337/9781781950241.00017.
xlvi Kenney, Martin, and David C. Mowery. Public Universities and Regional Growth: Insights from the University of California. 1st ed., Stanford Business Books, an Imprint of Stanford University Press, 2014. pp. 10-12.
xlvii Zoltan Acs, D.B. Audretsch, "The Knowledge Filter and Entrepreneurship in Endogenous Growth," Papers on Entrepreneurship, Growth and Public Policy, No. 08, Max Planck Institute of Economics, 2005.
xlviii Anselin, Luc, et al. "Local Geographic Spillovers between University Research and High Technology Innovations." Journal of Urban Economics, vol. 42, no. 3, Nov. 1997, pp. 422–448., doi:10.1006/juec.1997.2032.
DeVol, Ross, et al. "California's Innovation-Based Economy: Policies to ..." Www.milkeninstitute.org, Milken Institute, 1 Dec. 2015, www.remi.com/wp-content/uploads/2017/10/288-Milken-Institute-Californias-Innovation-Based-Economy.pdf. pp. 6-9.
l Economic Impact of the University of Oxford. Apr. 2017, www.ox.ac.uk/sites/files/oxford/Economic Impact of the University of Oxford.pdf. pp. 43-44.
li HM Treasury. "Our Plan for Growth: Science and Innovation." GOV.UK, GOV.UK, 17 Dec. 2014, www.gov.uk/government/publications/our-plan-for-growth-science-and-innovation.
lii Huggins, Robert, et al. "New Directions in Regional Innovation Policy: a Network Model for Generating Entrepreneurship and Economic Development." Regional Studies, vol. 52, no. 9, Dec. 2018, pp. 1294–1304. Regional Studies, doi:10.1080/00343404.2018.1453131.
liii "Driving Regional Innovation and Growth RESULTS." Aurp.memberclicks.net, Battelle Technology Partnership Practice, Aug. 3013, aurp.memberclicks.net/assets/documents/aurp_batelllereportv2.pdf.
liv "Evaluation of the Past & Future Economic Contribution of the UK Science Park Movement." ANGLE Technology, 16 Oct. 2003. http://www.tamana.com/apps/cms/articlefiles/70-UKSPAEvaluation-ExecutiveSummary.pdf
lv State Science and Technology Institute, "A Resource Guide for Technology-based Economic Development: Positioning Universities as Drivers, Fostering Entrepreneurship and Increasing Access to Capital," Prepared for the Economic Development Administration, U.S. Department of Commerce, August, 2006, pp.14-15. https://ssti.org/sites/default/files/resourceguidefortbed.pdf.
lvi "ECONOMIC ENGAGEMENT FRAMEWORK Assessment Tools - Aplu.org." Http://Www.aplu.org, Association of Public and Land-Grant Universities, May 2014, www.aplu.org/projects-and-initiatives/economic-development-and-community-engagement/economic-engagement-framework/related-resources/cicep-assessment-tools_201405.pdf.
lvii Tripp, Simon, et al. "The Importance of Research Universities." TEConomy, Sept. 2017, www.teconomypartners.com/services/. pp.16-17.
lviii Florida, Richard. "The Rise of the Creative Class--Revisited: 10th Anniversary Edition--Revised and Expanded: Richard Florida: 9780465029938: Amazon.com: Books." Http://Www.creativeclass.com, Basic Books, 2012, www.amazon.com/Rise-Creative-Class-Revisited-Anniversary-Revised/dp/0465029930
lix DeVol, Ross, and Shelly Wisecarver. "Micropolitan Success Stories from the Heartland." Walton Family Foundation, 24 June 2018, www.waltonfamilyfoundation.org/learning/micropolitan-success-stories-from-the-heartland. p. 24.
lx DeVol, Ross. "BLUEPRINT FOR A HIGH-TECH CLUSTER." Www.milkeninstitute.org, Milken Institute, 2000, assets1c.milkeninstitute.org/assets/Publication/ResearchReport/PDF/blueprnt.pdf. pp.32-33
lxi Chi, David. "The Role of the Arts in Urban Economic Development." Americans for the Arts, Economic Research Division, 2 May 2015, www.americansforthearts.org/by-program/reports-and-data/legislation-policy/naappd/the-role-of-

the-arts-in-urban-economic-development.

lxii Donal Costello, "The Economic and Social Impact of the Arts on Urban and Community Development," in Dissertation Abstracts International, A: The Humanities and Social Sciences, University of Pittsburgh, 1998.

lxiii Walesh, Kim, and Doug Henton. "The Creative Community - Leveraging Creativity and Cultural Participation for Silicon Valley's Economic and Civic Future." Collaborative Economics, Feb. 2001. http://www.coecon.com/assets/creative-communities.pdf

lxiv Fiske, Edward B. "Champions of Change: The Impact of the Arts on Learning." Center for Civic Innovation, Manhattan Institute for Policy Research. 52 Vanderbilt Avenue, New York, NY 10017. Tel: 212-599-7000; Fax: 212-599-3494; Web Site: Http://Www.manhattan-Institute.org, 30 Nov. 1998, eric.ed.gov/?id=ED435581

lxv Susan Ball and Clare Keating, "Researching for Arts and Health's Sake, "in 2nd Conference on Cultural Policy Research, 2002.

lxvi Benneworth, Paul, and Ben W. Jongbloed. "Who Matters to Universities? A Stakeholder Perspective on Humanities, Arts and Social Sciences Valorisation." SpringerLink, Springer, Dordrecht, 31 July 2009, link.springer.com/article/10.1007/s10734-009-9265-2.

lxvii Kubendran , Sindhu, and Liana Soll. "Best Cities for Successful Aging 2017." Milken Institute, Jan. 2017, www.milken-institute.org/publications/view/852.

lxviii Milken, Michael. "Creating Value." Mikemilken.com, May 2017, www.mikemilken.com/Reprintfinal.pdf. p. 32

lxix Kapucu, Naim. "Civic Engagement and Social Cohesion." Social Capital and Civic Engagement, vol. 4, no. 1, 2011, pp. 22–43.

lxx Ostrander, Susan A. "Democracy, Civic Participation, and the University: A Comparative Study of Civic Engagement on Five Campuses." Nonprofit and Voluntary Sector Quarterly, vol. 33, no. 1, 2004, pp. 74–93., doi:10.1177/0899764003260588.

lxxi "Higher Education Engagement in Economic Development." Association of Public & Land-Grant Universities, University of Economic Development Association, Aug. 2015, www.aplu.org/library/higher-education-engagement-in-economic-development-foundations-for-strategy-and-practice/file. pp. 14-15