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The False Promise of the Entrepreneurial University

Selling Academic Commercialism as an "Engine" of Economic Development in Milwaukee

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Abstract

"Entrepreneurial universities," in which academic research is commercialized and technology transferred through patents, licensing, and university-based business startups, are increasingly touted as the key driver of city and regional economic development. This paper reviews the relationship between research universities and local economic development in 55 major US regions, and finds no meaningful correlations between *any* gauges of entrepreneurial university activity (research expenditures, patents, or licensing) and core measures of city and regional economic well-being. Notwithstanding tendentious accounts of "success stories" such as Silicon Valley or Boston's Route 128, as if they represent the general historical pattern, these data as well as case studies such as Johns Hopkins University and Yale University reveal that even world-class research universities are neither necessary nor sufficient in promoting local economic development. University research parks are particularly oversold as engines of local economic growth.

While proponents of academic commercialism routinely overstate its economic benefits for cities and regions, they rarely mention the significant costs. These include potential undermining of the system of basic research and open science that has been the cornerstone of scientific discovery in the US, and, ironically, undercutting innovation. Contrary to claims by many university leaders that research commercialization will generate revenues for their institutions, for most universities tech transfer is a money-losing proposition. Tech transfer is a classic example of jackpot or casino economics, with very few big winners, and over half of US universities lose money in academic commercialization. Research funding and commercialization revenues are heavily skewed to the same "top 15" universities that have dominated these statistics for decades, and, as one expert has argued, outside of this top group most universities are getting nothing out of tech transfer "except a lot of economic development rhetoric."

This paper also includes an in-depth case study of efforts to transform the University of Wisconsin-Milwaukee (UWM) into an entrepreneurial university. All of the dubious claims regarding the impact of entrepreneurial universities on local economies and the revenue-generating potential of academic commercialism have been advanced by UWM leaders, with little debate, analysis, or public scrutiny.

"Entrepreneurial" UWM is pursuing two core "economic development" initiatives: 1) a suburban technology park, oriented around biomedical engineering; and 2) a School of Freshwater Studies, to propel Milwaukee as the alleged "Silicon Valley of water technology." The economic logic underpinning both initiatives, however, is deeply flawed. Biomedical engineering is not a field in which the Milwaukee region or UWM either start in an advantageous position or have obviously propitious prospects. The suburban Wauwatosa technology park has been vastly oversold as a potential engine of economic development. Urban universities have increasingly become anchor institutions in city economies, yet UWM plans to invest an estimated $150 million outside a city that has been buffeted over the past 30 years by growing joblessness, poverty, and the suburbanization of industry. Ironically, for an initiative deemed crucial to the economic future of Milwaukee, UWM's suburban tech park, by *disinvesting* in the

city, will help undermine the economics of agglomeration that economists and urban planners concur is a central ingredient of economic development.

UWM is already a major research institution in the field of Great Lakes ecology and freshwater science, and the new school will build on this tradition. But the economic development arguments for the SFS as the centerpiece of an emerging Milwaukee water technology "hub" are based on spurious claims and, to borrow a phrase, "irrational exuberance." The key points: 1) Measured by the location of water company headquarters, plants, or offices; the generation of water technology patents; or jobs in the industry, there is little evidence that Milwaukee is a "hub" or even an "emerging hub" of the industry; 2) The job creation potential of water technology in Milwaukee has been vastly exaggerated by boosters; in fact, the two leading companies of the local water lobby have created more jobs outside of Milwaukee than in it over the past decade; 3) UWM's water school will be neither a unique presence nor a "first-mover" in the field of water technology already brimming with university and corporate research facilities; and 4) As evidenced by the politics of locating a building for the SFS, the risks of excessive industry influence over the new school are significant.

The essay concludes with a call for alternatives to entrepreneurial universities. Although the economic logic of the entrepreneurial university is highly flawed, that does not mean that universities and university research are irrelevant to local economic development and urban vitality. Educating students and generating human capital; nurturing talent and intellectual curiosity; supporting the research commons through open, public science; and helping solve real-world, community problems – these are the ways in which *engaged* universities, rather than entrepreneurial ones, have historically contributed to community economic well-being.

Introduction

Across the United States (as well as Europe and Canada), academic leaders now routinely promote research universities as "engines" of local economic development. "Entrepreneurial universities," in which academic research is commercialized and technology transferred through patents, licensing, and university-based business startups, are touted as a *sine qua non* for cities and regions in the 21st century knowledge-based economy. Indeed, in many economically struggling cities, the entrepreneurial university is portrayed as nothing less than an "economic savior." (Fischer, 2006). Improving regional economic competitiveness by forging partnerships with local businesses and commercializing university-generated knowledge is now regularly cited as one of the core missions of the modern university (Slaughter and Rhoades, 2004; Washburn, 2005).

In Milwaukee, similar rhetoric has accompanied efforts in the last decade to reorganize the University of Wisconsin-Milwaukee (UWM) into a center of academic commercialism with, in the current chancellor's words, a "research portfolio that can truly transform this region" (Santiago, 2009). An entrepreneurial UWM has been heralded as a "driver" of the regional economy (*Milwaukee Journal Sentinel,* 2009c); an "economic piston" (Schmid, 2005) and "idea hatchery" (Haynes, 2008) whose commercialized research would be a "game changer" for Milwaukee (*Milwaukee Journal Sentinel*, 2009a); and a future "hothouse" of patents, licenses, and business spinoffs (*Milwaukee Journal Sentinel,* 2009b) that "will drive Milwaukee's economic reinvention" and "create jobs throughout southeastern Wisconsin" (*The Business Journal of Milwaukee*, 2009).

Such characterizations have taken on an aura of conventional wisdom, not only in Milwaukee but also in cities across the country. They have been embraced by civic leaders and trumpeted in media accounts, almost always accompanied by tendentious references to the classic entrepreneurial university success stories: Stanford and Silicon Valley, MIT and Boston's Route 128, and North Carolina's Research Triangle Park. Yet, as Joshua B. Powers perceptively notes, fervor over academic commercialism strongly resembles the "irrational exuberance" of the bubble economy: hyperbole about economic benefits, based on surprisingly little evidence or analysis (Powers, 2006).

In fact, as I shall argue, the contribution of university-based technology transfer to local economic development has been wildly exaggerated. Although it has become almost a cliché for entrepreneurial universities and regional leaders to boast of becoming "the next Silicon Valley," a systematic review of the historical record reveals that the celebrated success stories of university-led economic development are more the exception than the rule. Far more typically, the commercialization of academic research and investments in university technology transfer have had little discernible impact in reshaping the economic trajectory of cities or regions. Nor, for most universities, have university-generated patents and licenses produced the internal returns envisioned by proponents of academic commercialism. In the last analysis, the case for the entrepreneurial university as a "game changer" or "driver" of local economic development is more chimerical than compelling.

This paper is divided into two main sections. First, I examine the economic logic of the entrepreneurial university, assessing the extant literature and presenting data on research universities and economic performance in a sample of 55 large cities and regions. In addition, I review the evidence on the degree to which university technology transfer, which began in earnest after the passage of the Bayh-Dole Act in 1980, has produced the patenting and licensing returns predicted by advocates of academic commercialism. At the same time, I briefly discuss some of the serious costs generally overlooked and even disregarded by boosters of the entrepreneurial university model: the privatization of the intellectual "commons," an erosion of the productive American tradition of open, public science, and growing concerns about conflicts-of-interest that threaten the integrity of university research.

Second, I present a case study of recent efforts to transform the University of Wisconsin-Milwaukee into an entrepreneurial university. In the mid 2000s, in a city battered by deindustrialization, job loss, and inner city poverty, university leaders unveiled –and civic leaders embraced—a UWM "growth agenda," boldly selling the idea that university research, patents, and licensing could be the catalyst of a new Milwaukee economy. I analyze the economic assumptions underpinning the UWM "growth agenda," and examine, in particular, the "irrational exuberance" animating the agenda's two key components: 1) a suburban technology park, oriented around biomedical engineering, and 2) plans to transform Milwaukee into the "Silicon Valley of water technology," with entrepreneurial UWM research as the centerpiece. The UWM story is an especially instructive case study of the perils of academic commercialism for so-called "mid-tier" universities.

Finally, in a short concluding section, I summarize the case against the entrepreneurial university and briefly highlight alternatives. Although the economic logic of the entrepreneurial university is highly flawed, that does not mean that universities and university research are irrelevant to local economic development and urban vitality. Educating students and generating human capital; nurturing talent and intellectual curiosity; supporting the research commons through open, public science; and helping solve real-world, community problems – these are the ways in which *engaged* universities, rather than entrepreneurial ones, have historically contributed to community economic well-being.

Part I:

Entrepreneurial Research Universities and Local Economic Development: A Review of the Evidence

Universities, as numerous studies have shown, are key economic institutions in cities and metropolitan areas, through their purchasing, employment, real-estate development, and other investments (Initiative for a Competitive Inner City and CEOs for Cities, 2002; Amirkhanian and Habiby, 2003). Simply as an employer, for example, colleges and universities "are becoming increasingly important for cities as they struggle to keep their share of jobs in the metropolitan area;" indeed, universities now rank among the largest employers in many big cities (Harkavy and Zuckerman, 1999, 1). Almost every university president can pull an "economic impact study" out of his or her pocket showing, for example, that the eight research universities of metropolitan Boston "had a collective regional economic impact of more than $7 billion in 2000" (Appleseed. Inc, 2002), that Harvard itself produced a $4.5 billion impact in metro Boston in 2009 (Harvard University, 2009), or that spending by the 16 colleges and universities in Baltimore's "Collegetown Network" produced, directly and through multipliers, a regional economic impact of $17 billion and 162,000 jobs in 2008 (Clinch, 2008).

In addition, by educating students and generating human capital, universities boost private sector productivity and stimulate future economic growth. This has been the historical record nationally (Schultz, 1961; Goldin and Katz, 2008) and, to the extent these productivity gains are localized, urban and regional growth in jobs and income is likely to follow (Blackwell, Cobb, and Weinberg, 2002, 91).[1] This local effect, of course, is contingent on whether college graduates stay in the region – or whether the region attracts "human capital" from other regions. To the extent this local nurturing and clustering of talent occurs, productivity enhancements from a skilled labor force will stimulate regional economic growth. Moreover, a kind of labor force-based "tech transfer" occurs, as "young scientists and engineers who stay in the area help to transfer university findings to local firms or they may work in industrial labs that create knowledge that is valuable to local businesses" (Hill, 2006, 11).

Thus, Jesse Shapiro estimates (Shapiro, 2006, 324) that "from 1940 to 1990, a 10 percent increase in a metropolitan area's concentration of college-educated residents was associated with a 0.8 percent increase in subsequent employment growth" (with 60 percent of the employment growth effect of college graduates flowing from enhanced productivity growth). As Edward L. Glaeser and Albert Saiz conclude, in a highly influential paper, "The Rise of the Skilled City": "Human capital predicts population and productivity growth at the city and metropolitan area level as surely as it predicts income growth at the country level. High skill areas have been getting more populous, better paid and more expensive. Indeed, aside from climate, skill composition may be the most powerful predictor of urban growth" (Glaeser and Saiz, 2003, 42). This tendency appears to have become more pronounced since 1980.[2]

The entrepreneurial university approach, however, envisions a university role in economic development going well beyond these purchasing power, employment, and human capital impacts. Instead, what some call "academic capitalism" entails a direct insertion of market-oriented university research in the production process as the primary university contribution to economic growth. Implicitly, the entrepreneurial university "model" amalgamates three theories of economic development: [3]

1) "Endogenous growth theory," which argues that the stock of knowledge and technological innovation are the key determinants of the rate of economic growth; that ideas and technological change produce "increasing returns" (not the diminishing returns from traditional factors of production in neoclassical economics) (Romer, 1990; Warsh, 2006, 289-326);[4]
2) "Competitiveness" theory, popularized by Michael Porter (1998), in which regional prosperity flows from establishing competitive advantage for local firms in particular industry "clusters" (Paytas, Gradeck, and Andrews, 2004)[5];
3) "Market triumphalism," in which the university becomes part of an "everything for sale" culture (Kuttner, 1997; Block, 2008, 196); the university focuses "on knowledge less as a public good than as a commodity to be capitalized on in profit-oriented activities" (Slaughter and Rhoades, 2004, 29). A strong private market-orientation of universities, including "partnerships" with local businesses and extensive business elite involvement in university management, purports to serve the wider community interest by promoting economic growth.

Some have dubbed this the "triple helix" model -- a partnership of industry, government, and university science in promoting growth in a "global knowledge economy" via technology transfer (Etzkowitz, 2008; Campbell et al, 2004)--although this appellation seems to be more about catchy labeling than articulation of a rigorous theory of universities and economic development.[6] In any event, as Hill and Lendel point out, "science-based and technology-based economic development policies are attempts to build absolute regional economic advantage, or competitive advantage, in industries that emerge from the laboratories of universities or academic hospitals" (Hill and Lendel, 2007, 224).

If the production of knowledge is the really important thing in economic growth and the competitive advantage of local firms, then it follows that the research university, a creator of knowledge *par excellence*, becomes a cornerstone institution generating commercially relevant research and transferring it to the private sector, frequently to "clusters" of firms (such as biotechnology or electronics) targeted by local economic development policy. At entrepreneurial universities, this economic development role typically includes some or all of the following activities: patenting, licensing, research consortia, spin-off enterprises, research parks, start-up firm incubators, consultant services, and venture-capital funds (Matkin, 1997, 32).

The critical question, of course, is whether this entrepreneurial activity really delivers the economic development outcomes envisioned by proponents --- and at what cost? To what extent is the economic value of the knowledge created in research universities likely to be "captured" locally? The underlying assumption of academic commercialism is that "universities create local technology spillovers, which are then captured either within a state or metropolitan area…If spillovers are not captured locally, the benefits from [science and technology] investments will be quickly diffused to other regions and countries" (Bania, Eberts, and Fogarty, 1993, 761).

Curiously, despite the headlong rush of universities into academic commercialism, there is little systematic empirical research supporting the central premises of the strategy. For the most part, claims from representatives of the tech transfer profession such as the Association of University Technology Managers (AUTM) about "x thousands of jobs created" or "x thousands of businesses spun off," sprinkled with the usual anecdotal evidence of "success stories," have served as the "empirical" rationale for entrepreneurial university investments (Greenberg, 2007, 62; Goldstein and Renault, 2004, 734).

Here is a typical statement from a report extolling the seemingly self-evident economic virtues of entrepreneurial universities: "Academic research and development is a $1.1 billion industry in Wisconsin. It is driving the creation of thousands of jobs, directly and indirectly, and helping our core industries stay competitive in a changing world" (Wisconsin Technology Council, 2009, 1). Then, as if on cue, the report cites the usual entrepreneurial success stories –Silicon Valley, Route 128, and the North Carolina Research Triangle—as well as a few others (Austin and the University of Texas; Atlanta and Georgia Tech; and, closer to home, the city of Madison and the University of Wisconsin-Madison).

As is always the case with tendentious and self-interested reports of this sort, there is no systematic, methodologically defensible analysis establishing a causal relationship between the commercialization of university research and indicators of regional economic performance. In fact, most of these types of reports, typified by AUTM, consist mainly of a recitation of "program outputs" (e.g. licenses, patents, and spinoffs), not an analysis of economic development outcomes (Goldstein and Drucker, 2006, 29). The simplistic economic development argument seems to be: Austin and Atlanta –to take two examples-- are doing well economically; the University of Texas and Georgia Tech are entrepreneurial research universities, producing patents, licensing, and business spin-offs; *ergo*, the entrepreneurial university drives economic growth.

But such observations are incomplete and potentially misleading. There is no effort to control for the myriad of factors *other than university entrepreneurialism* shaping the economic performances of these cities and regions. There is no attempt to disentangle and weigh the various *mechanisms* of university impact on the local economy, or even the various mechanisms by which university-generated knowledge spillover occurs. Assume, for example, that Austin's economic prosperity is indeed related to the University of Texas: how much is due to research commercialization and tech transfer activity, as opposed to the human capital effects noted above, or simply the impact of the general dissemination of knowledge from open scientific research?[7] And finally, there is no effort to specify the *conditions* under which university entrepreneurialism might or might not pay off and thus affect the likely efficacy of the model in one setting as opposed to another. It is assumed that entrepreneurial university activities stimulate growth, no matter the state of the local economy ("weak market" v. "strong market") or no matter the type of university; these assumptions, as we shall see, are highly debatable. In short, these non-academic "impact" reports, despite their cascade of statistics on tech transfer, offer little reliable analysis on how much or even whether academic research commercialization significantly affects urban and regional economic performance.

As it turns out, there is scant support in the academic literature for the proposition that entrepreneurial universities are "drivers" of local economic development. At best, some studies show that *under some conditions,* certain *types* of universities --pursuing certain *types* of research activities and located in certain *types* of cities or regions-- may exert a modest influence on local economic development. Kent Hill's thorough survey of the literature concludes that the economic effects of university research are "discernible and statistically significant," but "skewed and modest." These impacts are likely to occur "when faculty are on the cutting edge of revolutionary commercial technologies, when graduate programs in science and engineering are top notch, and when the university is located in a large urban area with an existing concentration of industrial R&D and high tech production. These conditions are difficult to replicate" (Hill, 2006, 3). Moreover, Hill admits that even under these circumstances there is little evidence that the influence of tech transfer and other commercial activities is decisive, compared to the traditional university functions of conducting basic research or educating students.

* * * *

Since Adam Jaffe's seminal work (1989), there has been a burgeoning literature of econometric studies, based on "knowledge-production models," analyzing the economic impact of university knowledge creation (Jaffe, Trajtenberg, and Henderson, 1993; Anselin, Varga, and Acs, 1997). Typically, these models have found some relationship between university research (measured by R&D expenditures) and indicators of innovation (typically measured by corporate patents).

However, in two major ways, this literature is highly problematic in assessing the economic impact of entrepreneurial universities. First, these studies don't provide any *direct* evidence on the proponents' central claim: that the commercialization of academic research decisively influences the economic trajectory of cities or regions. In fact, the measures they use are "doubly indirect" – first, relating university R&D to "innovation," and in turn, using patents as a proxy measure of innovation and knowledge spillover. However, patents are, at best, a highly imperfect indicator of innovation; scholars tend to use them as a measure of innovation or knowledge creation mainly because data are readily available (Drucker and Goldstein, 1007, 33). As Hall, Jaffe, and Trachtenberg (2001, 6) note, innovations "vary enormously in their technological and economic importance" and simple patent counts are deficient in capturing this variation. Even careful studies that take this into account by looking at patent citations instead of simple counts don't fully solve the problem; although citations may give a better sense of "quality" patents which, presumably, represent genuine innovation, the fact remains that patents are just one indicator of "knowledge" production. As Drucker and Goldstein (2007, 33) point out: "Not all knowledge is patentable. For instance, codified knowledge is embodied in copyrights, trade secrets, and scientific papers as well as patents, whereas tacit knowledge and shared expertise may be as important to localized spillover effects as codified knowledge but are largely unmeasurable."[8] In short, a focus on patents may produce a misleading analysis of the level of innovation in a community.

Even assuming, however, that patents are a robust measure of innovation, the key question is: how well does this indicator correlate with real economic outcomes in a city or region, such as employment, incomes, or regional GDP growth? In fact, as we will examine shortly, empirical data suggest there is little relationship between either university R&D expenditures or the number of patents registered in a region and general measures of economic well-being.

Second, these studies all employ university R&D as the independent variable in their production-function equations. But this measure, again, doesn't get at the underlying claim of entrepreneurial universities: that traditional "blue sky" academic research is insufficient to produce economic development, and that *research commercialization*, involving university-generated patents, licensing, and spin-offs is how the modern, entrepreneurial university drives regional economies. By not separating different types of research activities, let alone the myriad other ways in which universities contribute to local economies, these econometric models do not actually test the entrepreneurial university strategy of economic development.

There have been just a few studies that look explicitly at the impact of university research –and, to some extent, the impact of the specific *mechanisms* of knowledge spillover (entrepreneurial versus traditional) – on regional economic outcomes. In an early, cross-sectional study, Bania, Eberts, and Fogarty (1993) looked at the relationship between university R&D and new-firm startups in six industries in 25 metropolitan areas between 1976-1978. They found the contribution of university research linked to growth in only one high tech industry (Electronic Equipment); for all other sectors, including another high tech industry (Instruments and Related Products), the results were statistically insignificant (765). Their conclusion: "The evidence presented in this paper suggests that states cannot generalize from the Route 128 and Silicon Valley experiences" (765).

Harvey A. Goldstein and his co-authors have published the most in-depth and systematic analyses so far of the regional economic development impacts of universities. Goldstein and Renault (2004) and Goldstein and Drucker (2006) construct multivariate regression models to compare, across 313 metropolitan areas (MSAs), the regional economic impact of several university-related variables to other indicators that plausibly influence economic development. The university-related variables include research expenditures, university-based patents, and the "production" of science and engineering graduates (degrees at the undergraduate and graduate levels); the non-university factors include the basic educational level of MSA population, level of local entrepreneurship, quality of life, and indicators of agglomeration or geographic/economic centrality. Both studies measure the regional economic impact of these factors by assessing their effect on changes in real average annual earnings per worker in MSAs, an indicator of "the quality of regional jobs" (Goldstein and Drucker, 2006, 28).

On the whole, Goldstein's studies provide no support for the vision of entrepreneurial research universities as engines of regional economic development. For the entire pool of 313 MSAs, Goldstein and Drucker (2006) found a very modest positive impact of university research expenditures on regional wage growth. But the model showed *no impact* at all of entrepreneurial university activity, measured by university-based patents, on changes in average annual earnings per worker in MSAs; thus, the results provide scant support for notions that "academic commercialism" as opposed to traditional, open science university research, is indispensible for regional economic development. Moreover, the small effect of university R&D expenditures on regional earnings growth was dwarfed by the importance of human capital variables, such as the overall level of educational attainment in the MSA or graduate-level share of degrees awarded in science and technology fields. In addition, standard economic development factors –agglomeration economies and industry structure—were much more important than university R&D expenditures in explaining changes in regional earnings.

The Goldstein-Drucker model also breaks down the pool of MSAs by size, with some interesting results. University R&D has a slightly more positive effect on regional wage growth in medium-sized metropolitan areas (75,000-200,000 employment) than in large ones (employment over 200,000) – a result hardly astonishing to even casual observers of "college towns" like Madison, Ann Arbor, Charlottesville, or Champaign-Urbana.[9] University patenting, though, while showing a modestly positive relationship to wage growth in large MSAs in the model, has a strongly negative relationship to wage growth in medium-sized areas, a puzzling variation.[10] Nevertheless, notwithstanding small and relatively isolated signs of an economic impact of university research or commercialization, these factors pale beside the influence of human capital and industry structure variables in Goldstein-Drucker's regression model, *no matter the size of the MSA*. To take one striking example: in large MSAs, whether or not a region is an "air hub" is a much more important influence on regional wage growth than either university R&D or university patenting.

In short, Goldstein's work seriously undercuts the characterization of entrepreneurial universities as "engines of economic development" in two main ways. First, among university activities themselves, the generation of human capital –not research expenditures or commercial activity—appears to be the most important university-related factor influencing regional economic fortunes. This confirms the saying that "the best form of technology transfer is the moving van that transports the Ph.D. from his or her university laboratory to a new job in industry" (Lester, 2005, 11).

Second, and most importantly, Goldstein's research reveals that, by a wide margin, the most significant factors shaping the economic trajectory of regions are *non-university* ones. "[F]actors external to universities, including the stock of business services and the educational attainment level, remain the most influential determinants of regional economic progress over all size regions. Agglomeration economies, such as those measured by business services and the base employment level, are significant as well" (Goldstein and Drucker, 2006, 37). This is an especially important finding to keep in mind as local policymakers embrace the entrepreneurial university as the "next big thing" in economic development strategy.

A final set of studies germane to the impact of entrepreneurial universities involves university science research parks. There are currently 174 university research parks in the United States and Canada, according to the Association of University Research Parks (AURP), an organization that promotes the development and operations of research parks in the same way AUTM promotes university-based technology transfer activities (AURP, 2009). Link and Scott (2007) define a university research park (URP) as "a cluster of technology-based organizations that locate on or near a university campus in order to benefit from the university's knowledge base and ongoing research. The university not only transfers knowledge but expects to develop knowledge more effectively given the association with the tenants in the research park" (Link and Scott, 2007, 662). As Daniel Felsenstein points out, the aim of university-related science parks is to function as "seedbeds" of innovation and "catalysts in urban and regional growth" that will lead regions "into a spiral of propulsive expansion" (Felsenstein, 1994, 93-94). Research parks seek "to play an incubator role, nurturing the development and growth of new, small, high-technology firms, facilitating the transfer of university know-how to tenant companies, encouraging the development of faculty-based spin-offs and stimulating the development of innovative products and processes" (Felsenstein, 1994, 93).

Like AUTM, the AURP churns out descriptive statistics on the economic impact of URPs, claiming they cumulatively housed 4,380 tenants in 2007, and reported total employment of 271,366.[11] When multiplier effects are tallied, AURP estimates that URPs generate almost 680,000 jobs nationally (Battelle, 2007, 17-18), most in high-tech, high-wage fields. There are numerous similar "impact reports" released for individual URPs (see, for example, Lim, 2007; RESI, 2008, 12-13). And, of course, there are many accounts of the biggest recognized research park success stories: the Stanford Research Park and the Research Triangle Park (RTP) in North Carolina, cases that are invariably cited when any university embarks on building a URP (Luger and Goldstein, 1991, 76-99; 122-154; Weddle, 2007; O'Mara, 2005, 97-141).

There are, however, few academic studies analyzing either the actual impact of URPs on regional economic development, or under what conditions URPs are likely to succeed or fail. Moreover, as Wallsten points out, "notably absent from the literature on science parks is any real discussion of their costs or estimates of public expenditures on them"

(Wallsten, 2004, 4), although a recent report for the AURP admitted that most parks have "limited or no profitability" (Battelle, 2007, 5). In any event, as Link and Scott conclude: "URPs are not well understood and attendant research on them is just beginning to burgeon" (2007, 662).

Measuring the economic development impact of URPs is methodologically tricky. It is more complicated than simply counting the number of tenants or jobs in research parks and then measuring multiplier effects, or even identifying the number of new firms with URP provenance. No matter how large a research park may be, the underlying purpose of developing URPs is to generate regional economic dynamism *outside* the park – otherwise, URPs may simply function, at best, as subsidized "enclaves" of innovation, not "seedbeds" of economic development (Felsenstein, 1994). As Wallsten points out, "in order to generate economic growth, a science park would have to encourage firm growth that would not have happened without the park or generate spillovers that would otherwise be absent" (Wallsten, 2004, 5). Yet:

> Cities and research park organizations routinely count as "success" *any* firms or employment in the park, with no regard to whether that economic activity was new to the region or simply relocated into the park, and no analysis of whether that activity would have been likely to occur without the park. Moreover…the costs of the park (many of which might be hidden, such as the opportunity cost of the land) are rarely calculated. In other words, cost-benefit analyses of research parks are likely to count as benefits any economic activity in the park regardless of whether it is, in fact, a net benefit, and ignore the costs altogether (Wallsten, 2004, 5).

Wallsten's study (2004), although limited in a number of ways, nevertheless provides one of the only systematic empirical analyses of the regional economic impact of research parks. He compares trends in high tech job growth and venture capital formation in a set of "matched" counties across the United States: "treatment counties" that built research parks after 1986, and economically similar "control counties" without research parks. Wallsten found little difference in the economic performance of the two sets of counties, and concluded that establishing a research park has no net impact on job growth of the amount of venture capital attracted to the county. "While success stories do exist, the analysis suggests that successes are the exception rather than the rule. Thus, policies intended to promote cluster development by subsidizing science or research parks are unlikely to be effective" (Wallsten, 2004, 15). Wallsten's findings confirm the assessment in Luger and Goldstein's 1991 study that "research parks are not likely to reverse the fortunes of regional economies whose industries have already shown distress" (Luger and Goldstein, 1991, 48).

In fact, for every Stanford, RTP, or University of Utah URP success story, there are languishing parks where dreams of becoming the next Silicon Valley have been dashed. Indeed, even the AURP's data show that only seven university research parks –roughly 5 percent of the URPs on which data was collected-- account for 54 percent all URP employment in North America (Battelle, 2007, 6); this highly skewed distribution means, of course, that many universities have cumulatively invested billions in a non-trivial number of thinly populated, low impact research parks. Boosters may conjure visions of mega-successes like Stanford or the RTP, but rarely mention the more typical range of URP outcomes. For example:

- The Texas Research Park, a University of Texas-San Antonio operation that opened in 1990 was supposed to spark a biotech boom in San Antonio, with 100 companies and 30,000 employees by 2020; by 2003, there were all of 15 for-profit companies in the park, and 300 employees (Hundley, 2003).[12] San Antonio remains a peripheral player in the biotechnology sector (Cortright and Mayer, 2002; Bailey, 2005).
- The University of South Carolina's "Innovista," a $250 million research park, was launched with great fanfare as a "transformational" project in the city of Columbia, a "campus developed by the university, centered on research in areas like hydrogen-powered fuel cells and biotechnology. The aim is to cluster research labs, private companies, and condominiums" in a creative "live-work-play" setting (Goodman, 2008; Innovista, 2009).

  Three years after launch, the project already looks like a classic case of URP oversell: construction has been delayed on nearly every major Innovista capital project, and tenants and private investors have been slow to materialize (Aiken, 2008; Aiken 2009; Hammond and Jackson, 2007). Moreover, one of the research centerpieces of the project, commercial development of hydrogen-powered fuel cell, may be seriously compromised by the decision of the Obama Administration to slash funding for hydrogen-car research (Aiken, 2009) – a potentially painful and expensive lesson in the foibles of university administrators picking research clusters based on commercial prospects.

In a telling comment on the burgeoning fiasco, one critic put it: "How does this kind of thing happen? I think the root of the problem is that Innovista is not innovative. Instead, university and state officials just tried to copy what someone else had done. Specifically, they hoped to replicate the Centennial Campus, the wildly successful research campus project at North Carolina State University in Raleigh. Apparently the thinking went something like this: Raleigh is a state capital and Columbia is a state capital; N.C. State is a big state school and USC is a big state school; it worked there, so it will work here. Let's throw tax money at it and see what happens" (Fisher, 2008). As we shall see, this kind of shallow, "mimicry-as analysis" on universities and economic development is not limited to South Carolina. Meanwhile, Columbia's economy was the subject of a recent *New York Times* headline: "Reeling South Carolina city is a snapshot of economic woes" (Goodman, 2008). By August 2009, after the embarrassing firing of Innovista's developer, USC's president acknowledged "struggles" and the need for a "fresh assessment [of Innovista] in light of what we have learned in the past few years" (Washington, 2009).

- In the 1980s, under the visionary and entrepreneurial leadership of president George Low, Rensselaer Polytechnic Institute (RPI) launched an effort to explicitly replicate the Stanford-Silicon Valley model in the Capital District of New York State, encompassing the cities of Albany, Troy, and Schenectady. "Hewlett-Packard and Stanford – that's the model," stated Low, in launching the Rensselaer Technology Park as one of his core initiatives (Leslie, 2001, 256). With the park, Low argued, the Capital Region "will be counted among a few select places in the nation where technology flourishes," and the park was envisioned as a crucial institution in arresting regional decline and transforming the economic culture of the region towards entrepreneurialism and dynamism (Leslie, 257). The park had some modest success, launching a number of high tech companies (such as Raster Technologies), and in 2009, 28 years after breaking ground, reporting 70 tenants and 2,400 employees (Rensselaer Technology Park, 2009). But no one would seriously argue that the region became one the nation's "few" high tech centers, or that the park –or RPI's other entrepreneurial initiatives, for that matter— dramatically altered the economic trajectory of its region. "Troy may have been the 'Silicon Valley of the Nineteenth century'," writes Stuart W. Leslie. "Today its economic future looks as bleak as the view from RPI on a winter afternoon" (Leslie, 2001, 236).

In short, university research parks are anything but sure-fire investments in urban or regional economic prosperity. Success is relatively uncommon, as Wallsten's impact study makes clear. "Game-changing" success – the kind that remakes a regional economy—is even more rare, the product of unique historical factors, good luck, and timing. For example, the North Carolina Research Triangle Park's oft-cited (and oft-emulated) success, "was built around its first-mover status in the field of science parks," generous state and federal funding, and a uniquely patient multi-decade commitment by political leadership – and even with all those difficult-to-replicate factors in its favor, it took more than 30 years to see evidence of the cluster development attributed to the park (Weddle, 2007, 7). Universities that cavalierly pursue and oversell URPs as "transformational" economic development investments risk creating white elephants and misallocating millions of dollars that could be better invested bolstering the core missions of their institutions.

* * * *

To more fully examine the relationship between research universities, academic commercialism, and local economic development, I have assembled data for a sample of 55 of the nation's largest metro areas.[13] I have collected four different types of data to measure the extensiveness of university research operations as well as commercialization activities:

- *Total academic research and development expenditures*, published by the National Science Foundation.[14] NSF collects the data for universities; I have aggregated the university data by metropolitan areas. In addition, I have collected the data for all years since 1985;

- *University research expenditures per capita in metropolitan areas*, to control for region size. Presumably, $1 billion in research expenditures is a more influential economic factor in a region of 250,000 residents than in one of 5 million;
- *University-generated patents*, again published for each university (by the United States Patent and Trademark Office) and then aggregated by me by metropolitan area. I have collected these data for all years since 1985, and broken them down per 100,000 population in metropolitan areas.[15]
- *Revenues generated* through the licensing of university research and inventions. These data are published annually by the Association of University Technology Managers' survey of university licensing operations; I have aggregated the 2007 university data by metropolitan area, broken down per 100,000 population, as an indicator of the level of university-based "entrepreneurialism" in a region.[16]

To analyze how these university research and commercialization variables affect local economic development, I have collected data on four key measures of city and regional economic performance: job growth in the city proper; the growth in employed residents in the city (a composite measure of demographic and economic dynamism); growth in employed residents in the metropolitan area; and growth in overall economic activity in the region, measured by change in metropolitan area gross domestic product.

The entrepreneurial university strategy rests on two key, testable premises: 1) Research universities are the linchpins of city and regional economic development in the modern, global, "knowledge-based" economy; and 2) The entrepreneurial "tech transfer" activities of licensing and patenting are the key mechanisms by which university-generated knowledge spillover to the larger city and regional economies occurs. In short, for the entrepreneurial model to be credible there should be a strong correlation between levels of university research expenditures and city and regional economic well-being; more importantly, as a test of the *mechanism* of academic commercialism, there should be a strong relationship between levels of university patenting and licensing and overall city and regional economic performance.

Tables 1 and 2 array some of the basic data on university research, entrepreneurialism, and the economic performance of regions and their central cities. A broad scan of the tables reveals a variety of scenarios.

On the one hand, the data confirm that metropolises popularly portrayed as successful "cities of knowledge," such as Boston, Austin, San Francisco, and Raleigh, rank very high in research expenditures, university patent production, and most of the indicators of regional economic well-being.[17] These data, of course, say nothing about the causal link between academic commercialism and regional economic success in these places (more on that below) – but they do support popular characterizations of these regions as centers of university research, knowledge commercialization, and economic growth.

However, although boosters of the entrepreneurial university strategy constantly refer to these celebrated "success stories" as if they represent a *general* historical pattern, Tables 1 and 2 make clear that there are many other scenarios and that the "success story" outcome is hardly the most common. There are many regions with high-ranking research universities and weak overall economic performance. What's more, contrary to the deterministic view that entrepreneurial research universities are a *sine qua non* for regional economic success, there are numerous regions with minimal university R&D expenditures, little or no university entrepreneurial activity, and yet among the highest levels of job creation and GDP growth in the country. In fact, Table 3 shows that among the 10 metropolitan areas in the sample registering the highest GDP growth between 2001-2006, only San Diego and Sacramento ranked near the top in academic R&D expenditures per capita between 1985-2006.

Tables 4 through 7 focus on these scenarios a little more directly, looking at the two key economic indicators: overall regional growth (measured by GDP), and job growth in the urban core (measured by central city job growth). The tables highlight cases of high university R&D and high regional economic performance; high university R&D and low economic performance; and low university R&D and high economic performance. The latter two scenarios are much more common than the first, casting considerable doubt on the "research university as a growth machine" argument. In fact, as Table 7 shows, the top quintiles of metro areas, ranked by university R&D expenditures, actually registered *lower* rates of GDP growth, metro area employment growth, and job growth in the urban core, than did the regions in the bottom quintiles – places essentially lacking major research universities. This is hardly a ringing confirmation of the

Table 1:
University Research Expenditures and Commercialization Indicators In Selected Metropolitan Areas[18]

Metropolitan Area	*Total Academic R&D $, 1985-2006 (in billions $)*	*Total # of University-generated patents, 1985-2005*	*University Patents per 100,000 pop, 1990-1999*	*University patents as % of metro area patents, 1990-1999*
Baltimore	$23.387	1014	39.7	8.2%
Boston	21.547	3378	99.2	6.6%
New York	18.587	1589	17.1	6.7%
Los Angeles	17.781	N/A	N/A	N/A
Raleigh	15.766	1324	111.4	14.3%
San Francisco	15.401	N/A	N/A	N/A
Chicago	13.548	729	8.8	1.3%
Detroit	13.099	934	21.0	2.7%
Philadelphia	11.463	1,113	21.8	4.3%
San Diego	10.694	N/A	N/A	N/A
Atlanta	10.135	736	17.9	4.6%
Washington, D.C.	9.416	527	10.7	3.4%
Seattle	9.233	480	19.9	3.6%
Pittsburgh	8.129	618	26.2	4.2%
Minneapolis	8.016	701	23.6	4.6%
Newark	6.708	670	33.0	4.3%
Houston	6.687	175	4.2	0.6%
Oakland	6.640	N/A	N/A	N/A
Columbus	6.588	379	24.6	6.6%
St. Louis	6.586	507	19.5	4.4%
Sacramento	6.514	N/A	N/A	N/A
New Haven	5.693	348	64.2	4.8%
Austin	5.641	1529	122.3	10.8%
San Jose	4.502	N/A	N/A	N/A
Dallas	4.388	24	0.7	0.1%
Rochester	4.233	250	22.8	0.7%
Birmingham	3.940	240	26.1	14.8%
Cleveland	3.752	224	10.0	1.8%
Nashville	3.503	221	17.9	9.9%
Buffalo	3.435	N/A	N/A	N/A
Miami	3.320	101	4.5	2.4%
Cincinnati	3.062	167	10.1	1.3%
Salt Lake City	3.044	432	32.4	4.5%
Providence	2.605	177	14.9	4.5%
Portland	2.603	214	11.2	1.9%
Tampa	2.568	210	8.8	3.3%
San Antonio	2.016	3	0.2	0.0%
Milwaukee	2.015	63	4.2	0.7%
Phoenix	1.965	108	4.5	0.8%
Richmond	1.827	102	10.2	4.5%
Omaha	1.113	N/A	N/A	N/A
Louisville	1.035	20	1.9	0.7%
Orlando	1.006	188	11.5	4.1%
Toledo	.643	79	12.8	5.1%
Norfolk	.480	6	0.4	0.5%
Las Vegas	.479	0	0	0
Memphis	.464	2	0.2	0.1%
Akron	.368	120	17.3	4.7%
Kansas City	.328	0	0	0
Denver	.226	5	0.2	0.1%
Charlotte	.154	0	0	0
Boise	.070	3	0.7	0
Greensboro	.053	0	0	0
Jacksonville	.019	0	0	0
Des Moines	.010	0	0	0

Sources: National Science Foundation; United States Patent and Trademark Office

Table 2:
Academic R&D and Economic Indicators in Selected Regions[19]

Rank	*Metropolitan Area*	*Academic R&D $ Per Capita, 1985-2006*	*% change City Jobs, 1992-2004*	*% change Employed Residents in City 1990-2008*	*% change Employed Residents in Metro Area 1990-2008*	*% change Real Metro GDP 2001-2006*
1	Raleigh	$13,271	+8.2	+68.0	+70.9	+17.5
2	New Haven	$10,500	-25.7	-12.7	+1.5	+9.3
3	Baltimore	$9,160	-3.8	-19.6	+13.4	+14.7
4	San Francisco	$8,896	+0.6	+8.3	+9.6	+11.9
5	Boston	$6,324	+17.1	+2.1	+7.5	+8.3
6	Austin	$4,513	+9.5	+56.5	+83.2	+22.8
7	Birmingham	$4,277	+7.4	-16.9	+18.8	+9.3
8	Columbus	$4,277	+20.0	+18.5	+25.3	+8.3
9	Sacramento	$4,001	+6.8	+19.9	+37.7	+29.6
10	Rochester	$3,854	-16.2	-15.8	-0.1	+9.5
11	Seattle	$3,823	+2.1	+23.0	+32.2	+13.3
12	San Diego	$3,801	+15.3	+23.7	+27.1	+23.7
13	Pittsburgh	$3,446	-0.4	-7.5	+6.0	+6.0
14	Newark	$3,300	-2.4	-9.5	+3.2	+7.2
15	Detroit	$2,949	-8.7	-11.0	-1.1	0.0
16	Buffalo	$2,935	-9.9	-15.2	-1.0	+9.4
17	Nashville	$2,845	+15.9	+15.8	+41.1	+23.2
18	Oakland	$2,775	+0.2	+9.0	+9.6	+11.9
19	Minneapolis	$2,700	-3.5	+3.4	+23.8	+11.6
20	San Jose	$2,676	-6.5	+3.7	+1.5	+13.1
21	St. Louis	$2,529	+4.0	-13.6	+6.8	+5.7
22	Atlanta	$2,464	+29.1	+25.0	+57.8	+13.8
23	Salt Lake City	$2,282	-6.7	+37.7	+58.2	+16.7
24	Philadelphia	$2,247	+0.7	-11.2	+7.9	+12.4
25	Providence	$2,192	+12.0	+2.4	+6.2	+12.8
26	New York	$1,996	+11.4	+20.2	+10.3	+12.2
27	Washington, D.C.	$1,913	+8.7	-0.7	+27.2	+20.9
28	Los Angeles	$1,868	-0.3	+5.0	+10.5	+19.2
29	Cincinnati	$1,860	-15.4	-5.7	+17.6	+7.5
30	Richmond	$1,833	+0.1	-2.4	+27.4	+8.2
31	Cleveland	$1,667	-11.2	-9.1	+3.4	+6.0
32	Chicago	$1,638	-2.1	+2.4	+15.4	+7.6
33	Houston	$1,601	+15.4	+20.0	+37.4	+15.2
34	Omaha	$1,552	+24.0	+29.5	+25.8	+17.5
35	Miami	$1,473	+3.7	+12.7	+38.4	+22.0
36	Portland	$1,357	+17.1	+26.2	+35.0	+26.2
37	Milwaukee	$1,343	-3.5	-7.3	+7.2	+8.2
38	San Antonio	$1,266	+36.0	+46.1	+45.5	+18.2
39	Dallas	$1,247	+6.6	+3.4	+37.8	+16.6
40	Tampa	$1,071	-13.2	+12.5	+27.4	+23.3
41	Toledo	$1,040	-7.0	-9.7	+1.3	+5.2
42	Louisville	$1,009	-2.0	+0.7	+12.9	+9.5
43	Orlando	$612	+62.0	+46.3	+62.5	+33.9
44	Phoenix	$604	+37.6	+59.6	+81.1	+29.5
45	Akron	$530	-2.9	+3.9	+16.5	+10.4
46	Memphis	$409	+10.2	+7.8	+18.5	+14.3
47	Las Vegas	$306	+85.7	+98.5	+138.0	+43.9
48	Norfolk	$305	+12.0	+3.3	+22.5	+16.8
49	Kansas City	$185	+8.0	-0.8	+17.8	+10.2
50	Boise	$163	+51.6	+54.9	+77.8	+27.8
51	Denver	$107	+12.1	+28.5	+47.8	+12.1
52	Charlotte	$103	+28.8	+49.8	+43.3	+24.9
53	Greensboro	$42	-2.2	+18.9	+14.7	+6.4
54	Des Moines	$22	-4.9	+0.2	+30.4	+22.6
55	Jacksonville	$17	+25.7	+26.4	+41.2	+27.4

Sources: National Science Foundation; U.S. Department of Housing and Urban Development; Bureau of Labor Statistics; and U.S. Department of Commerce, Bureau of Economic Analysis

Table 3:
University Research Expenditures in Fastest Growing Regions in Sample
(Academic R&D Rank in "Top Ten" GDP Growth Metros)

Metropolitan Area	*Real GDP Growth, 2001-2006*	*Total Academic R&D, 1985-2006 (in billions$)*	*Rank Among 55 Regions in Academic R&D Per Capita*
Las Vegas	43.9%	.479	47
Orlando	33.9%	1.006	43
Sacramento	29.6%	6.514	10
Phoenix	29.5%	1.965	44
Boise	27.8%	.070	50
Jacksonville	27.4%	.019	55
Portland	26.2%	2.603	36
Charlotte	24.9%	.154	52
San Diego	23.7%	10.694	12
Tampa	23.3%	2.568	40

Table 4:
The Classic Success Stories

Metropolitan Area	*Academic R&D Per Capita, 1985-2006 Rank*	*City Job Growth, 1992-2004 Rank*	*Metro Area GDP Real Growth, 2001-2006 Rank*
Raleigh	1	23	19
San Francisco	4	32	33
Boston	5	11	44
Austin	6	21	12
San Diego	12	15	9

Table 5:
High University R&D… But Low Economic Performance

Metropolitan Area	*Academic R&D Per Capita, 1985-2006 Rank*	*City Job Growth, 1992-2004 Rank*	*Metro Area GDP Real Growth, 2001-2006 Rank*
New Haven	2	55	41
Baltimore	3	44	24
Birmingham	7	25	41
Rochester	9	54	38
Pittsburgh	13	36	52
Newark	14	40	49
Detroit	15	49	55
Buffalo	16	50	40
St. Louis	21	28	53
Philadelphia	24	31	30

Table 6:
Low University R&D… But High Economic Performance

Metropolitan Area	*Academic R&D Per Capita, 1985-2006 Rank*	*City Job Growth, 1992-2004 Rank*	*Metro Area GDP Real Growth, 2001-2006 Rank*
Jacksonville	55	8	6
Des Moines	54	45	13
Charlotte	52	7	8
Denver	51	16	32
Boise	50	3	5
Kansas City	49	24	36
Las Vegas	47	1	1
Phoenix	44	4	4
Orlando	43	2	2
Dallas	39	27	22

Table 7:
University Research Expenditures and Regional Economic Outcomes
(Averages on economic indicators, by academic R&D rank quintiles

QUINTILE/ACADEMIC R&D EXPENDITURES	% CHANGE CITY JOBS, 1992-2004	% CHANGE EMPLOYED RESIDENTS IN CITY 1990-2008	% CHANGE EMPLOYED RESIDENTS IN METRO AREA 1990-2008	% CHANGE REAL METRO GDP 2001-2006
Top quintile (regions ranked 1-11)	+2.4	+11.9	+27.3	+14.0
Second quintile (ranks 12-22)	+3.0	+2.2	+15.9	+11.4
Third quintile (ranks 23-33)	+1.2	+5.3	+20.1	+12.6
Fourth quintile (ranks 34-44)	+14.7	+20.0	+34.1	+19.1
Fifth quintile (ranks 45-55)	+20.4	+26.5	+42.6	+19.7

centrality of entrepreneurial research universities in generating regional economic development, or in alleviating urban economic distress.

Table 5 provides an especially vivid snapshot of what Heike Mayer calls economic development "failure in the presence of universities" (Mayer, 2007, 41). These are all regions characterized by: 1) strong (and, in most cases, world-class) research universities; 2) rank at the top of metro areas in the amount of academic research dollars secured; 3) substantial university commitment to tech transfer, including patenting and licensing; and 4) location of the major research university (or universities), in most of the cases, in the region's core city. If entrepreneurial universities could spur urban and regional prosperity, these should be the cities and regions where the evidence of such impact would be palpable.[20] Yet, as table 5 shows, they all rank poorly on key indicators of urban and regional economic health. Taken as a group, the metropolitan areas in table 5 posted an average real GDP growth rate since 2001 only 40 percent as high as the remaining regions in the pool (6.8 percent compared to 16.8 percent). The record on urban job growth in these "research university cities" was even worse: the group of metro areas in table 5 reported an average *decline* of 6.7 percent in the number of jobs located in the city since 1992; by contrast the remaining regions reported a 10.9 percent increase in the number of urban jobs.

A brief closer look at two of these individual cases, Baltimore and New Haven, is instructive, underscoring how much boosters oversell the notion of research universities and academic commercialization as engines of city and regional economic development.

Baltimore. If any city and region should be reaping the benefits of world-class university research and commercial spillovers it would be Baltimore. Between 1985-2006, the region posted more than $23 billion in academic research expenditures; one university --the Johns Hopkins University-- generated around $20 billion of this total. Johns Hopkins, with a main campus and a world-renowned medical school in the central city, and an "Advanced Physics Laboratory" in the suburbs, is the unambiguous powerhouse of U.S. academic R&D funding in science and engineering: it has topped the NSF rankings in research expenditures for 29 consecutive years. The numbers are staggering: between 1999-2006, Johns Hopkins accounted for 3.1 percent of all academic R&D expenditures in the United States, and 4.5 percent of all federally-funded R&D expenditures. To put these totals in perspective, Johns Hopkins' R&D expenditures since 1999 have been *66 percent higher* than the second ranked university (UCLA), and 80 percent higher than such top-ranked research institutions as the University of Wisconsin-Madison. The Johns Hopkins University's R&D expenditures since 1999 have been larger than for Stanford and MIT – the archetypes for the "university research as engine of economic development" trope-- *combined.*

In addition to the Johns Hopkins research machine, Baltimore is home to: 1) the growing research operation of the University of Maryland, Baltimore (located in downtown Baltimore, with over $2 billion in research expenditures between 1999-2006); 2) the University of Maryland Baltimore County (located in suburban Catonsville, with over $350 million in R&D between 1999-2006); and 3) a campus of the University of Maryland Biotechnology Institute (UMBI), located in the revitalized Inner Harbor area of downtown (Hopkins, 2007).

In short, by any measure, Baltimore is America's urban capital of academic research funding: indeed, only Boston approaches Baltimore's aggregate university research expenditure since 1985 (see Table 1). Baltimore has a flow of university research funding that few cities and regions can even dream of approaching. Yet, the data make clear that university-based research has not automatically translated into an economic renaissance in Baltimore: the region ranks in the middle of the pack in metro area GDP growth, and, despite a heralded downtown revitalization program and neighborhood gentrification around the harbor waterfront, the city remains one of America's most economically troubled (Levine, 2000). Maryann Feldman, who has studied the impact of research at the Johns Hopkins University on local economic development, argues that Baltimore "has not captured the benefits of proximity to a research university" (Feldman and Desrochers, 2003, 6) and that Hopkins is the counterfactual case to Stanford and MIT: a world-class research university that "has not been a catalyst for the location of industrial R&D facilities" or spin-off companies in Baltimore (Feldman, 1994, 70). Moreover, despite Johns Hopkins' scientific reputation as well as the ambitious UMBI established in 1985 to create a "Maryland version of Silicon Valley" in biotechnology, 25 years later Baltimore does not rank among the nation's top biotechnology centers (DeVol, 2009; Walker, 2009).

Feldman and others assert that a history of "disdain for profit-making enterprises" among Johns Hopkins scientists, and an aloofness "from the needs or wants of business and industry," have been the primary factors explaining this limited regional economic impact (Feldman and Desrochers, 2004, 14; Bishop, 2007). This argument, however, exaggerates Johns Hopkins' aversion to commercialization, particularly in recent years, and is not persuasive. Although Johns Hopkins has historically manifested a tenacious and admirable commitment to open, public science, it has hardly boycotted tech transfer. Although Johns Hopkins has not embraced entrepreneurialism with perhaps the same fervor as, say, Stanford, UW-Madison, or MIT, it nevertheless ranks fairly high among U.S. universities in "research commercialization." Johns Hopkins ranks 6^{th}, for example, among all universities in patents secured since 1969 (USPTO, 2005). Among the metropolitan areas examined in this paper, Baltimore ranks 5^{th} in patents per 100,000 population (see Table 1).[21] Moreover, according to data on the licensing of research products by universities published by AUTM, which I have aggregated by metropolitan area, only Boston, Raleigh, and Seattle reported more university licenses per 100,000 population in 2005-2007 than did Baltimore (although data were not available for cities such as San Francisco, San Jose, and San Diego that likely ranked higher than Baltimore).[22] The allegedly "non-entrepreneurial" Johns Hopkins University took in $42.7 million in gross licensing revenues between 2004 and 2007 (AUTM, 2004, 2005, 2006, 2007). Finally, Hopkins has recently embarked on a massive $1.8 billion redevelopment project that is the quintessence of university entrepreneurialism: bulldozing slum-ridden neighborhoods around its medical campus to build a biotechnology park that "will transform the east side of Baltimore into a shiny new corporate Mecca for drug developers, medical device makers and gene decoders" (Barbaro, 2003).

In short, insufficient academic commercialism is not a plausible culprit for Baltimore's desultory aggregate economic indicators – let alone, for the relentless urban decay afflicting wide swaths of the city's neighborhoods, including the one surrounding the Johns Hopkins Medical campus in East Baltimore. On the contrary, Baltimore may be the archetypical case demonstrating the degree to which entrepreneurial research universities have been oversold as engines of local economic revitalization, particularly in stagnant, older urban centers.

New Haven. The presence of Yale University, one of the great research universities in the world, has not prevented the relatively small city of New Haven from experiencing steep economic decline (Rae, 2003). If the "research portfolio" of entrepreneurial universities can truly "drive" local economies, then presumably small cities such as New Haven –much like small and mid-sized "college towns"—should be even more susceptible to research-led transformation than larger, more economically complex places such as Baltimore (or, for that matter, Milwaukee). But, revival in New Haven has been elusive: as Tables 2 and 5 show, despite posting the 2^{nd} highest per capita academic research expenditures among the 55 metro areas analyzed in this paper, New Haven's economy continues to shrink economically, to the point that Yale University's weight as an employer and real-estate developer has turned the city virtually into a "company town" (Prevost, 2009).

There is ample evidence that Yale's real-estate policies have created pockets of revitalization in New Haven, particularly, as intended, in the area surrounding the campus (Branch, 2009; Wilson, 2007). But, to what extent is Yale leading a research-driven economic renaissance in New Haven? Yale was once notable for scorning the "steering [of] its academic research down marketable avenues," Stanford or MIT-style, but that is no longer the case (Woelber, 2006; Lueck, 1986). Yale's tech transfer operation, the Office of Cooperative Research (OCR) is recognized as an aggressive, entrepreneurial unit – by 2000, with nearly $41 million from 100 licenses of its research products, Yale ranked third among U.S. research universities in licensing income (Fellman, 2001). As OCR director Jon Soderstrom put it: "I looked around the country and figured that if there was ever going to be another Silicon Valley or Route 128, New Haven was as likely a place as any" (Fellman, 2001). An article in the university's alumni magazine breathlessly declared: "Ever since the gun factories left, Yale's host city has been searching for new economic engines to replace them. A surge in biotechnology may point the way" (Fellman, 2001). In the last ten years, according to the OCR, Yale tech transfer has helped start 34 new companies in New Haven and the surrounding area, with a total investment of $3.3 billion (Fellman, 2009).

In the early 1980s, Yale launched "Science Park," a biotech incubator in an abandoned Winchester firearms factory not far from the university's main campus, intended to attract research and technology-driven businesses and startups. Science Park's turbulent history initially was marked nearly two decades of struggle to attract tenants and consistent annual operating losses (Kaplan, 2007). However, by the end of the 1990s, a $100 million infusion of funds from the State of Connecticut and partnership with a prominent developer of biotech complexes (Lyme Properties) helped kindle something of a biotechnology "explosion" at the park, with higher occupancy and successes like Alexion pharmaceuticals (although Alexion ultimately left Science Park for headquarters in suburban Cheshire, 15 miles north of New Haven, and a manufacturing facility in Rhode Island). Nevertheless, by 2007, one 266,000 square-foot building in Science Park, renovated at a cost of $30 million, was only partially occupied; Lyme's other Science Park holdings, including over one million square feet of the former Winchester factory, remained vacant and largely in disrepair (Kaplan, 2007).[23] New Haven biotech growth had stalled, and OCR's Soderstrom acknowledged "really difficult times." Critics suggested that "biotechnology, the once-touted savior of the Elm City, is ebbing," and that "New Haven –unlike its counterparts in Cambridge and Palo Alto—has been unsuccessful in developing a self-sustaining [biotech] cluster effect" (Woelber, 2006). By 2009, Yale was scrambling to bolster Science Park by moving 600 university workers there, relocating a data center, a copy center, its commercial printing and graphics office, and a facilities management office to the site – hardly the stuff of high tech economic development (O'Leary, 2009).

This is not exactly surprising. Yale and New Haven are simply one among many university-city tandems to discover, as Joseph Cortright and others have documented, that chasing biotechnology is a treacherous local economic development strategy (Cortright and Mayer, 2002; Dewan, 2009). "Besides being trendy," notes one observer, biotechnology is an industry "that has never been profitable," provides surprisingly few jobs, and is concentrated in just a few, path dependent regions (Hoover, 2005; Hoover, 2005a).[24] Nationally, the vast majority of biotechnology companies lose money, and just two companies –Amgen and Genentech—garner the lion's share (over 50 percent) of industry profits (Pisano, 2006, 115).[25] By OCR's own estimates, Yale spinoff companies operating in New Haven support only 800 jobs; indeed, of the six companies founded on Yale research that have gone public over the past decade, only two remain in New Haven – a sign of how even the economic successes of university tech transfer frequently "leak" out of the city, particularly in weak-market cities, and thus ultimately provide little local economic benefit.

Yale continues to forge ahead along the path of academic commercialism, looking to turn research in nanotech, genomics, and environmental engineering into "useful products" and spinoff businesses. It has recently acquired, for $100 million, the state-of-the-art labs of the 136-acre former Bayer HealthCare campus in suburban West Haven, 7 miles west of the university's main campus, (Arenson, 2007); a university official heralded it as a site for "some interesting partnerships" (Fellman, 2009), although presumably the advancement of scientific research, whatever its ultimate commercial potential, was the primary purpose of the acquisition (Christofferson, 2007).[26]

Moreover, despite its difficulties, Science Park continues to attract interest from developers (Macmillan, 2009).

Nevertheless, in terms of economic development, as one writer sympathetic to Yale's academic commercialism admitted: "The biggest question is whether the [Yale] startups will ever have a serious impact on the employment picture in New Haven" (Fellman, 2009). 27 years after the opening of Science Park and Yale's first steps towards academic entrepreneurialism, the data in Tables 2 and 5 in this paper offer little evidence that commercialized research from one of the world's finest research universities can turn around an economically troubled city or region.

* * * *

The Yale/New Haven and Johns Hopkins/Baltimore stories exemplify the elusive connection between research universities, academic entrepreneurialism, and local economic development. Almost without exception, the same narrative of overselling and disappointment recurs – especially, as Table 5 highlights, in older, historically industrial cities. In Rochester, as former employment stalwarts such as Kodak and Xerox have slashed employment, political and academic officials have trumpeted the eminent and entrepreneurial University of Rochester as "turbocharging a local economy…[with] new discoveries at the university spinning off local companies…and scores of skilled jobs" in sectors such as digital imaging (Richardson, 2000; Safford 2005).[27] In Pittsburgh, the conventional narrative now is that "this is what life in one American city looks like after an industrial collapse:" major research universities, Carnegie Mellon and the University of Pittsburgh, fueling a technology-driven renaissance in computer software and biotechnology to replace steel (Streitfeld, 2009; Dyrness, 1998; Jordan and Kornblith, 2009). Rochester and Pittsburgh-- as well as St. Louis (with Washington University), Newark (with Rutgers and Princeton in vicinity), and Philadelphia (with the University of Pennsylvania and fast-rising Drexel University)-- have attracted billions of dollars in academic R&D since the 1980s and rank high among universities in churning out patents, licenses and business spinoffs.

Yet, the economic indicators for these cities and regions, as arrayed in Tables 2 and 5, are no more impressive than in older industrial cities *without* top-tier levels of academic R&D expenditures, such as Kansas City or Milwaukee. There's little evidence supporting the popular narratives, in places such as Pittsburgh, for example, of city or regional economic development success driven by commercialized academic research. In fact, according to the "Pittsburgh Indicators Project," the new university research-fueled Pittsburgh economy has consistently posted since 2002 the lowest new business formation rate of the forty largest regions in the United State.[28] As Table 2 illustrates, only three regions among the 55 analyzed in this paper have posted lower rates of metro area GDP growth since 2001 than Pittsburgh. The "Pittsburgh turnaround" narratives also never mention that, while this university-driven renaissance was supposedly occurring, the city went bankrupt in 2003 and remains in financial receivership to Pennsylvania's state government.

Yale, Johns Hopkins, Rochester, Pennsylvania, et al. are not just "any" research universities; they are acknowledged as among *the best research universities in the world*. Yet, there is little evidence that their efforts to bring science to market have been transformative for their local economies. This is a crucial point, as universities that will never reach the levels of research funding or scientific eminence of places like Yale or Penn make major investments in academic entrepreneurialism, profoundly reshaping their institutions, in the name of economic development. If such world-class research universities have had limited impact in bending the economic trajectory of their cities or regions, what is the plausibility that less endowed institutions will do so?

Table 8 provides the most salient summary statistics on the connections between research universities, academic entrepreneurialism, and economic development in medium-to-large U.S. metropolitan areas. For the 55 regions, I have calculated bivariate correlations between the key independent variables on entrepreneurial universities (levels of research expenditures, patents, and licensing) and a series of dependent variables representing economic development outcomes (city job growth, employment city and metro area residents, and metro area GDP growth). The correlation coefficients between these variables are arrayed in Table 8.

The results are eye-popping. There are no meaningful correlations between *any* of the entrepreneurial research university variables and any of the gauges of city or regional economic well-being; indeed, only a few of the coefficients are even slightly positive, but these are far too low to suggest any relationship. Simple correlation analysis, added to the descriptive statistics presented earlier, reveals no support for rhetoric that entrepreneurial research universities are engines of local economic development.

Table 8:
University Research Expenditures and Regional Economic Outcomes
Correlation Coefficients

UNIVERSITY VARIABLES (BY METROPOLITAN AREA)	% CHANGE CITY JOBS, 1992-2004	% CHANGE EMPLOYED RESIDENTS IN CITY 1990-2008	% CHANGE EMPLOYED RESIDENTS IN METRO AREA 1990-2008	% CHANGE REAL METRO GDP 2001-2006
Aggregate University Research Expenditures, 1985-2006	-.196	-.194	-.243	-.236
University R&D Per Capita, 1985-2006	-.287	-.099	-.128	-.203
University Patents per 100,000, 1990-1999	-.174	+.094	+.062	-.124
University Licenses Per 100,000, 2007	-.119	-.132	+.071	-.097

Why Do Entrepreneurial Research Universities Fail as "Engines" of Urban and Regional Economic Development?

The review of existing studies, statistical evidence, and short case studies presented in this essay confirm Mayer's assessment that "world-class research universities are neither necessary nor sufficient in growing high-technology regions… or creating economic growth" (Mayer, 2007, 43, 47). This conclusion, of course, runs counter to the conventional wisdom derived from stylized popular accounts of the classic "success stories" of Silicon Valley or Boston's Route 128. Why, for most cities and regions, have entrepreneurial research universities historically *not* been the engines of local growth claimed by boosters of academic commercialism?

At the outset, it is important to recognize the *atypical* nature of the classic success stories. All of the cases arrayed in Table 4 arose out of highly unusual and rarely replicated combinations of specific historical circumstances, regional political economy, local economic culture – and luck. These factors, in turn, became "initial conditions" that, through path dependency, shaped future regional economic trajectories (David, 1985; Krugman, 1991). Take Stanford and Silicon Valley, for example. Saxenian (1994) and Kenney (2000), among others, have detailed the unique and not-easily-replicated culture of competition, collaboration, and community in Silicon Valley that was so fertile for high technology development. Several studies point to the decisive role of Cold War political economy –in particular, the massive infusion of defense contracts and research expenditures—in the making of Silicon Valley and entrepreneurial Stanford (O'Mara, 2005); as Leslie puts it, the Department of Defense was the original "angel investor" in "turning both Stanford and its surrounding industrial community into high technology powerhouses" (Leslie, 2000, 66). Indeed, the atypicality of the Silicon Valley model was underscored when Frederick Terman, the Stanford provost acknowledged as the "father" of the model, retired in the mid 1960s and began consulting around the country on how to replicate the Stanford-Silicon Valley model. "As it turned out," writes Leslie, "he couldn't, despite some sizable investments by business groups and state agencies in New Jersey, New York, Texas, and Oregon (Leslie, 2000, 66-67). Terman "overemphasized the university's value in the Silicon Valley equation" (Leslie and Kargon, 1996, 469) and failed to recognize the unique historical circumstances that gave rise to this success story. Small wonder that the field of regional economic development is littered with failed "next" Silicon Valleys and "next" Stanfords. In short, as Richard Lester cogently puts it: "Not all local economies are like Silicon Valley; not all industries are like biotechnology or software; and not all universities are like Stanford" (Lester, 2005, 28).[29]

Two factors stand out in explaining why academic commercialism is generally ineffectual as a "driver" of economic development in most cities and regions. First, while boosters promote research universities as "hothouses" of patents and business startups, in fact even the most entrepreneurial universities produce a trivial share of a region's stock of patents or new businesses. Nationally, university-owned patents represented less than two percent of all utility patents issued in 2005, and only 3.5 percent of all US-owned patents in that year (USPTO, 2005). Despite the surge in university entrepreneurial activity in recent years, this percentage has actually been declining since the late 1990s. As Table 2 shows, in very few of the 55 metropolitan areas examined in this paper did university patents constitute as much as one-tenth of the total stock of regional patents generated in the 1990s; on average, for these MSAs, university patents represented 3.3 percent of the regional stock. And all this assumes that regional patents actually translate into meaningful regional economic development; in fact, for the MSAs examined in this paper, there is a -.182 correlation between MSA patents per 100,00 residents (1990-1999) and metro GDP growth (2001-2006), and even less of a correlation between regional patenting and job growth in the urban core (-.240). The relationship between where patents originate and where they have an economic impact is highly complex and, in any event, universities are minor contributors to the regional stock of patents.

Not only are university-owned patents a trivial share of the regional patent stock, but patenting and licensing – the "marquee" activities of entrepreneurial universities— also account for a small portion of university knowledge-transfer. A study by Agrawal and Henderson of patenting in the Department of Engineering at MIT –one of the most unabashedly entrepreneurial of major US research universities—found that patenting plays a small role in the transfer of knowledge from university labs to industry; traditional, *non-entrepreneurial* mechanisms such as publishing ("open science") and consulting were much more important (Agrawal and Henderson, 2002). Even at MIT, "a small fraction of faculty patent at all" and these faculty estimate that patents were responsible for only 7-10 percent of the knowledge transferred from their labs (Agrawal and Henderson, 2002, 44-45). These findings were confirmed in a Carnegie Mellon survey of R&D labs in manufacturing across the U.S.: published science was, by far, the dominant mechanism of university knowledge transfer (Cohen, Nelson, and Walsh, 2002).

Similarly, despite the well-publicized stories of business startups generated by entrepreneurial universities, "new business formation around university science and technology is a very small fraction –probably no more than 2-3%-- of the total rate of new business starts in the US" (Lester, 2005, 10). Even this estimate may be much too high. The Federal Reserve Bank of Minneapolis points out that the entrepreneurial University of Minnesota has averaged three licensed startups a year since 2003; yet, in 2007 alone, over 28,00 new businesses registered with the secretary of state's office. The Minneapolis Fed, whose district includes not only the University of Minnesota but also the entrepreneurial powerhouse of WARF at the University of Wisconsin-Madison, concludes:

> The benefits that these activities bestow on universities and their communities are questionable. A headcount of startups that have come out of district research universities over the past decade shows that TTOs [technology transfer offices] have had limited success in creating new companies through technology licensing…The relative rarity of university-licensed startups means that their effect on regional economies is minimal…And the inherent risks of investing [university] resources in embryonic enterprises cast doubt on business formation as a tech transfer strategy" (Davies, 2008, 8).

The second and most important factor explaining the limited economic development impact of entrepreneurial universities relates to what might be called the "absorptive capacity" of the city and region (Florida and Cohen, 1999, 605). As noted earlier, the assumption underlying arguments about research universities as "engines of growth" is that the innovation and inventions flowing out of university labs will be "captured" locally; in the parlance of economics, there will be a geographic localization of knowledge spillovers. As Fogarty and Sinha write: "R&D spillovers associated with new technology will become a source of long-run economic benefit only if the local industry R&D network draws from the technology, if commercialization occurs locally, and if the region's industries capture the technology through diffusion and investment" (Fogarty and Sinha, 1999, 474).

It turns out, however, that the extent to which spillovers remain localized is highly contingent on the overall economic "ecosystem" in which a university is located. University patent and licensing counts, of course, tell us nothing about "how tech transfer activity translates into new products, increased company sales, bigger payrolls, and rising products" (Davies, 2008, 5). Nor do these counts tell us where these economic outcomes are located.

As it happens, there is considerable evidence that commercialized research, instead of "driving" local economic development, more frequently "leaks" from the university's home community. Simply because a professor at a given university makes a patentable discovery doesn't mean that it will be licensed to a local firm, manufactured or marketed locally, or ultimately produce any local jobs. For example, a survey by the Minneapolis Fed found that 74 percent of licensees of University of Minnesota research were located out-of-state, and 63 percent of WARF licensees were located outside Wisconsin (Davies, 2008, 4), leading the Fed to conclude that "this perception of technology licensing as an engine of regional economic development is overblown" (6).[30] Cortright gives the example of a potential blockbuster anti-leukemia compound developed at the Oregon Health Sciences University in Portland: "The economic impact in the Portland area is zero because the rights to manufacture and market this drug were already owned by Novartis" (Dewan, 2009).

Perhaps the most illuminating analysis of the geography of university research spillovers is Fogarty and Sinha's study of Cleveland, where university-industry partnerships have been at the heart of local economic development strategy. Cleveland has attempted to channel university R&D spillovers -- centered around Case Western Reserve University (CWRU), a "top 40" research university nationally, with almost $4 billion in R&D expenditures since 1985— to generate economic development in three technology-driven clusters: Functional Electrical Stimulation (FES); Polymer Displaced Liquid Crystals (PDLC); and Microelectro-Mechanical Systems (MEMS). The efforts, however, failed: Cleveland's stagnant economic ecosystem did not have the infrastructure to absorb the research spillovers, and the technological breakthroughs generated at CWRU and other Cleveland labs rapidly diffused to other regions – notably Boston, San Francisco, Los Angeles, and New York, as well as Japan; places with the requisite infrastructure of production facilities, industrial R&D, and labor force skills.

Thus, Fogarty and Sinha conclude that older, economically stagnant regions cannot "imitate" Silicon Valley, mechanistically apply the entrepreneurial university model, and expect that university-generated knowledge spillovers will be captured locally and generate economic development. On the contrary, they argue that Cleveland's experience of "limited absorption" of research spillovers has been reproduced in places like Detroit, Philadelphia, and Baltimore (Fogarty and Sinha, 1999, 501). Certainly, we saw evidence of this in the case of New Haven, where a striking share of Yale-related biotech startups have ended up leaving New Haven. Historian Stuart Leslie found "striking confirmation" of Fogarty and Sinha's arguments in his study of academic commercialism at Rensselaer Polytechnic in New York State's economically depressed "Capital Region": "For all they accomplished in transforming RPI, they could not overcome the regional disadvantage that kept them from competing effectively with emerging high-technology centers in other parts of the country…Without a strong regional industrial base to capture and hold their innovations being generated…RPI ended up exporting its best ideas and best graduates to other places, including Silicon Valley itself" (Leslie, 2001, 237).

Joan Fitzgerald's recent work on "green" economic development and urban job growth also demonstrates the complex ways in which regional absorptive capacity mediates the local economic impact of research universities (Fitzgerald, 2009). In Austin, she points out, "all the elements are seemingly in place to make the city a pioneer in the use of energy as a catalyst for economic development," including a clean-technology research program at the University of Texas' flagship Austin campus. Yet, she points out, "even with all these elements in place, Austin is not seeing the hoped-for development of a large scale solar-energy industry;" production and design centers are locating in neighboring states that are offering attractive incentives packages. Conversely –and quite ironically, given Austin's much more dynamic regional economy—Toledo, Ohio has emerged as a solar-energy industry center, felicitously combining traditional industrial infrastructure in glass technology and manufacturing with research at the University of Toledo, which has spun off seven solar-energy startups. Clearly, in these two cases, regional absorptive capacity matters as much, if not more, than university research: "Toledo's glass specialists have been able to retool to meet the needs of thin-film solar-panel producers, while Austin's info-tech specialization evidently does not translate well into the skill sets needed in solar-energy production" (Fitzgerald, 2009, A6). Yet, even in the salutary case of Toledo, there are storm clouds on the horizon: will the university continue to generate spinoffs, will the spinoffs stay in Toledo (companies are building plants in Asia and Europe), and will other public policies support the local industry retooling necessary to create manufacturing jobs in the city (Sterzinger, 2009)?

The implications of these studies are clear – and consistent with the data on research universities and the economies of older, industrial cities presented in Tables 2 and 5. Entrepreneurial universities are not "engines" of local economies; local economic development is a complicated, multi-faceted process in which research universities are a small component; and academic commercialism is not a panacea for stagnant, older industrial cities and regions. Ironically, the entrepreneurial university, churning out patents, licenses, and startups, is increasingly sold to policymakers as a *sine qua non* not just for regional growth, but for the economic *turn-around* of declining regions; yet, for a variety of reasons, these are precisely the places where academic commercialization is *least* likely to have a decisive economic impact.

In fact, university research-driven economic development has figured integrally in the economic turn-around of only one stagnant, historically industrial city and region: Boston, since the 1970s. And, as in the case of Silicon Valley, Boston's renaissance, particularly around biotechnology, was the product of a "highly contingent" and not easily replicated regional economic ecosystem, one which "grew from a commitment to open science, in which information, knowledge, and human capital irrigated a broad community" (Powell, Owen-Smith, and Colyvas, 2007, 139). Dense "knowledge networks" in Boston, resting on a unique economic culture as well as path dependency from historical flows of government funding, made it likelier that "technology spillovers" of economic value would be absorbed in the region than in, say, Cleveland or Milwaukee (Owen-Smith and Powell, 2004).[31] But what's fascinating is Powell's argument that the Boston model works because, although there is plenty of academic commercialism in the region, Boston's economic culture is *not* dominated by entrepreneurial treatment of university knowledge as a proprietary commodity. "In this exemplary case," he argues, "universities and hospitals played an essential role in the creation and expansion of biotechnology *precisely because they acted like the traditional university, an open institution where knowledge readily spilled over into the surrounding community*" (Rhoten and Powell, 2007, 364. Emphasis added).

In any event, the unique Boston economic ecosystem has not been replicated in any other older, historically industrial city. And the historical record in other cities and regions suggests that the benefits of the Boston model are unlikely to be garnered by universities simply building an "off-the-shelf" research park, or beefing up their engineering school to go out and chase patents – in the absence of the underlying components of the Boston economic culture.[32]

In short, the scenario of economic development failure in the presence of world-class university research and academic commercialism is not an anomaly; indeed, it is a much more common outcome than the vaunted success stories constantly invoked when university leaders embark upon entrepreneurial strategies. For academic commercialism to meaningfully influence the local economy, a "coincidence of special conditions must occur that are difficult to create" (Hill, 2006, 31); moreover, these conditions almost never are found in the "weak market" cities and regions now pursuing academic entrepreneurialism as the new "silver bullet" of local economic development.

The university is a component in a complex local economic ecosystem, not an "engine" that can propel a local economic turn-around. As Goldstein and Drucker's regression analysis noted earlier clearly showed, factors such as agglomeration tendencies, levels of human capital, and local industrial structure all are significantly more influential than university research or commercialization in shaping local economic development. Thus, "strong market" regions (e.g. Denver, Jacksonville, Charlotte, Las Vegas) do well despite lacking major research universities; regions such as Portland or Boise thrive as "knowledge-intensive" economies, with private R&D, not universities, providing the lion's share of technology spillovers (Mayer, 2007); and most "weak market" regions, despite entrepreneurial, world-class research universities, remain stagnant. University patents, licensing, and startups, for all the hype, constitute a small fraction of local economic activity almost everywhere. And, in most communities, the local economic impact of university research is generally mitigated as scientific knowledge and subsequent commercialization "leak" to other regions – only in very particular cases does the local absorptive capacity permit significant local capture of these knowledge spillovers. Consequently, academic entrepreneurialism and university-industry partnerships will almost "never generate the returns that politicians and administrators covet" (Powell, Owen-Smith, and Colyvas, 2007, 141) and "as a regional development strategy, university research programs almost never live up to their founding promises" (Leslie, 2001, 264).

The Costs of Academic Entrepreneurialism

While proponents of academic commercialism routinely overstate its economic benefits for cities and regions, they rarely mention the potentially significant costs. This is not the place for a full discussion of the dangers of academic entrepreneurialism: the potential undermining of the system of basic research and open science that has been the cornerstone of scientific discovery in the US over the past century; the threats to the "intellectual commons" from "selling private rights to public knowledge" (Powell, Owen-

Smith, and Colyvas, 2007, 121); and a full range of potential damage to the fabric of universities, from excessive corporate influence and over-commercialization, to rampant conflicts-of-interest and, in rare but troubling cases, outright corruption (Washburn, 2005; Greenberg, 2007; Rhoten and Powell, 2007; Shapin, 2008). There is a burgeoning literature addressing these subjects in some detail. But, as universities plunge headlong into entrepreneurialism, in the name of putative local economic benefits that we've already seen are largely chimerical, we should highlight at least some of the costs that they risk incurring – costs that entrepreneurial university leaders invariably ignore or gloss over.

Ironically, a major cost is financial. This is especially curious since many university leaders explicitly advocate commercialization activities as a revenue-*enhancing* strategy for their institutions, especially at public universities where state support over the past two decades has shrunk as a proportion of university operating budgets. Such leaders paint rosy visions of increased extramural research funding (including support from private industry)[33], remunerative royalties from the licensing of university discoveries, and lucrative equity shares in start up companies. A "gold rush" fever has developed among entrepreneurial-minded university leaders, fueled by well-publicized blockbuster returns from: 1) drug discoveries such as Emory University's $525 million royalties from Emtriva, New York University's $650 million from Remicade, or Yale's $277 million for D4T-Zerit; 2) techniques, such as Stanford and UCSF's $250 million for gene-splicing technology, Columbia's $400 million for the "cotransformation" biotechnology technique, or UW-Madison's estimated $200 million potential in stem cell patents (Gallagher, 2008); or 3) returns from equity in university-generated startups, such as Stanford's $336 million from the sale of Google stock or Carnegie Mellon's $60 million windfall from its equity in Lycos (Greenberg, 2007, 62; Masterson, 2009). As we've noted, AUTM produces an annual survey on the income generated by university licensing and startups, and the media dutifully report that "research and inventions earn big bucks for American universities" (Masterson, 2009).

But, the dirty little secret is that for most U.S. universities, tech transfer and academic entrepreneurialism do not function as "cash cows." In fact, for most universities, *tech transfer is a money-losing proposition*. Although the blockbuster successes are well known, they are rare; the vast majority of university patents and startups generate no income, and when they do, typically the gains range from negligible to modest. The most credible analyses suggest that fully half of all universities engaged in tech transfer lose money on the operations, as *their licensing revenues are insufficient to cover administrative costs and the legal expenses of filing and maintaining patents* (Powers, 2006; Stevens, 2005; Campbell, Powers, Blumenthal, and Biles, 2004; Feldman, 2003; Ehrenberg, Rizzon, and Jakubson, 2003; Thursby and Thursby, 2007; Bulut and Moschini, 2009). Among the universities that do produce *net* revenues, only a select few actually generate significant income from academic commercialization; most barely scrape by with very modest net returns. "Clearly, while some offices are generating substantial net income, *there are a very large number for whom the office is a net drain on university resources*" (emphasis added) (Thursby and Thursby, 2007, 629).[34] This is a devastating indictment: not only does academic commercialization generally not deliver regional economic development or an infusion of net revenues to the university, but in a substantial number of cases, commercialization apparently *drains* resources from other university activities.

Here are the basic numbers behind the risky finances of university licensing. Thursby and Thursby (2007, 627-629) estimate, simply considering the legal and salary costs of tech transfer offices (TTO) and *ignoring all other costs*, that a TTO with the median number of employees and legal fees expended around $1.1 million in 2004.[35] My calculations from the 2004 AUTM licensing survey, displayed in Table 9, show that over 52 percent of universities responding to AUTM reported licensing revenues less than $1 million (with over 40 percent generating less than $500,000). Thus, assuming these universities incurred the low-ball median expenses of TTOs calculated by Thursby and Thursby, they unambiguously were net financial losers in the tech transfer business. Another 12.9 percent of university TTOs generated between $1-2 million in 2004, meaning some were undoubtedly net losers, while others squeaked out a tiny net gain; in an event, there were no "cash cows" for universities in this group. In short, Table 9 confirms the assessment of other researchers noted above: over half of universities lose money in academic commercialization, and nearly 40 percent generate so little licensing income (under $500,000) that their expenditures in academic "venture capitalism" are undoubtedly draining non-trivial resources from other areas of the university.[36]

Table 9:
Gross Licensing Revenues Among U.S. Universities, 2004

Gross Licensing Income	*% of all universities*
> $5,000,000	23.2%
$2-5,000,000	11.6%
$1-2,000,000	12.9%
$500,000-$1,000,000	11.6%
<$500,000	40.6%

Source: AUTM, 2004

The distribution of licensing "winners" is astonishingly skewed, resembling a "winner-take-all" distribution in which the rich keep getting richer. In 2007, among universities responding to AUTM's survey, the top 15 licensing revenue-generators alone garnered a staggering 79.5 percent of all licensing revenues secured by U.S. universities; just five universities took in 56.8 percent of total revenues in 2007. Although more and more universities are becoming "entrepreneurial," the skew has actually intensified over the past decade: in 2000, for example, the top 15 universities took in "only" 65.2 percent of licensing revenues, and the top 5 "only" 45.2 percent.[37] Moreover, there is very little turnover at the top: the same universities are the top 15-20 licensing income earners, with just a few exceptions, year after year in the AUTM survey.

Not coincidentally, a similarly skewed distribution characterizes overall research expenditures at U.S. universities. There is an incredibly high +.903 correlation between the top 200 universities ranked by the National Science Foundation by total research expenditures in 1985, and the 2007 NSF rankings. As in the case of university licensing revenues, there is a fairly rigid hierarchy and strong path dependency noticeable in research funding: essentially, with a few exceptions, the top 200 in 2007 are the same as the top 200 in 1985, and in roughly the same order.

Entrepreneurial university administrators at perceived "lower-tier" institutions often talk of cracking the "top 100" in research expenditures as a measuring stick. Putting aside whether such a gauge is meaningful, there is, to put it mildly, limited permeability into this top grouping. Only seven academic research institutions from outside the "top 100" in academic R&D funding in 1992 cracked the top 100 in 2007 – *15 years later*. And all were already reasonably close to the top 100 in 1992, further illustrating the difficulties for "wannabe" institutions, much lower in the rankings, to make the leap into the upper tier.

Moreover, with one exception, these institutions, shown in Table 10 below, were either medical schools or universities housing a medical school. That's the other little secret of academic commercialism: unless you're an MIT, it is almost impossible for a university without a medical school to generate the levels of academic R&D and licensing income that would make entrepreneurial activities financially remunerative. This conclusion is echoed in Bulut and Moschini's (2009) sophisticated regression analysis. The authors confirmed that "only a few U.S. universities are obtaining large returns" and most are generating "negligible or negative returns." In particular, the prospects for returns for public universities without a medical school were miniscule, lagging well behind all other types of institutions (public with a medical school, private with a medical school, and private without a medical school).[38] They attribute this "medical school effect" to the fact that most top revenue-generating university licenses are from biomedical research.

In short, university leaders embarking on entrepreneurial strategies face startlingly long –and almost always unacknowledged—odds. Generating serious revenue from academic commercialism is *not* a tried and true path to success; on the contrary, it is akin to trying to make money at a casino or buy a winning lottery ticket. This form of "jackpot economics" is placing university leaders in roles for which most are unequipped: acting as academic venture capitalists, trying to outguess the market and pick commercial "winners" in research fields that might "hit the big one" and yield a lucrative, blockbuster discovery. In this search for the "jackpot," as Powers and others have suggested, the entrepreneurial university strategy has more than a little in common with the "irrational exuberance" and uncontrolled "animal spirits" of the recently burst bubble economy (Shiller, 2000; Akerloff and Shiller, 2009).

Table 10:
Cracking the "Top 100" in Research Funding

Academic Institutions Outside the NSF "Top 100" in 1992
That Were In the "Top 100" in 2007

Institution	*Rank 1992*	*Rank 2007*
Medical College of Wisconsin	121	100
Medical University of South Carolina	102	94
Florida State University	113	90
University of Texas Health Sciences Center	104	88
Dartmouth College	108	86
Oregon Health and Science University	116	63
SUNY Albany[39]	130	59

Source: National Science Foundation, FY Survey of Research and Development Expenditures at Universities and Colleges

Beyond the financial deficits of academic entrepreneurialism, there are potentially devastating costs to the very fabric of the university and its core missions of creating and disseminating knowledge. In a revealing interview with author Jennifer Washburn (2005), Michael Crow – the trailblazing head of tech transfer at Columbia before becoming president of Arizona State University—was blunt in criticizing this "jackpot" mentality. "A lot of these places are hell-bent on trying to get the commercial operations going. They get all messed up, because all of a sudden the universities have to start thinking like companies and they're bad at that." In efforts to emulate Stanford and MIT, said Crow, lower-tier universities risk turning into "job shops –marginal, industry-driven, technology transfer-driven enterprises…*These institutions need to be very, very careful because what they will turn into, in the end, won't be a university*."[40] Most tellingly, Crow argued that any school ranked below the "top 15" on AUTM's royalty earners lacks the critical mass of research capacity or resources to do commercialization successfully.[41] "They're basically getting nothing out of it, except a lot of economic development rhetoric" (Washburn, 2005, 187-188).[42]

Yet, the intense focus of entrepreneurial universities on possible profits, industry partnerships, and market potential threatens to divert resources from "blue sky" research and the university's role in nurturing human capital – and, ironically, in the eyes of some, *harm* economic development. Indeed, Feller (2004) raises the alarm that, in the name of economic development, state governments will target university appropriations to "niche technology areas," while cutting investment in other vital parts of the university and thereby contribute to an overall erosion of education and basic research.[43] As we will see below in the UW-Milwaukee case study, this is precisely what is happening in the name of a so-called university/economic development "growth agenda."

J. Rogers Hollingsworth has done some fascinating work on how major scientific discoveries –the paradigm-shifting breakthroughs-- have emerged over the past century (Hollingsworth, 2008). Among his many insights –especially on the roles of collaboration and patience in scientific discovery-- is how academic commercialism potentially undermines basic research and long-term economic growth. "The [entrepreneurial] sector has been heavily dependent on decision-makers with short-term horizons. As a result, the sector has tended to emphasize incremental research, designed to maximize profits in the short term. If society becomes excessively dependent on this sector for the production of knowledge, there is not likely to be enough new, basic knowledge necessary for high technological and economic growth over the long run" (Hollingsworth, 2008, 341).[44] The heart of the discovery process is uncertainty, patience, and letting scientists follow their noses (Shapin, 2008, 132); pressures to produce market-ready innovations that maximize profits can undercut that creative process (Rae-Dupree, 2008). This is especially problematic, given the jackpot-economics of university patents that create powerful incentives for faculty to find "winning" patents. Is a casino-like academic structure, oriented toward interest-group dominated economic development, the best framework to produce breakthrough science?

Put another way, university-industry partnerships, designed with the value of "economic development" elevated above all else and often marked by significant corporate or donor influence over research, may actually have the perverse effect of stunting innovation. Paul Berg, the Nobel Prize-winning Stanford University biologist whose research helped lay the groundwork for the biotechnology revolution, noted that corporate "partnerships" would have stifled the path-breaking work of the 1960s and 1970s. "The biotech revolution itself would not have happened had the whole thing been left up to industry," said Berg in an interview with Jennifer Washburn (2005, 241).

"Venture-capital people steered clear of anything that didn't have obvious commercial value or short-term impact. They didn't fund the basic research that made biotechnology possible." As Washburn notes: "The freedom of universities from market constraints is precisely what allowed them in the past to nurture the type of open-ended fundamental research that led to some of the most important (and least expected) discoveries in history" (Washburn, 2005, 241).[45] William Brody, the former president of Johns Hopkins University, offers perhaps the most eloquent statement on the virtues of public science as well as the dangers to science posed by academic entrepreneurialism:

> Our scientists are by nature explorers – they are off sailing uncharted seas in search of discoveries. Asking them to become managers, marketers and accountants is unrealistic and ultimately inimical to the research enterprise. Time spent in the boardroom is time away from the laboratory, making them less productive and less likely to achieve the things most suited to their abilities…When Hopkins scientists discovered restriction enzymes, one of the bases of the biotechnology industry, we put the discovery in the public domain – losing millions and millions in potential royalties. Foolish? Perhaps. But I know we didn't slow down science or diminish the leading role [that] American industry plays in this field (Brody, 1999).

A number of studies over the last decade have begun to appraise the ultimate potential cost of the entrepreneurial university: the disturbing ways in which academic commercialism threatens to undermine the canons of public, open science and the credibility of university research. The extreme cases, most involving the pharmaceutical industry, are marked by conflicts of interest and even corruption, and have received extensive attention (Greenberg, 2007; Washburn, 2005; Angell, 2009; Blumenstyk, 2009). The recent revelations of drug company "ghostwriters" producing articles for top medical journals under the names of academic authors, "suggesting that the level of hidden industry influence on medical literature is broader than previously known" (Singer, 2009), vividly underscored the dangers of university-industry partnerships and academic entrepreneurialism (Wilson and Singer, 2009). Less dramatic but no less worrisome are findings suggesting that research funding from industry is increasingly associated with reports or studies favorable to industry sponsors (Campbell, et al, 2004), a kind of entrepreneurialism that effectively puts "science for sale" (Greenberg, 2007) and ultimately undermines the integrity of university research (Bok, 2003, 57-

78). At a minimum, entrepreneurial universities need vigilant and vigorous safeguards against the kinds of research bias and even misconduct that commercialization can encourage – and it is far from clear that most entrepreneurial institutions have put sufficient safeguards in place, or, in some instances, even fully recognized the dimensions of the issue.

Beyond the risks of excessive industry influence and research misconduct, academic commercialism also appears to be creating a more subtle corrosion of "the culture of inquiry that is the soul of the academy" (Powell, Owen-Smith, and Colyvas, 2007, 141). As one critic puts it: "Does the injection of the profit motive into scientific research distort the kinds of questions that get investigated and degrade the quality of the results that get produced" (Deresiewicz, 2009)? There is, as Greenberg notes, "ample evidence that scientific research is being delayed, deterred or abandoned due to the presence of patents and proprietary technologies" (Greenberg, 2007, 65). Rebecca Eisenberg and Michael Heller have raised the specter of a "tragedy of the anticommons," an erosion of the Mertonian "communalism" of the scientific enterprise, in which patenting reduces the willingness of researchers to exchange results and materials, and research progress suffers from "too many property rights" leading "to excessive transaction costs and risks of bargaining failures" (Heller and Eisenberg, 1998; Eisenberg, 2008, 1098). Although Eisenberg's most recent analysis concludes, "it is rare for an ongoing project to be stopped because of patents" (Eisenberg, 2008, 1098)[46], other analysts, such as Liebeskind and Oliver argue that the threats posed by academic entrepreneurialism to collegiality and research collaboration, particularly in the biomedical sciences, are real:

> Our research [found] that academics in the biomedical sciences widely perceive that patenting has changed collegial relations in the field. Scientists interested in patenting…may restrict the size of their research teams to minimize disputes over claims to inventions. Some scientists are even reluctant to engage in casual conversation with their colleagues, present new ideas at meetings, or have students or other faculty work in their laboratories on a visiting basis… "Contracted exchange[s]" among academics [are] beginning to substitute for the more informal, trust-based exchanges that took place before intellectual property concerns became so important in the life sciences (Liebeskind, 2001).

Although Liebeskind concedes that there isn't compelling evidence that burgeoning university entrepreneurialism has had a "chilling" effect yet on research, the potentially corrosive long-term impact, along the lines noted by Hollingsworth above, is serious – and essentially ignored by boosters.

In short, given these tangible and potential costs of academic commercialism, does it make sense to allocate scarce university resources to "economic development" activities that, as we saw earlier, rarely produce the promised outcomes for communities and, for most universities, are money-*losing* propositions? Jennifer Washburn puts the matter succinctly and persuasively: "At a time when many schools are bleeding red ink, cutting courses, downsizing full-time teaching, and increasing class size, is this really a wise investment? When one factors in the other costs –the conflict-of-interest entanglements, the threat to academic freedom, and the enclosure of the scientific commons—is the investment justified" (Washburn, 2005, 270)? In short, is there any compelling reason for universities "to turn academic science over to the logic of the marketplace" (Deresiewicz, 2009)?

Part II:

Academic Commercialism and Local Economic Development: The Case of The University of Wisconsin-Milwaukee

The University of Wisconsin-Milwaukee (UWM) has been, for many years, a widely respected urban research university. Over the years, UWM has quietly attracted a solid base of highly productive faculty researchers, many of whom are nationally and internationally recognized scholars, across the natural sciences, social sciences, and humanities. Several university academic departments and programs are ranked highly nationally, and in 1994, UWM received the coveted designation of the Carnegie Foundation as a "Doctoral/Research University-Extensive" institution. Between 1985-2004, according to data from the National Science Foundation arrayed in Table 11, UWM more than tripled its total annual academic R&D expenditures (from $9.1 million to $28.3 million) and more than quadrupled its total federal research funding (from $3.2 million to $13.7 million). Over those twenty years, the federal share of UWM research expenditures grew from 35.4 percent to 48.4 percent, a sign of the extent to which UWM's research activities were increasingly attracting extramural funding.[47]

Table 11:

Research Expenditures at the
University of Wisconsin-Milwaukee, 1985-2007
By Source of Funding
(000$)

YEAR	FEDERAL	STATE AND LOCAL	INDUSTRY	INSTITUTIONAL	TOTAL
1985	3,211	n/a	n/a	n/a	9,068
1986	3,643	n/a	n/a	n/a	10,383
1987	3,939	n/a	n/a	n/a	11,079
1988	4,662	n/a	n/a	n/a	12,424
1989	5,447	n/a	n/a	n/a	13,428
1990	6,715	n/a	n/a	n/a	15,639
1991	6,808	n/a	n/a	n/a	16,865
1992	7,641	6,341	689	2,497	18,567
1993	7,455	6,710	452	2,348	18,245
1994	7,977	6,531	363	2,771	19,180
1995	7,749	5,675	516	4,211	19,684
1996	8,026	5,751	252	4,039	19,679
1997	8,156	5,884	374	4,111	19,995
1998	8,936	4,192	554	6,039	20,807
1999	9,409	4,503	535	6,534	22,207
2000	8,425	3,358	568	6,394	20,010
2001	11,089	2,972	529	7,398	23,492
2002	11,461	3,498	297	7,894	24,933
2003	13,704	3,969	463	7,435	27,259
2004	13,670	3,653	515	8,171	28,268
2005	15,893	4,584	516	9,314	32,748
2006	15,867	4,193	785	11,217	34,033
2007	18,368	5,054	1,076	13,540	40,023

Source: National Science Foundation

Through the early 2000s, while UWM's reputation as a research university grew steadily along with the intellectual influence of its faculty in their respective fields, the university's academic *commercialization* efforts were decidedly low-key. The university operated the obligatory technology transfer office and a few faculty participated in "business-industry" partnerships, but these were not activities significantly subsidized or even emphasized as an institutional priority by campus leadership. Patenting and licensing were largely *terra incognita* at UWM; according to the U.S. Patent and Trademark Office, a grand total of eight utility patents were granted to the university between 1985 and 2005 (USPTO, 2005).

Table 12:

Sources of Research Expenditures at the
University of Wisconsin-Milwaukee, 1985-2007
By % share

YEAR	FEDERAL	STATE AND LOCAL	INDUSTRY	INSTITUTIONAL	OTHERS
1985	35.4	n/a	n/a	n/a	n/a
1992	41.1	34.2	3.7	13.4	7.6
1998	42.9	20.1	2.7	29.0	5.3
2003	50.3	14.6	1.7	27.3	6.1
2004	48.4	12.9	1.8	28.9	8.0
2007	45.9	12.6	2.7	33.8	5.0

Source: National Science Foundation

In the early 2000s, however, UWM adopted the "university as an 'engine' of economic development" strategy, and campus leadership declared its intent to become "entrepreneurial." In 2000, UWM's then-Chancellor Nancy L. Zimpher asserted, in language that will be vaguely familiar to readers of the first section of this paper: "Universities drive industry and business competitiveness in the new high-tech economy, as exemplified by Palo Alto, Boston, Austin, San Diego, and Durham/Chapel Hill" (Zimpher et al, 2000, 17). Under Zimpher, UWM took the leading role, along with a local business organization, the Metropolitan Milwaukee Association of Commerce (MMAC), in the 2001 formation of TechStar, an entity to "pump emerging technologies into the business community" by commercializing the technology developed by academic institutions in southeastern Wisconsin: to "turn ideas into companies and jobs" (Zimpher et al, 2000, 17; Gertzen, 2004). "We can be a major innovation engine to revitalize and reinvent manufacturing and lead technological advances," said Zimpher (Toosi, 2003).[48]

TechStar was explicitly envisioned as Milwaukee's version of the Wisconsin Alumni Research Foundation (WARF), the celebrated research commercialization arm of the University of Wisconsin-Madison; in addition, TechStar leaders talked of establishing a $20 million "venture" fund that would make investments in young companies (Gertzen, 2004a). At one point, Zimpher floated the idea of a TechStar university research park, possibly located in the city of Milwaukee's deindustrialized and ramshackle Menomonee Valley: a "TechStar Valley," as Zimpher called it, that would house business start-ups, research laboratories, and engineering programs (Toosi, 2003).[49] Five years and $3 million in public "seed" funding later, though, TechStar folded, unable to generate long-term financial support from private sources (Gertzen, 2004a; McCormick-Jennings, 2006).

Zimpher left UWM in 2003, for the presidency of the University of Cincinnati.[50] Her successor, Carlos E. Santiago, however, didn't miss a beat in making the transformation of UWM into an entrepreneurial university the signature policy of his new administration. Asserting to local media that he was hired to "reverse" UWM's "declining" research profile and "upgrade its role as an economic catalyst for the region" (Schmid and Twohey, 2006), Santiago announced, barely a month into his chancellorship -- and with no consultations with faculty yet underway-- that "a culture shift [at UWM] has to occur. The faculty needs to think about commercialization" (Gertzen, 2004b). "UWM's mission," Santiago would later say, "is as much about driving economic growth as it is about education" (Schmid, 2007). UWM must adopt a "culture of risk," argued Santiago (Schmid, 2007a) – an ironic formulation given the casino- or lottery-like economics of academic commercialism documented in part I of this paper. Unless UWM adopted an entrepreneurial approach, warned the Chancellor, "our survival as a major research university…will steadily and inexorably erode in the coming years" (Santiago 2005).

Curiously, Santiago's apocalyptic depiction of UWM research on a "downward trend" (Schmid, 2005a) came, as Table 11 shows, after a four-year period (2000-2004), right *before* his arrival in Milwaukee, in which the university's federally funded research expenditures had actually *jumped* by 65 percent.[51] (By way of contrast, in the first three years of Santiago's tenure as chancellor, federal research funding at UWM climbed by only 34 percent, and federal funds as a share of total research expenditure at UWM actually declined. See Tables 11 and 12).

Table 13:

UWM's Ranking in Research Expenditures
Among U.S. Universities, 1985-2007

YEAR	TOTAL R&D	FEDERAL R&D	NON-FEDERAL R&D
1985	158	181	123
1992	163	180	150
1998	180	203	161
2003	195	204	172
2004	202	214	170
2005	191	209	165
2006	190	214	166
2007	179	200	163

Source: National Science Foundation

Santiago's case for remaking UWM into a center of commercialized research consisted of the two standard –and, as we have already seen, highly dubious-- components of the entrepreneurial university playbook. His primary argument for investing in research at UWM was not about "blue sky" science or the magic of discovery; it was about local economic development. "Academic research in southeastern Wisconsin is too low," said Santiago, "and that's what's keeping our growth rate" slower than places like Madison or Chicago (Perez, 2008).[52]

Santiago relentlessly asserted that an entrepreneurial UWM, generating commercializable technology and business spinoffs, would be the prime "catalyst" to address Milwaukee's "30 years of economic decline." "UW-Milwaukee is the only institution in this region," he said, "that can take the lead as a catalyst for economic development. If we do not step up to this role, the quality of life for Wisconsin's citizens will continue to decline compared to other states" (Santiago, 2008).[53] Santiago frequently claimed – and Milwaukee's one daily newspaper endlessly repeated without analysis or scrutiny—that "no big metropolitan area has transitioned into the 21st century knowledge-driven economy without an [entrepreneurial] research university at its core" (Schmid, 2007b). The economic case for academic commercialism at UWM was summarized by Santiago's short-tenured first "research czar," who exhorted Milwaukee (and UWM) to emulate Atlanta and Georgia Tech, where, supposedly, "there is a direct correlation between the economic growth in Atlanta and research dollars attracted by Georgia Tech" (Vanden Plas, 2006; Ourmazd, 2006, 6-10).

None of these propositions was ever subjected to rigorous analysis or in-depth debate at UWM. As we have already illustrated (see Tables 2-8), there is little empirical basis for them. It is unclear precisely what Santiago means by "transitioning" to a knowledge-economy, but if we assume he means "economic well being," we have already seen that many high-performing cities and regions rank low in measures of academic R&D and commercialization (Denver, Charlotte, Jacksonville, Boise, Kansas City – see Table 6), while many cities and regions rank high in academic R&D and commercialization but low in economic performance (Baltimore, Philadelphia, New Haven, Rochester, Buffalo – see Table 5). Contrary to self-serving, simplistic, and tendentious examples such as the alleged "Atlanta-Georgia Tech" connection[54], as Table 8 showed, for the 55 large metropolitan areas examined in this paper, there is no correlation between academic R&D or measures of academic commercialism (patenting and licensing) and economic performance indicators in cities or regions. As Goldstein and Drucker and others have demonstrated, there are simply too many other variables explaining city and regional economic performance to make such a oversimplified (and unwarranted) link between entrepreneurial universities and economic development.

In fact, Santiago's statement should be turned on its head: have there been *any* economically declining big cities or regions whose fortunes have been reversed by the kind of academic commercialization Santiago wants to pursue at UWM? Pittsburgh has been cited as an example of a city that has "made the turn" due to university entrepreneurialism, but as we've seen that claim is grossly exaggerated; Pittsburgh's economic performance over the past twenty years has been no better than Milwaukee's. Perhaps the most plausible candidate for a university-generated turnaround city is Boston, But, again, as discussed earlier (see pages 40-41 and especially endnotes 31 and 32), the Boston story is much more multifaceted than the entrepreneurial university narrative suggests, involving open, not necessarily commercial, university science; the presence of not simply "research universities," two of the *best* universities in the world; a high stock of regional human capital; and massive public investments (in infrastructure and defense contracts). As was the case with Silicon Valley, few cities can hope to reproduce the unique combination of factors that underlay the post-1970 Boston renaissance.

In short, the fundamental premise underpinning UWM's entrepreneurial turn – that academic commercialism is a *sine qua non* for economic growth or revitalizing a declining city or region—is unsupported empirically. Indeed, as I argued earlier, the key, unanswered question for boosters of entrepreneurialism at UWM is: on what basis is it logical to believe that an entrepreneurial UWM can propel the economic revitalization in Milwaukee, when such distinguished research universities as Yale (New Haven), Johns Hopkins (Baltimore), Washington University (St. Louis), the University of Pennsylvania (Philadelphia), and the University of Rochester have failed to engineer economic turnarounds in their distressed home cities?

The second component in Santiago's entrepreneurial strategy was internal. In an era of stagnant or shrinking funding for public universities, he asserted that academic commercialism would be a prodigious and indispensable moneymaker for UWM. Since 1999, state appropriations as a share of the UWM budget have fallen from 36.7 percent to 24.7 percent; in real, inflation-adjusted dollars, UWM's state appropriations have shrunk by almost 10 percent over the past decade (University of Wisconsin System, 2008; University of Wisconsin System, 2000). As UWM leaders pointed out: the university is no longer state supported; rather, it has become an increasingly privatized, modestly state-subsidized institution.[55]

In this context, Chancellor Santiago insisted that "grow[ing] funded research in the sciences and engineering…has the greatest potential to *create a large, ongoing revenue stream that will benefit the university as a whole*" (Santiago, 2008)(emphasis added). The chancellor proclaimed a goal of raising UWM's research expenditures to $100 million within five to 10 years (it was $28 million when he became chancellor) (*Milwaukee Journal Sentinel*, 2005). To "keep more of the income from any licensing deals for UWM" (*Milwaukee Journal Sentinel*, 2009), Santiago withdrew from the UW System's technology transfer program (WiSys) to set up UWM's own licensing and patenting operation, the UWM Research Foundation.

There is, of course, one giant problem with this logic: as we have documented, far from being a cash cow supporting a wide range of university activities, academic commercialism is a money-*losing* enterprise for most universities. Many of the non-losers make just a little bit – hardly the lucrative stream of patenting and licensing revenues Santiago envisions filling UWM's coffers. Moreover, the 15-20 universities that year after year draw the lion's share (almost 80%) of all licensing royalties in the U.S.[56] have a depth and breadth of scientific research that Santiago acknowledges he will not have the resources to reproduce at UWM (Santiago, 2008a). As Michael Crow, George Low and others have noted, the tech transfer "winners" among universities all have the resources to sustain essentially Nobel-prize winning science.

As for Santiago's objective of reaching the $100 million level in research expenditures at UWM in "five to 10 years" (putting aside whether that metric is a meaningful indicator of the creation and dissemination of knowledge at a university, or of an institution's financial health): perhaps that will happen, but recent history is not encouraging. Over the most recent ten years for which data are available, *only two* universities in the country reached the $100 million mark starting from the level of research expenditure at UWM when Santiago arrived in 2004 ($28 million). Table 14 below shows a few other universities that got close, a much larger number that didn't get close, and a few that started at slightly higher levels than UWM and crossed the $100 million threshold.

In addition, as was the case with the few universities that cracked the "top 100" in research expenditures between 1992-2007 (see Table 10), *all but one of the institutions making rapid gains in research expenditures over the past decade housed medical schools*, which, of course, UWM does not. Moreover, as Table 14 shows, notwithstanding the success of a few "lower-tier" universities at increasing their overall levels of research expenditure between 1997-2007, few of these "gainer" institutions were generating significant amounts of licensing revenue; indeed, given what we know of the economics of tech transfer offices, only a handful of all the universities listed in Table 14 were earning even a miniscule return on investment in their commercialization activities.[57] In short, Santiago was proposing a major reorientation of UWM's mission –and, as we shall see, a substantial reallocation of university resources—in a low-odds pursuit of a winning jackpot in the academic commercialization casino. He truly was proposing a "culture of risk" -- but for community economic development benefits and university financial gains that have proven more illusory than real across the country.

Table 14

Getting to $100 Million in Academic R&D in Ten Years?

The Record from 1997-2007 of Universities Starting
Near UWM's 2004 R&D Level

University	1997 R&D Exp. (in millions $)	2007 R&D Exp. (in millions $)	2007 Licensing Revenues
Mississippi (all campuses)	$26.2	$108.2	$1,503,647
Central Florida	$18.9	$111.6	$1,226,758
Florida International	$17.4	$90.9	$6,166
Drexel	$19.3	$96.5	$325,508
Louisville	$33.4	$151.2	$87,629
North Dakota State	$35.2	$106.2	$1,223,000
Oregon	$31.5	$61.9	$5,125,837
Loyola (Chicago)	$31.0	$34.9	-
Southern Illinois-Carbondale	$30.0	$64.7	$524,584
Clark Atlanta	$28.9	$8.5	-
Howard	$27.8	$38.0	-
Georgia State	$27.1	$51.4	-
St. Louis	$26.5	$54.2	-
Lehigh	$26.4	$36.4	$156,015
Florida A&M	$25.4	$16.5	-
Michigan Tech	$24.1	$55.0	$426,716
Notre Dame	$24.1	$77.4	$84,059
William and Mary	$24.0	$49.8	$2,000
Alabama	$23.7	$70.0	$1,117,135

Sources: National Science Foundation; AUTM U.S. Licensing Activity Survey

The post-2004 "entrepreneurialization" of UWM emerged in two broad phases. First, in 2005, the university launched a "Research Growth Initiative" (RGI), designed to use internal resources to seed research that might generate extramural funds, and, most tellingly, "support the state's economic development through innovation" (UWM Graduate School, 2009). This was not an initiative primarily designed to seed blue-sky science or research across the disciplines; indeed, the chancellor was clear about the commercialization and entrepreneurial tilt of the RGI. "You'll see, hopefully, more patents, more disclosures, more start-ups" as a result of the RGI, he said in early 2006 (Schmid and Twohey, 2006).

It was not surprising, therefore, that the chancellor's priority of "economic development"-relevant research has been reflected in first four years of RGI expenditures. 86.5 percent of the funded proposals have been in the life sciences, health[58] and engineering, and other technology-related fields; 90.9 percent of the total dollars distributed in the first two rounds of the RGI ($11.6 million of the $12.7 million spent) were allocated to these fields.[59] A trivial share of the RGI has gone to the social sciences or humanities -- a token amount "to avoid an uproar on campus and accusations that UWM is driven entirely by the economics of technology spinoffs" (Schmid, 2006). But there is no question that the RGI has constituted a stealth reallocation of internal resources at UWM towards disciplines that university leadership believes will generate commercializable research, licensing revenues, and business spinoffs in the years ahead.[60] Indeed, lest anyone not grasp the focus of UWM's intended research expansion, the title of a glossy university report on its research made it clear: "Partnerships powering economic prosperity" (UWM Graduate School, 2009a).[61]

Second, beyond the RGI, the university launched a "Growth Agenda:" a plan for UWM to "power southeastern Wisconsin's knowledge-based economy." Once again, there was little in the plan about traditional university goals of "discovery," scientific breakthroughs, or problem solving; the initiative was unabashedly all about profit, to emphasize "research in emerging fields to attract federal and private research funding to create new intellectual property and work with existing businesses to spur economic development and job creation through technology transfer and new business start-ups" (University of Wisconsin-Milwaukee, 2006; 2007).

University leaders, acting as de facto venture capitalists, identified biomedical sciences, engineering, and water research, as "clusters" within which future hiring and investments would be targeted. It is unclear how these choices were made. No white paper was presented indicating why they made sense either in the context of either UWM's academic strengths or the structure of the Milwaukee economy. No process was established either for a probing and inclusive campus-wide vetting of these ideas or a debate on a range of alternatives. UWM requested $30 million in increased state funding, phased in over six years, to hire faculty and expand research in these areas; through 2009-10, the university had received only the first $10 million installment, as well as potential access to as much as $180 million in state of Wisconsin bonding authority to build facilities for these initiatives.[62]

Nevertheless, by mid-2009, UWM was well on the way to launching the two cornerstones of the chancellor's entrepreneurial "Growth Agenda": a suburban technology park, oriented around biomedical engineering; and a School of Freshwater Sciences at UWM, which would be the centerpiece of Milwaukee's emerging economic development strategy to become the "Silicon Valley of water technology."

Biomedical Sciences, Engineering, and the UWM "Innovation Park"

From the outset, Chancellor Santiago promoted a beefed up engineering research program and a Stanford-style university technology/business park as linchpins in his plan to make UWM the "engine" of economic development in Milwaukee. "The problem is [that] engineering in southeastern Wisconsin is much too small," argued Santiago; in his view, expanding science and engineering at UWM would be the key to economic revitalization of the region (Perez, 2008).

However, contrary to Santiago's assertion and local conventional wisdom (*Milwaukee Journal Sentinel*, 2009d), there is no evidence that this purported academic weakness in UWM's engineering programs had resulted in a shortage of engineers in the Milwaukee region. Through 2008, metro Milwaukee ranked a respectable 28th of the 55 large MSAs examined in this paper in the percentage of the workforce employed in science and engineering occupations (4.2 percent). Indeed, this figure is slightly above the percentage for all MSAs (4.1 percent), and is comparable to some older, historically industrial regions such as Pittsburgh (4.2 percent) and Chicago (4.1 percent) that UWM leadership often cited as successful examples of cities "transitioning" to the knowledge-based economy (National Science Foundation, 2008).

The conventional wisdom in Milwaukee corresponds to the widely promulgated belief nationally that the U.S. suffers from a shortage of scientists and engineers. However, as researchers at the Urban Institute and Duke University have reported, this is something of a myth. From 1985 to 2000 there were about 435,000 graduates annually with degrees in science and engineering from U.S. universities, but only 150,000 jobs added annually to the science and engineering workforce (Lowell and Salzman, 2007, 30). Twenty-five to 40 percent of engineering graduates don't become engineers, and 80 percent of corporations reported filling their engineering job openings within four months – hardly data reflective of a severe shortage of engineers (Wadhwa, 2007; Wadhwa, 2006; Wadhwa, 2006a). "Forget the conventional wisdom," writes Wadhwa. "U.S. schools are turning out more capable science and engineering grads than the job market can support" (Wadhwa, 2007).

Moreover, in terms of regional economic development, there is little evidence that higher concentrations of scientists and engineers in a region's workforce correlate significantly with regional economic growth. For the 55 large MSAs examined in this paper, the correlation coefficient between the proportion of scientists and engineers in the workforce and regional GDP growth is -.080, conveying the lack of relationship between the variables. Numerous regions with lower concentrations of scientists and engineers than Milwaukee –Orlando (3.5 percent), Phoenix (3.8 percent), Tampa (3.7 percent), Charlotte (3.7 percent), Des Moines (3.9 percent), Nashville (3.2 percent), and San Antonio (3.6 percent)—have posted higher rates of metro area GDP growth since 2000 than has Milwaukee. Several regions with high concentrations of scientists and engineers – such as Rochester, Hartford, and Detroit—are economic development laggards. Clearly, increasing the engineering sector of the local economy is hardly a sure-fire path to economic prosperity.[63]

In short, the scenario of UWM engineering-led economic development in Milwaukee is problematic on two levels. First, it is a "solution" for a non-existent problem: an alleged shortage of scientists and engineers vital to local economic development. Milwaukee does not lack for engineers; and, in any event, regional economic health appears uncorrelated with the proportion of scientists and engineers in the labor force. Second, as we have already examined in detail in Part I of this paper, the *inputs* of university-based commercialization in science and engineering –academic R&D, patents, and licensing—are not correlated with city or regional economic *outcomes* such as GDP growth or employment gains. So boosting the commercialization of engineering research at UWM is unlikely to have the economic impact touted by Chancellor Santiago and his supporters among Milwaukee's business elite and in the local media.

The “marquee” component of the UWM engineering expansion was the plan to develop a university research park, oriented around biomedical engineering. The tech park would be located in suburban Wauwatosa, on land that the Milwaukee County government agreed to sell to the university in May 2009. Enthusiasts dubbed this planned “engineering campus” an economic “game-changer” for Milwaukee (*Milwaukee Journal Sentinel*, 2009a), an “idea hatchery” that would churn out inventions and spinoff new businesses that would revitalize a stagnant city and region (Haynes, 2008). “People will look back someday,” said a university spokesman on the day of the land sale, “and say this was when we started the engine of economic development that we’ve been building at UWM” (Daykin, 2009). Yet, beyond the hyperbole, there were troubling questions about the plan, barely debated on campus or scrutinized in the media. Why biomedical engineering? Why a university research park? And why, in a central city starved for investment, locate these activities in suburbia, miles from the main university campus, students, and faculty?

First, on what cost-benefit calculus was it sensible for UWM to make major investments in biomedical engineering? After all, this is a field in which UWM heretofore possessed no depth or breadth of expertise, and no national ranking or reputation. Yet, like so much university science-based economic development, it is also a field in which only the very best programs have even a modest economic impact, and the financial costs of “jumping rank” are prohibitively high (Hill and Lendel, 2007) – costs that Chancellor Santiago acknowledges UWM will never have the “flagship campus-style” resources to absorb.

Moreover, in terms of regional economic development, biomedical engineering is already a relatively “mature” industry, with high entry costs and clusters across the country far more developed than Milwaukee’s. Unsurprisingly, almost all of the major biomedical engineering clusters are located in regions housing expensive, *top-ranked* biomedical engineering graduate programs. As Table 15 shows, in 2008 Milwaukee ranked only 22nd of the 39 metropolitan areas identified by the Bureau of Labor Statistics (BLS) as employing biomedical engineers. What’s more, this list does not include 11 other metropolitan areas whose employment totals for biomedical engineers were not disclosed by the BLS , to protect the confidentiality of large employers. This

Table 15

Regional Concentrations in Biomedical Engineering in the US
Biomedical engineers as % of total employment, 2008

	Metropolitan Area	# of Biomedical Engineers	% of total regional employment
1	San Francisco	1,430	0.141
2	Boston	2,140	0.125
3	College Station-Bryan TX	100	0.110
4	Philadelphia	1,840	0.067
5	Seattle	840	0.058
6	Washington, D.C.	1,200	0.042
7	Minneapolis	740	0.041
8	Madison WI	140	0.041
9	Charlottesville VA.	40	0.041
10	San Jose	380	0.041
11	Worcester MA	100	0.041
12	Salt Lake City	220	0.035
13	Durham NC	80	0.029
14	Memphis	170	0.027
15	Oakland	270	0.026
16	Gainesville FL	30	0.025
17	Rochester NY	110	0.022
18	Baltimore	260	0.020
19	Cleveland	210	0.020
20	Pittsburgh	200	0.018
21	Newark	170	0.017
22	Milwaukee	120	0.014
23	Springfield MA/CT	40	0.013
24	New York	1,070	0.013
25	Edison NJ	120	0.012
26	Denver	140	0.011
27	Dayton OH	40	0.010
28	Knoxville TN	30	0.009
29	Buffalo	40	0.007
30	Houston	190	0.007
31	Albany NY	30	0.007
32	Dallas	130	0.006
33	Atlanta	140	0.006
34	Portland	60	0.006
35	Tampa	50	0.004
36	Phoenix	60	0.003
37	Cincinnati	30	0.003
38	Los Angeles	120	0.003
39	Allentown PA	40	0.001

*Metropolitan areas reporting employment of biomedical engineers, but whose totals BLS has suppressed to preserve employer confidentiality, are: Santa Ana (CA), Fort Collins (CO), New Haven (CT), Wilmington (DE), Miami (FL), Chicago, Detroit, Indianapolis, Kansas City, San Diego, and St. Louis.

Source: Bureau of Labor Statistics, 2009.

"non-disclosure" list includes regions such as San Diego, Santa Ana (CA), Chicago, St. Louis, Detroit, and New Haven – all places (save one) boasting top 20 bioengineering/biomedical engineering programs (University of California-San Diego, Northwestern University, Washington University in St. Louis, and the University of Michigan-Ann Arbor)[64] and all regions that likely have more robust biomedical engineering sectors and research operations than does Milwaukee (Bureau of Labor Statistics, 2009).

In brief, biomedical engineering is hardly a field in which the Milwaukee region or UWM either start in an advantageous position or have obviously propitious prospects. There are numerous regions that already have a much more solid economic toehold in the sector; in addition, given the eminence of other universities in the field as well as the massive resources required to penetrate the top tier, the likelihood is small that UWM can be a significant research center in biomedical engineering. Furthermore, given the more mature biomedical engineering economic infrastructure in regions elsewhere, the probability is that whatever success UWM has in generating discoveries or inventions, the economic benefits of commercial development and job creation will "leak" to those leading regions, as Fogarty and Sinha's important analysis of Cleveland's engineering research cluster noted earlier would suggest.

How, then, given these realities, was biomedical engineering chosen as a multi-million dollar investment in "entrepreneurial" UWM's future? Certainly, no rigorous cost-benefit study was ever presented by university officials to justify the investment. Vague rhetoric about "aligning university research with the economy," and potential "partnerships" with the Medical College of Wisconsin and GE Healthcare, passed for analysis of the strategy – an approach, as we examined earlier, that is not only dubious for universities as a means of producing good science, but also increasingly problematic for UWM in 2009 and beyond as GE and other putative potential partners increasingly *disinvest* in Milwaukee.[65] It is difficult to avoid the conclusion, as has often been the case with the biotechnology sector in regions across the U.S., that no small bit of "fad chasing" and a "herd mentality" was involved in UWM's entrepreneurial focus on biomedical engineering (Hoover, 2005; Dewan, 2009).

The second key question: why invest millions in building a new university research park? One small fact seemed lost in the hyperbole about a UWM research park as a "game-changer" for the Milwaukee economy: the Milwaukee region *already has* a technology research park. Located on the very same county-owned land on which UWM proposed to develop its park, the 175-acre Milwaukee County Research Park opened in 1987 as a "university-related research park," designed to "nurture technology-based companies, strengthen Milwaukee County's business base, create new employment opportunities, and facilitate technology commercialization…by bringing together the substantial academic, intellectual, business and entrepreneurial resources of the metropolitan Milwaukee area in a physical environment conducive to such activities" (Milwaukee County Research park, 2009). What would a UWM Park add to a technology park *already on site* at the county grounds, and still, after 22 years, not at 100 percent occupancy (*The Business Journal of Milwaukee*, 2009a)? Concomitantly, there's another inconvenient fact for the "game-changer" argument: no one would seriously argue, after 22 years of operation, that the Milwaukee County Research Park has jump-started the Milwaukee economy. If, after 20 years, this tech park hasn't been decisive in "transitioning" Milwaukee into the 21st century economy (as the UWM chancellor likes to put it), why is it likely that UWM's "Innovation Park" would be the "game-changer?" Proponents of the UWM Park failed to even address these questions, let alone satisfactorily respond to them.

As we have seen, it is not surprising that Milwaukee's existing tech park has had little impact on the city or region's economic trajectory: the studies of Wallsten, Felsenstein, and others examined earlier made clear the spotty record of science and tech parks as engines of economic development. In addition, far from being "cash cows" for fiscally strapped universities, virtually all science parks operate in the red (see pp. 15), some incur serious cost overruns in construction (e.g. Innovista), and few deliver significant revenue streams from early stage investments in business startups or intellectual property licenses. Yet, UWM will spend, in its entrepreneurial aspirations, an estimated $150 million on a redundant and speculative development, oversold as the new "driver" of the modern Milwaukee economy. Perhaps this is the type of gambling the chancellor had in mind when he proclaimed a new "culture of risk" at UWM. What's more, not only is the $150 million tech park a highly risky expenditure, but it also represents a huge opportunity cost for UWM. The university has desperate needs for on-campus physical refurbishing, as well as the unique opportunity to secure a long-coveted, soon-to-be abandoned facility adjacent to the campus (Columbia Hospital), a collection of buildings ideal for retrofitting into a science research installation. Yet, campus leadership's determination to pursue the tech park essentially pushed such alternatives off the table, with little analysis or debate, and consequently constrained the university's master planning process.

In short, the tech park proposal made little academic or economic sense. But, even if it had, what was logic behind locating it in the Milwaukee suburb of Wauwatosa, 12 miles from the UWM campus, with poor public transit connections between the two sites? Ostensibly, the tech park is all about economic development; but what is the economic development logic of a major urban university *disinvesting* in a central city that has been buffeted over the past 30 years by growing joblessness, poverty, and the suburbanization of industry? Urban universities have increasingly become anchor institutions in city economies, yet UWM was preparing to invest an estimated $150 million outside the city, contributing to a further decentralization of economic activity in the region. Ironically, for an initiative deemed crucial to the economic future of Milwaukee, UWM's suburban tech park, by reinforcing patterns of sprawl, will help undermine the economics of agglomeration that economists and urban planners concur is a central ingredient of economic development.

Equally ironic: UWM is planning a suburban park at a time when even proponents of university research parks increasingly regard suburban sites as obsolete, a relic of the 1950s and 1960s when the iconic Stanford and North Carolina Research Triangle Parks were built. As Anthony Townsend, a leading national consultant on tech parks, has written: "It is increasingly clear that the post-war model of a single-purpose science park is no longer viable…Over the next decade, we will continue to witness a broad shift around the world in the design and siting of new R&D facilities, from science 'parks' to science that is embedded in the city" (Townsend and Pang, 2007, 1). Yet, in promoting an anachronistic and off-the-shelf suburban park, UWM's leaders seem oblivious to the "New Urbanism" trend that emphasizes cities as "science and engineering *innovation zones*…attracting and retaining world-class scientific and technical talent and often reinventing older industries for the global age" (Townsend and Pang, 2007, 1).

By the same token, UWM's leadership utterly failed to explain how a suburban tech park would have a salutary impact on either teaching or research at the university. There was great ambiguity concerning how many faculty would be located in Wauwatosa: accounts ranged from building a new campus for the entire College of Engineering to simply relocating a small contingent of perhaps 10 or so biomedical engineers. If a large number of engineering faculty were relocated to Wauwatosa, what would be the impact on the education of students at UWM's main campus? Concomitantly, how would isolating engineers in Wauwatosa, away from other scientists at UWM's main campus, be good for scientific research and innovation, which thrives on collaboration, informal discussion, and the easy exchange of ideas? And if only a small number of biomedical engineering faculty were to be housed in Wauwatosa, ostensibly to be near potential partners such as the Medical College of Wisconsin (MCW) or GE Healthcare, why not simply rent space nearby, perhaps at MCW or even in the Milwaukee County Research Park, rather than soaking up precious resources for a huge, risky, and potentially counterproductive investment in a UWM Research Park?

Some city officials and university faculty raised concerns about the academic and economic logic of the Wauwatosa location, but the chancellor brushed off such critics as naysayers (Daykin, 2009a; Perez, 2009). With little campus debate on alternatives and little public scrutiny of the plans, UWM was poised to break ground in mid-2010 on the "Innovation Park." In September 2009, however, a monkey wrench was thrown into these plans when wealthy Milwaukee businessman/philanthropist Michael J. Cudahy, after whom the "Innovation Park" was to be named and whose offer to finance the lion's share of land acquisition costs in Wauwatosa was a crucial component of the deal, withdrew his pledge (Daykin, 2009c). University officials cavalierly dismissed the stunning development as "a minor issue in a multimillion-dollar initiative" (Daykin, 2009c), but it remained to be seen whether the resources would be available for the misguided Wauwatosa plans to move forward.

The "Silicon Valley" of Water Technology

In 2009, UWM also launched the second key initiative in its entrepreneurial aspiration to become the driver of economic development in Milwaukee: a School of Freshwater Sciences (SFS). During the preceding two years, Milwaukee's civic leadership had coalesced behind a regional economic development strategy, led by business executives who organized something called the "Milwaukee 7 Water Council," to "brand itself as the global capital of freshwater research" (Schmid, 2007c). "Milwaukee can be the Silicon Valley, or the hub, of water technology," said U.S. Senator Russ Feingold, reflecting the emerging consensus -- and exuberance—of the region's corporate and political elite (Schmid, 2008). UWM leaders portrayed the new School of Freshwater Sciences as a "magnet or anchor tying together the water cluster" (Schmid, 2007c), while boosters trumpeted the school as the vital ingredient, "by providing research and graduate students," to "help make southeastern Wisconsin 'the Silicon Valley of water'" (*Milwaukee Journal Sentinel*, 2008).[66] Corporate Milwaukee anticipated "substantial increases in the number of faculty…who will work with local businesses" (Milwaukee 7 Water Council, 2009).

Few would dispute the academic merits of building an interdisciplinary graduate degree program in freshwater studies. The SFS promised to "advance, create, and disseminate new knowledge that would protect, restore, and sustain the health and well-being of freshwaters and the lives of people and other living beings dependent upon them" (Wisconsin Legislative Fiscal Bureau, 2009, 1). The Great Lakes, of course, are a vital, but increasingly fragile freshwater ecosystem, facing a myriad of complicated environmental and resource management issues (Annin, 2006). UWM's long-standing tradition of research excellence in Great Lakes studies and freshwater sciences, including work on "chemical pollution from PCBs, mercury, and other contaminates, new sources of pollution by pharmaceuticals and personal care products, invasive species and exotic pathogens, and sewer overflows," would be enhanced by the new school (Wisconsin Legislative Fiscal Bureau, 2009, 2). Finally, the new SFS would also be a locus of much-needed interdisciplinary public policy research and teaching on issues of water economics and resource management, sustainable development, public health, and environmental infrastructure.

However, the main selling point for the new school by UWM's leaders was its ostensible contribution to regional economic development – and this was what excited and galvanized Milwaukee's business and political elite. "We can be and we will be the water capital of the world," enthused Rocky Marcoux, commissioner of Milwaukee's Department of City Development (BizTimes Daily, 2008). The economic development case for Milwaukee as a global hub of water technology contained three premises: (1)

Water technology is a “gargantuan industry, rapidly growing in importance as we confront worldwide water issues;” (2) Milwaukee is “uniquely positioned,” to become the world’s center of water industries, already a “leader” in water technology, because of its Lake Michigan location and unparalleled “cluster of water-related companies;” and (3) A School of Freshwater Sciences at UWM would establish in Milwaukee a unique research facility, positioning the region as a hub for the development and attraction of water technology companies; in turn, the water hub would be a core driver of job creation and economic growth in the region (Meeusen and Jones, 2009). As we shall see, however, each of these premises is either exaggerated, oversimplified, misleading, or simply spurious.

At the outset, though, it is important to point out that, “strictly speaking there really is no such thing as the water industry” (Maxwell, 2009, 12).

> What there is instead is a balkanized and teeming “bazaar” of fundamentally quite different businesses –all of which have something to do with delivery of clean water, but which can’t all be quite accurately classified under any single heading. As most observers loosely use the term, the ‘water industry’ includes a very broad array of sectors: steel and concrete pipe manufacturers; specialty chemical producers; measurement; monitoring and testing firms; tank manufacturers; all kinds of treatment equipment manufacturers; new technology developers of all stripes; manufacturer’s representatives who sell all of these things to different end users; engineers and consultants; contract operators of water plants, and many others – companies which may be quite different and whose only similarity is that they are somehow involved in the process of providing clean water (Maxwell, 2009, 12).

This fragmented and diffuse nature of the water business has two crucial implications for local economic development that have been completely ignored by Milwaukee’s water boosters. First, since companies in the water business are “fundamentally quite different” and only superficially linked by involvement “in the process of providing clean water,” what is the likelihood that *any* region, let alone the Milwaukee region, will emerge as *the* hub, a proverbial “Silicon Valley” of water? What interdependencies or synergies exist between the disparate businesses in the water industry that would propel the same kind of geographic clustering that occurred in electronics, computers, and information technologies in Silicon Valley? To what extent do water industries exhibit the tendency of "increasing returns" from agglomeration that economists such as Paul Krugman argue is the cause of such clustering?

In fact, the locational dynamics of the water business may be less like computers and more like, say, the multi-sectoral health care industry. Although some cities and regions have more robust health care sectors than do others, virtually all medium- and large-sized regions in the U.S. contain a critical mass of health care institutions and enterprises -- there is certainly no "Silicon Valley of health care." Similarly, as we shall see shortly, the locational geography of the water industry in the U.S. is quite diffuse, and claims about incipient clustering in Milwaukee are more myth than reality.

Second, in light of the segmented nature of the water industry, rhetoric on the "gargantuan" global significance of water –as if that observation itself establishes the water sector as a ripe local economic development opportunity-- is misleading and, indeed, almost meaningless.[67] The key questions are: *which* segments of the water industry are growing, and does a given community possess strengths in those growth segments?

Analysts seem to agree that subsectors likely to be the fastest growing in the years ahead are in "higher-technology sectors," chiefly in water purification: filtration (including microfiltration and ultrafiltration membrane treatment and ultraviolet (UV) disinfection systems); desalination (including reverse osmosis and thermal desalination); water test equipment; and engineering/consulting services (Dray, Samuelson, Zepf, and Kejriwal, 2008, 10-11; Maxwell, 2009, 12). In a recent Goldman Sachs research report on the water sector, no Milwaukee-headquartered companies were listed among the high-tech sectoral leaders – not exactly a promising point of departure for a putative water technology hub (Dray, Samuelson, Zepf, and Kejriwal, 2009, 46-50).[68] This analysis squares with the appraisal of respected Milwaukee water engineer/consultant John Tonner, who notes that the "big trend" in global water technology "is to remove smaller and smaller materials from water," chiefly via desalination and various membrane technologies, "and Milwaukee is not in that space" (Schmid, 2008a). "We can and should have a key role in the Great Lakes," says Tonner, "but should remember that the necessary science and skills don't automatically apply to other areas of the nation, never mind the world" (Haynes, 2009).

Given these observations, on what basis do Milwaukee's water boosters claim the region is "uniquely positioned" as a global water technology hub? The case hinges on a couple of widely publicized statistics and assertions. The Milwaukee region supposedly is already home to a vibrant and growing water sector, comprising somewhere between 76 and 120 "water-related" companies (including local branches of five of the world's 11 largest water companies).[69] According to water boosters, these numbers are larger "than in any other city in the United States" (BizTimes Daily, 2008); they confirm that Milwaukee is "already a leader in water technology" (Meeusen and Jones, 2009); and they confer on the region significant "first-mover" advantages in the race to become the "Silicon Valley" of water.

All of these claims, however, are problematic. Is Milwaukee truly home to "*far more*" water-related companies than other regions (White, 2008, 7; italics added)? Is 76 or 120 companies a large roster? Nationally, to what extent are water technology companies concentrated in certain cities or regions, or dispersed throughout the country? Curiously, no one in Milwaukee has done the comparative research on the water sector in other metropolitan areas that would be necessary to confirm whether a uniquely large "cluster" of water companies is located in the region.[70] The white paper prepared for the M-7 Water Council by UWM's Sammis White, on which this contention is based, did not provide any comparative urban or regional statistics. Nonetheless, Milwaukee's water business boosters have made this bold assertion repeatedly, as if it were fact and represents prima facie evidence that Milwaukee should invest economic development resources to become the "Silicon Valley of water."

As it happens, even a cursory analysis suggests that metro Milwaukee hardly stands out as a place with uniquely high concentration of water companies -- let alone as a "hub" or a "first-mover" in the water technology business. For example:

- **Fresno, California** claims 120 water technology companies in the region (McEwen, 2007), with 5,000 employees (ICWT,2005). Since 2002, Fresno leaders have aggressively targeted water technology as the "perfect" industry for the region, "a natural outgrowth of the [San Joaquin] Valley's rich agricultural heritage" (Nax, 2004). Building on this foundation, corporate leaders there have proclaimed (just like their counterparts in Milwaukee):

"Fresno...can become the Silicon Valley of water technology" (St. John, 2007), and "the epicenter of the water technology industry, just as San Jose became the epicenter for electronics" (Steinberg, 2002). Fresno State University has launched an "International Center for Water Technology," and, along with local businesses, raised $4 million to build the Claude Laval Water and Energy Technology incubator, a testing center that can also house up to five startup water technology businesses (St. John, 2007). "After decades of missed hunches, high unemployment and low wages," enthused one Fresno observer, "we're on the verge of economic revolution" (McEwen, 2007). In short, far from being unique or a "first-mover," Milwaukee is following the post-2002 Fresno playbook, apparently almost word-for-word.

- **Toronto**, while not a U.S. city but certainly a major Great Lakes presence and regional "competitor" for Milwaukee, boasts that it is home to "over 400 companies providing water-related products and services," including global heavyweights GE Water and Processes; Pipeline Inspection Company; Pathogen Detection Systems; Siemens Water; and Veolia Water. (Toronto Region Research Alliance, 2008). Toronto universities received $11 million in water-related research grants in 2007, in fields including drinking water; wastewater and water resource management; and aquatic ecosystems and species.
- **Minneapolis** houses an impressive collection of global powerhouse water-related companies, including the headquarters of three of the world's 40 largest water companies (Pentair, 3M, and Dow Water Solutions), local operations of GE Water and Siemens, and, from a preliminary scan of the region's business directories, over 100 water-related firms. In 2008, Dow announced the third expansion of its Minneapolis (Edina) manufacturing operation in the past eight years, an $88 million investment to produce additional reverse osmosis and nanofiltration membranes –cutting-edge products in the high-growth end of the water technology business (Water Technology, 2008). As one analyst put it: "[Minnesota] is an emerging hub in a multibillion-dollar [water] business...I don't know if there is another state that has seen as much activity (Beasley Allen, 2005).

- Internationally, several locations have emerged as substantial centers of water technology. **Israel** reports 270 water technology companies operating in the country, employing 8,000 workers, proving that location near a large body of freshwater is not a necessary –let alone sufficient-- condition for building a world-class water technology industry. Israel is a world leader in desalination and filtering technologies, with annual exports over $1 billion (Wrobel, 2007). It boasts a combination of rapidly growing indigenous water technology companies, increasing multinational corporation investments in Israel, and heavy public investment in the goal of becoming, in the words of government officials, the "Silicon Valley of water technology" (HaLevi, 2007; IEDC, 2009). Ironically, an Israeli company (Miltel Communications), is a major licenser of technology to Badger Meter in Milwaukee, one of the corporate leaders of the Milwaukee water campaign – which may offer a hint regarding the relative positions of Israel and Milwaukee in the global water technology hierarchy (*The Business Journal of Milwaukee*, 2008).

  Another major international center is **Singapore**, which has declared its intention to become a "global hydro-hub," backed up by a five year, $219 million government investment "to position Singapore as an R&D base for environment and water solutions" (EDB Singapore, 2009). Singapore has attracted major investments from global firms such as Siemens, Black & Veatch, GE Water, and CH2M-Hill, nurtured scores of local companies, and aims to capture three percent of the global water technology market in the next decade (Goh, 2009), much of it in the cutting-edge areas of desalination, including ultrafiltration membrane technologies (Water and Wastes Digest, 2009).

Beyond these anecdotal cases, a few more systematic comparative indicators also suggest that local boosters have exaggerated Milwaukee's place as the "hub" or even an "emerging hub" of the U.S. water industry.

Water company headquarters. Of the 40 global water companies listed by a Goldman Sachs report as generating the highest revenues (Dray, Samuelson, Zepf, and

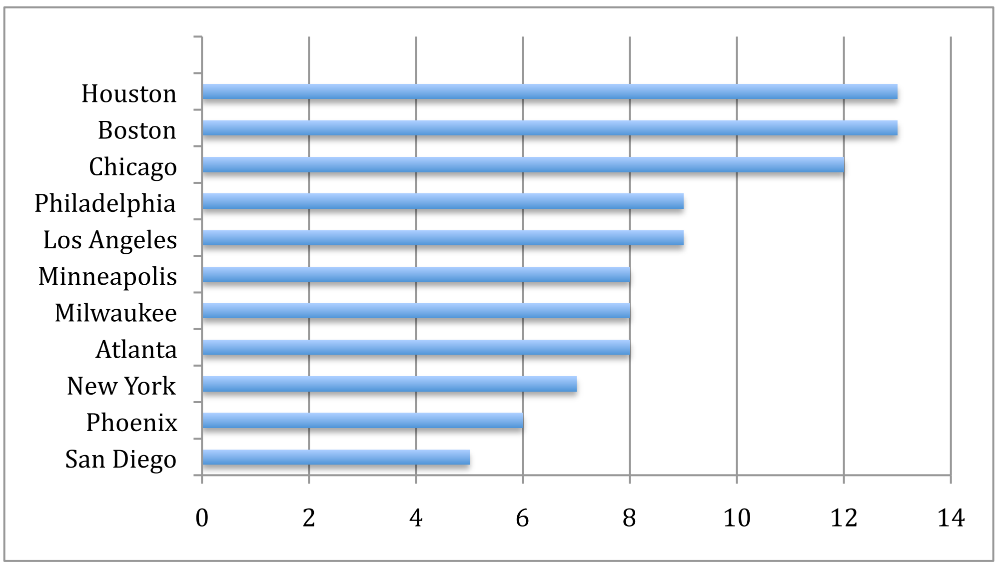
Kejriwal, 2008, 15), *none* have their U.S. headquarters in Milwaukee. Headquarters cities are at the top of the hierarchy for any industry; they are the "command and control" centers that determine investment flows, shape strategy, and foster development around them. The real Silicon Valley, of course, is headquarters to scores of top-tier electronics and computer-related companies; it is *Silicon Valley,* in part, because Apple, Intel, Google, Hewlett-Packard, etc. are headquartered there. There is no equivalent concentration of headquarters in the water industry, but the leading U.S. headquarters locations for the global "top 40" water companies are New York (4); Minneapolis (3); and Boston, Chicago, Dallas, Los Angeles, and Philadelphia, each with two. One such headquarters office is located in metro areas such as Atlanta, St. Louis, Omaha, Spokane, Houston, Kansas City, Sacramento, Sarasota, and Washington, DC.[71] But none are based in Milwaukee.

Water company plants and offices. What about the locations of *all* U.S. plants and offices –not simply headquarters-- for global "top 40" water companies? Chart 1 shows the U.S. metropolitan areas with the highest number such plants and offices. This count does not speak to the size of these operations, or to the employment or value-added generated at them. Nor does it fully reveal the highly diffuse geography of the U.S. water industry: *over 50 metro areas are home to at least one U.S. plant or office of the global water "top 40*."[72] What's more, as in the case of headquarters noted above, the vast majority of these facilities are located in the suburbs, exurbs, and small towns of metropolitan areas, generally not in the central cities. Thus, as suggested earlier, this suggests that the economics of clustering and agglomeration may not be at a premium in the fragmented water technology industry, and that no one place is likely to emerge as a "Silicon Valley" of water.

Nevertheless, Chart 1 perhaps gives us a rough idea of what U.S. regions are in the mix as leading players in the global water industry. Milwaukee is certainly in the picture, with 8 of the global top 40 having some presence in the region. But by no means do these locational dynamics signify, as one local business reporter put it with typical hyperbole, "consolidation in the water-driven industries around Milwaukee" (Schmid, 2008c), especially given the diffuse geography of water companies already noted. The Boston and Houston regions are home to offices or plants of 13 of the global "top 40," while Chicagoland houses facilities from 12 of them. Moreover, given the number of headquarters, as well as major plants and offices in places such as Minneapolis, Los Angeles, and Philadelphia, it would appear that Milwaukee is in a visible, but secondary position in the national hierarchy of water industry locations.

Chart 1
Leading U.S. Locations of Offices and Plants
"Top 40" Global Water Companies

number of plants and offices in metro area



Patents. A third possibly revealing indicator of regional hierarchies in the water industry is the geography of water technology patents. As I argued earlier in this essay in a different context, patent counts are an often-used but quite imperfect indicator of regional innovation. Nevertheless, it is at least a plausible hypothesis that metropolitan areas generating the highest number of water technology patents are the locations where the industry is most likely to flourish. Given the fragmented and diverse nature of the industry, there is no one patent class called "water technology" for which the U.S. Patent and Trademark Office (USPTO) aggregates data. However, as a rough metric, we can examine which regions in the U.S. have produced the most patents in water purification technology[73] -- a critical, high-growth sector of the industry.

Table 16

U.S. Regional Leaders in Water Technology Patents

Top 40 US Metropolitan Areas in Liquid Purification
Patents per 100,000 population, 1995-1999

	Metropolitan Area	# of "Class 210" Patents, 1995-1999*	Patents per 100,000 pop
1	New Haven	51	9.41
2	Boulder, CO	18	6.18
3	Boston	190	5.58
4	Wilmington, DE	26	4.44
5	Reno, NV	14	4.13
6	Minneapolis	116	3.91
7	Madison, WI	16	3.75
8	Ann Arbor, MI	19	3.28
9	Houston	115	2.75
10	Chicago	227	2.74
11	Pittsburgh	63	2.67
12	Philadelphia	132	2.59
13	Hartford	30	2.54
14	Denver	53	2.51
15	Nassau-Suffolk, NY	69	2.51
16	Toledo	15	2.42
17	Louisville	24	2.34
18	Orange Co, CA	63	2.21
19	Milwaukee	33	2.20
20	Salt Lake City	29	2.17
21	San Jose	36	2.14
22	Raleigh	23	1.94
23	Charlotte	29	1.93
24	Boise	8	1.85
25	Newark	36	1.77
26	Grand Rapids	19	1.74
27	San Francisco	30	1.73
28	Oklahoma City	18	1.66
29	Tucson	14	1.66
30	Buffalo	19	1.62
31	Seattle	38	1.57
32	Austin	19	1.52
33	Cleveland	34	1.51
34	Oakland, CA	36	1.50
35	Atlanta	61	1.48
36	West Palm Beach, FL	16	1.41
37	Jacksonville, FL	15	1.36
38	San Diego	37	1.31
39	Akron	9	1.30
40	Cincinnati	21	1.28

*USPTO Patent class "210" = liquid purification and separation; Source: United States Patent and Trademark Office

The leading U.S. metropolitan areas generating water purification patents are arrayed in Table 16. USPTO aggregated data on metropolitan areas are only available through 1999, so these figures are somewhat dated.[74] Be that as it may, the patent data give little support to the characterization of Milwaukee as a hub of water technology innovation. Clearly, Milwaukee ranks respectably in the middle of the 40 metro areas registering the highest rate of water purification patent production, but hardly in the vanguard.

Occupations. Labor market indicators offer a final angle to examine Milwaukee's place in the national water market. There isn't, of course, an occupational category of "water jobs" for which data is collected; and we know that water technology employment will be spread across a range of occupations (production workers, engineers, lawyers, scientists, accountants, lobbyists, etc.).

But there is one water science occupation for which data is collected: hydrologists, who study the "quantity, distribution, circulation, and physical properties of bodies of water" (Bureau of Labor Statistics, 2009a). Says one expert: "Any research or problems having to do with water, there's a hydrologist working on it" (Zimmerman, 2009). This is an imperfect indicator of the state of a region's water industry, to be sure, but it seems plausible to think that a putative water sector hub would likely exhibit particularly high concentrations of hydrologists in the workforce.

Table 17 below lists the metropolitan areas in the U.S. in which the BLS finds employment of hydrologists. Once again, although Milwaukee is certainly a prominent location, the data do not suggest a dominant, "hub-like" status for the region. In addition, the data reveal again the diffuse geography of the water sector in the U.S.: hydrologists are found in metropolitan areas throughout the nation, with no obvious physical locational advantages accruing to certain places (e.g. proximity to freshwater).

In short, the rhetoric of Milwaukee water boosters about the region's place in the water technology industry has been riddled with spurious claims. Milwaukee does not have a "far more" developed water technology sector than places around the U.S. or elsewhere in the world. Nationally, the water industry is highly dispersed: collections of water companies can be found in a large number of metropolitan areas; and, within metropolitan areas, water companies are generally sprawled to the far corners of regions

Table 17
Regional Concentrations of Hydrologists in the US
Hydrologists as % of total employment, 2008

	Metropolitan Area	# of Hydrologists	% of total regional employment
1	Carson City, NV	30	.1000
2	Albuquerque	310	.0784
3	Reno-Sparks, NV	120	.0549
4	Tucson	150	.0397
5	Fort Collins, CO	50	.0378
6	Madison, WI	120	.0355
7	Columbia, SC	100	.0287
8	Trenton, NJ	60	.0268
9	Raleigh, NC	80	.0268
10	Sacramento	220	.0246
11	Boise, ID	70	.0245
12	Boulder, CO	40	.0243
13	Anchorage, AK	40	.0243
14	Denver	210	.0167
15	Tampa	190	.0157
16	Austin	120	.0155
17	Seattle	210	.0145
18	Hartford, CT	80	.0139
19	Portland, OR	140	.0134
20	Minneapolis	210	.0118
21	Milwaukee	90	.0106
22	Washington, D.C.	230	.0099
23	Miami	230	.0099
24	Phoenix	170	.0090
25	Las Vegas	80	.0086
26	Baltimore	110	.0085
27	Salt Lake City	50	.0079
28	Oakland, CA	80	.0077
29	San Diego	100	.0075
30	Oklahoma City	40	.0070
31	Indianapolis	60	.0066
32	Boston	100	.0058
33	Pittsburgh	60	.0053
34	Columbus, OH	50	.0053
35	San Francisco	50	.0049
36	Edison, NJ	50	.0049
37	Santa Ana, CA	70	.0046
38	New York	370	.0044
39	San Antonio	30	.0036
40	Atlanta	80	.0033
41	Philadelphia	60	.0022
42	Houston	50	.0019
43	Los Angeles	60	.0014

Metropolitan areas reporting employment of hydrologists, but whose totals BLS has suppressed to preserve employer confidentiality, are: Fort Lauderdale, Port St. Lucie, FL, Dallas, Tacoma, WA, Detroit, West Palm Beach, FL, and Nassau-Suffolk, NY.

Source: Bureau of Labor Statistics, 2009.

rather than concentrated in central cities.[75] Milwaukee is certainly on the map in the economic geography of water. But, whether we look at headquarters locations, offices and plants, patents, or certain occupations, the Milwaukee region is hardly a "unique" presence in the industry, or even a "first-mover" in attempting to promote water technology as a local economic development strategy. Several regions, in the U.S. and abroad, do seem to have a leg up in growing and attracting water technology companies, but the industry doesn't appear to exhibit a clustering that remotely resembles a "Silicon Valley." And to the extent that there is a nascent Silicon Valley of water out there, Minneapolis, Toronto, Israel, or Singapore all seem like better bets at this point than does Milwaukee.

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The primordial objective for any local economic development strategy is simple: job creation. Clearly, the underlying premise of the water initiative in Milwaukee --and the economic logic underpinning entrepreneurial UWM's School of Freshwater Sciences— is that the water sector supposedly represents the region's most promising sector to create jobs. As Paul Jones, CEO of A.O. Smith and co-chair of the Water Council put it: "We've already got 20,000 people working in this area on water related things. That could be 50,000 or 100,000 in a very short period of time, just by attracting industries" (Gunn, 2009).

Let's put aside the exaggerated claim that the water industry currently employs 20,000 in Milwaukee. (A generous tabulation of total water-related employment in Milwaukee at the companies in the Water Council directory reveals that the figure is closer to perhaps 7,500).[76] Or the hyperbole that 100,000 local jobs in the sector is a realistic possibility "in a very short period." The best estimate is that around one million workers are employed nationally in the water sector, with little anticipated growth (Grigg, 2007); apparently, notwithstanding the diffuse locational dynamics of the industry, Milwaukee's water boosters think that the region can capture 10 percent of all water sector jobs in the US. By way of comparison, New York (finance hub) holds 7 percent of the nation's financial industry jobs, Charlotte (banking hub) is home to 2 percent of US banking employment, and Silicon Valley is the location of 8 percent of US jobs in computer systems design.

Milwaukee's recent employment history in the water sector, though, belies this roseate job growth rhetoric. We have been able to collect employment information, covering 2000 and 2008, for 39 of the 76 companies listed in the M-7 Water Council's directory of the region's water companies (including almost all the larger ones). In the past decade, employment reported at these companies *declined* by around 20 percent – not exactly the jobs trend one would expect in an incipient water technology hub.

This doesn't necessarily mean that water industry employment has declined by 20 percent in Milwaukee since 2000; the calculation doesn't include those companies, albeit mostly small ones with low employment, that arrived or emerged in the region after 2000. Nevertheless, the data do suggest that water-related industries have not been generating anything approaching the job growth in Milwaukee implied by the overheated "Silicon Valley" rhetoric of local boosters. Symbolic in this regard was the announcement in late 2008 by Minneapolis-based Pentair, whose presence in suburban Milwaukee had been touted as a sign of the Milwaukee region's growing status as a water technology hub, that it would be eliminating 560 Milwaukee-area jobs –over one-third of its local workforce (Schmid, 2008b; Schmid 2008c).

Employment trends in recent years at the two companies spearheading the Milwaukee water campaign – A.O. Smith and Badger Meter—hardly provide grounds for thinking that water companies will drive job growth in the Milwaukee region. A.O. Smith employs a mere 110 staff at its "world" headquarters in Milwaukee. Moreover, the headquarters of A.O. Smith *water products* are not even in the self-proclaimed Milwaukee water "hub;" they are in Ashland City, Tennessee, outside of Nashville, where approximately 1,600 are employed at the headquarters and in "the world's largest water heater manufacturing plant" (A.O. Smith Corporation, 2003).

In addition, since 1986, A.O. Smith has been an active participant in the offshoring of American industry, first moving jobs to Mexico, and then expanding their employment base south of the border. By the early 1990s, even before NAFTA, A.O. Smith was already employing "more production workers in Mexico than in their home state" (Fauber and Norman, 1991). NAFTA, of course, accelerated the offshoring of US manufacturing, and A.O. Smith currently employs about 5,500 workers in Mexico, including 4,000 in the border city of Juarez (Rovito, 2009; Bracamontes, 2009).

But A.O. Smith's growth *away* from Milwaukee in recent years has not been limited to Mexico. In 2006, with the purchase of GSW Inc., A.O. Smith acquired a 1,200-employee water heater manufacturing plant in Johnson City, Tennessee (*The Business Journal of Milwaukee*, 2006). Most extraordinarily, for a company whose CEO touts Milwaukee as a research-driven water technology hub, in 2008 A.O. Smith announced a $1.5 million investment in a "high-tech research and development facility" and engineering design center --- *in Johnson City*. "We believe that Johnson City's vision of becoming a technology center would enable us not only to attract, but retain the engineering talent that we need to be competitive in the industry," said Kevin Wheeler, an A.O. Smith executive (NETVRIDA, 2008).[77] In short, A.O. Smith has not only favored for many years low-wage locations such as Mexico and Tennessee over Milwaukee for its manufacturing facilities and water products headquarters operations, but also now is locating high-end, technology and engineering jobs *away* from Milwaukee's putative water "hub" as well.

Similarly discouraging employment trends are evident at Badger Meter, a manufacturer of meters and other devices that measure and control the flow of liquids. Richard Meeusen, the CEO of Badger Meter, is co-chair of the M-7 Water Council and, by far, the most conspicuous corporate face of the Milwaukee water "hub" campaign. Employment at Badger Meter's suburban Milwaukee headquarters rests at 500, including around 210 production workers; and total Milwaukee employment at Badger Meter has declined by around 10 percent since the mid-1990s. In the meantime, the company has expanded outside Milwaukee, beginning in the 1970s when it built a pre-NAFTA "maquiladora" plant in Nogales, Mexico, in search of cheap labor (Fauber and Norman, 1991; Fauber, 1991). In 2008, post-NAFTA Badger Meter opened a second, $8.5 million plant in Nogales; all told the company now employs about 600 in Mexico (Rovito, 2009a).

In April 2009, at the same time that CEO Meeusen was extolling almost daily in speeches and media appearances the job-creation possibilities in Milwaukee's "Silicon Valley of water," he announced that Badger Meter would be shifting an undetermined additional number of jobs from its Brown Deer production facility, located just outside the city of Milwaukee, to the new plant in Nogales (Rovito, 2009a). The attraction of cheap labor elsewhere has always been the key factor explaining Badger Meter's failure to expand in Milwaukee; but, at various points, Meeusen has also invoked "health care costs" (Lank, 2006), Milwaukee's "tax climate" (Schwartz, 2002), and, most feebly, labor force "skills" as reasons for investing in Mexico rather than Milwaukee ("It is easier to hire people [elsewhere], said Meeusen in 2006. "It has been getting harder to hire skilled people" in Wisconsin) (Lank, 2006). This was truly a novel explanation for creating jobs in Mexico rather than Milwaukee: the search of skilled labor. Nevertheless, whatever the excuse, over the past decade Badger Meter has invested more in Mexico than it has in Milwaukee.

Indeed, it is perhaps emblematic of the disconnect between the rhetoric and the reality of water sector economics in Milwaukee that both of the leading companies in the Water Council have generated more economic development *away* from Milwaukee in recent years than in the region they vaunt as a water technology hub. "Somebody's going to do it," says A.O. Smith's Paul Jones on the race to become the "Silicon Valley of water." "I think it should be Milwaukee. And I'm going to do everything I can to make sure that happens" (Gunn, 2009). As we've seen, however, Jones certainly had a peculiar way of doing "everything" possible to make Milwaukee a global hub for water technology: building an R&D center in Johnson City, TN and offshoring employment to Juarez.[78]

Stanford University sociologist Walter Powell, among others, has advanced an "anchor-tenant" theory of economic development. "Just as an anchor store will define the character of a mall," anchor-companies or anchor-institutions will "define the character of an economic community" and "set the norms" (Gawande, 2009, 42). If A.O. Smith and Badger Meter are the anchors or "bellwether" companies of the Milwaukee water "hub" (Schmid, 2009b), then surely the recent job-creation record at these companies –in particular, their consistent pattern of investment in places *other* than Milwaukee-- should be troubling to local boosters of the water technology sector as the "driver" of the future Milwaukee economy. At a minimum, advocates of public support for water tech development need to answer a basic question: if the "bellwether" water companies have not been creating jobs in Milwaukee, what is the likelihood that water companies will be a source of future employment growth? Is the structure of the industry, with its extensive reliance on the offshoring of production, such that few jobs will be created in places like Milwaukee? In a city where employment has declined 14 percent over the past fifteen years, which ranks 45th among the nation's 50 largest cities in employment "growth" over the past decade, and where black male joblessness is over 51 percent, these are crucial questions (Levine, 2009; Levine 2008). Astonishingly, they haven't even been raised, let alone answered, as Milwaukee's leaders have rushed to become water tech boosters.

The dismal job creation history of these "bellwether" companies casts considerable doubt on the wisdom of betting the city and region's economic future on water industries, especially given the reality that, by any reasonable comparative measure, Milwaukee is not a leading-edge, first-moving "hub" of water technology. Moreover, notwithstanding the stunning speed with which the water bandwagon has gained political traction in Milwaukee, the fact is that water sector employment represents about *one percent* of regional employment, and water technology patents constitute less than *two percent* of patents generated in metro Milwaukee. Only around one-third of the region's water companies are located in the city itself. This is not, by any serious economic reckoning, one of Milwaukee's "base" industries.

Despite these realities, the M-7 Water Council has proven to be an extraordinarily adroit lobbying and public relations organization. It has raised the profile of its industry, shaped the terms of local economic development discourse, and lobbied effectively to "brand" Milwaukee in ways that advance the economic interests of its corporate members. Milwaukee's political leaders, desperate to shed the image of the city as an industrial relic and lacking many ideas on how to create jobs, have enthusiastically embraced the water strategy, without any serious vetting. They are eager to create an "identity" for Milwaukee as the "Fresh Coast" or the "Silicon Valley of water," as if branding or imagineering can change the city's economic trajectory. There is, however, much reason for skepticism about whether the economic interests of this alliance of water companies is in the larger public interest of generating jobs and raising incomes in a city and region desperately in need of both.

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Squarely in the middle of this dubious local economic development strategy is "entrepreneurial" UW-Milwaukee and its School of Freshwater Sciences (SFS). In the eyes of the water boosters, UWM and its new school would play the same role in Milwaukee's "Silicon Valley of water" as they imagine Stanford did in the creation of the real Silicon Valley. "We've had preliminary conversations with water-related companies," said UWM Chancellor Santiago, "and in many respects, they're just waiting. They just want to know where we're going to plant the UWM flag and then they make decisions themselves about where they may be located. Or we can attract new companies" (WUWM, 2009). The water industry, insisted A.O. Smith's Paul Jones, is "going to go where the scientists are that can work with them" (Gunn, 2009).[79]

This, then, is the premise: that UWM's SFS will be a "one-of-a-kind" center for water technology research, making location in Milwaukee indispensable for entrepreneurs and established water companies alike, and conferring "first-mover" advantages for the region in the race to become the global hub of water technology. However, like so many of the claims surrounding the general issue of university-based entrepreneurialism as well as the specific case of the Milwaukee water initiative, this premise does not hold up to scrutiny. In particular, the uniqueness as well as the relevance of the SFS to economic development has been dramatically overstated.

Belying the notion that the UWM venture will be a "one-of-kind" entity, the map is already dotted with both university-based and corporate water technology research programs around the world. A sampling:

- As already noted, Fresno State University runs an "International Center for Water Technology," including a water technology business incubator. The ICWT is self-described as "the world's leading center for state-of-the art water technology and related applied fluid sciences" (ICWT, 2005),[80] and claims to represent "500 businesses, non-profits, public agencies, and individuals from around the world" (Regional Jobs Initiative, 2007).
- Several university-based water research programs cluster in the Toronto region: the University of Waterloo (industrial research chair in water treatment); the

University of Toronto (drinking water research group); the University of Guelph (water security, water management, and groundwater contamination research groups); and McMaster University (water resources and hydrologic modeling laboratory; water resource public policy; Great Lakes studies). (Toronto Region Research Alliance, 2009).

- UCLA's School of Engineering and Applied Science formed, in 2005, a "Water Technology Research Center" (the Wa TeR Center), to "develop technologies to turn brackish or seawater into freshwater" (UC Newsroom, 2005). In other words, UCLA's center, unlike UWM, has substantial expertise and research focus on next-generation desalination, purification, and reclamation technologies, widely recognized as the cutting-edge frontier in dealing with world water scarcity. By 2009, according to their web site, the Wa Ter Center had filed for a number of patents in key water technology areas: desalination methods, membranes, and reverse osmosis. (Wa Ter Center, 2009).

- In 2005, Purdue University (Calumet) launched the Purdue Water Institute (PWI), designed to "use water as a competitive advantage to attract and retain companies that depend on the availability of abundantly clean and secure sources of water for the success of their core businesses." The PWI works with the Purdue Technology Center "on incubation and commercialization efforts to create new start-up companies with water-related technologies," and collaborates with the U.S. Department of Energy's Argonne National Laboratory (outside Chicago) "on applied research to advance knowledge in water resources and support regional economic development" (Argonne National Laboratory, 2005).
- In addition to university efforts, numerous, well-funded corporate water technology R&D centers have been built around the world in recent years. GE Water and the National University of Singapore are investing $100 million in a Singapore Water Technology Center, "which will focus on the development of new technologies for low-energy seawater desalination, water reclamation and more efficient water reuse" (Water and Wastes Digest, 2009). In 2009, Dow Water Solutions began construction of a "Water Technology Development Center" in Tarragona, Spain (Dow, 2009). The $15 million center will employ 25

researchers, "will do product application development and component testing and is designed to accelerate Dow's commercialization of its membrane and ultrafiltration technologies" (Water Technology, 2008). Finally, IBM has established of "IBM Centre of Excellence for Water Management" in Dublin, designed to apply IBM's sensor, monitoring, and modeling technologies to key "environmental challenges such as the movement of pollutants in fresh water, marine, and oceanic environments." The Dublin center aims to foster collaborative development with small and medium-sized enterprises and create "new business for Irish technology companies" (IBM, 2008). IBM has also established a similar global research center in Amsterdam (IBM, 2008a).

These are just a few examples; there are several other prominent university water research centers in California, as well as Minnesota, Arizona, Maryland, and Washington, to name a few, and corporate water R&D operations scattered across the country. In addition, cutting-edge water technology research does not occur solely in "water centers;" commercially relevant water technologies can emerge from a wide variety of academic departments or programs. For example, at Yale University's program in environmental engineering, a doctoral student and his adviser recently devised a new desalination technique –"forward osmosis"—to produce freshwater from seawater or industrial waste water, using a small fraction of the energy of conventional desalination systems employing reverse osmosis (Yale, 2009). Patents have been filed on the technology and Yale helped start the commercialization process via a university-based startup company called Oasys Water Inc.[81]

In short, even a cursory overview reveals that if water technology companies are likely to "go where the scientists are," UWM's SFS will not be a "one-of-a-kind" attraction. Amidst all the hyperbolic rhetoric about Milwaukee becoming the "Silicon Valley of water," none of the water boosters have explained, in a world brimming with water research programs, how UWM and Milwaukee will suddenly emerge as *the* place for research-driven companies to locate. This logic is especially flawed in light of the reality that UWM is nowhere near the forefront in cutting edge areas of water technology, such as desalination research, likely to be high-growth fields in the years ahead; at best, UWM would be playing catch-up -- and with limited resources. As we have seen, millions have been invested in water technology research facilities around the world – much of it corporate, and many more dollars than have yet been committed, or are likely to be committed, by corporate Milwaukee. Moreover, when that reality is added to the diffuse locational dynamics of the water industry we observed earlier, it becomes increasingly clear that the scenario of a UWM-driven "Silicon Valley of water" in Milwaukee verges on fantasy. But it is not an innocuous fantasy; it is one that threatens to misdirect considerable public and private economic development and educational resources in Milwaukee.

That said, it should be underscored that the *academic* rationale behind the UWM School of Freshwater Sciences is unassailable. It offers an opportunity to build on the university's historic excellence in the important field of Great Lakes ecological studies and freshwater research, and do what academic programs are supposed to do: create and disseminate knowledge. *But, conceptualizing the school as the cornerstone of a flawed, business-dominated local economic development strategy risks compromising this scientific mission.* To what extent, for example, will the M-7 Water Council influence the hiring, curriculum, and research agenda of the SFS? As the Nobel prize-winning pioneers in biotechnology quoted earlier in this paper made clear, had researchers in the 1960s been constrained by close partnerships with business and followed the ideas of existing companies regarding what constituted worthwhile research in the field, the great breakthroughs in biotech might not have happened. Will the faculty in the SFS, which the M-7 Water Council explicitly states will be hired "to work with local businesses," be able to follow their noses and conduct blue-sky research – the hallmark of open science that underpins genuine scientific and technological progress? Or will self-interested corporate leaders exert undue influence?

The blurred lines between corporate interests and the university scientific mission in the water initiative were epitomized in mid-2009 by UWM's plan to locate a $25 million "signature" building for the new freshwater sciences school on prime real estate at the Milwaukee lakefront (Millard, 2009). All of the serious scientific research and teaching of the SFS would occur elsewhere, at the laboratories of the current Great Lakes WATER Institute located within the Port of Milwaukee. The proposed lakefront building would house a small number of administrative offices of the school, but mainly it was envisioned as a "showcase" headquarters for the M-7 Water Council and its member companies to “strut their stuff” to the world (Milwaukee 7 Water Council, 2009; Taylor, 2009). As the ubiquitous Rich Meeusen explained, “other cities closely tied to a specific industry all boast bricks-and-mortar structures to denote their status. Paris has the Louvre…New York has the Broadway theater district…and Nashville…the Grand Ole Opry” (Kirchen, 2009).

No one – not the chancellor, not corporate leaders, not supportive newspaper editorialists—argued that the lakefront building would primarily serve scientific functions; nor did anyone explain why it would make academic sense to divide the SFS between two sites, physically separating administrative and academic activities. The lakefront building was backed, above all, as a public relations-oriented “keystone structure,” symbolizing Milwaukee’s branding as the “global center for water technology” (Kirchen, 2009), and providing “a prominent, attractive location to impress visiting business executives” (Daykin, 2009a).[82] “It’s important,” said Chancellor Santiago, “to have a front door to the water industry” (Daykin, 2008).

What a vivid example of how academic entrepreneurialism can inappropriately elide a university’s academic mission with private business interests. Instead of locating the school’s administrative offices where the actual scientific research will occur, and rather than allocating university resources to upgrading these facilities[83] (as well as other pressing physical refurbishment needs on campus), university leaders proposed squandering precious funds from UWM’s hard-earned capital improvements budget on a “showcase” building so that the local water business lobby could “impress visiting business executives.” The UWM lakefront building looked suspiciously like a back-door effort to provide public dollars (the university’s capital budget) for private purposes (a “signature” Water Council “headquarters”), and a public cover (the SFS) for private business use of prime lakefront property that would ordinarily be prohibited by the Public Trust Doctrine governing Wisconsin waterways.[84]

Surprisingly, in September 2009 UWM abruptly reversed direction and withdrew its proposal for the lakefront building, claiming that the location had become too politically divisive, and that the university didn’t want to jeopardize the transformation of “Southeastern Wisconsin into the water technology capital of the world” over “siting issues” (Daykin, 2009d). Nevertheless, there was no indication that UWM was retreating from the flawed economic development logic that produced the lakefront plans in the first place. Although some boosters urged UWM officials to reconsider giving up on the lakefront site (*Milwaukee Journal Sentinel,* 2009e), early reports were that UWM officials and M-7 Water Council executives were "looking outside the city of Milwaukee" (Millard, 2009a), at suburban locations in St. Francis and Port Washington, to locate a building with "the high-profile image that supporters want and need to draw in visitors and companies from around the world" (*The Business Journal of Milwaukee,* 2009b). If such suburban or even exurban location plans go forward, then combined with building a technology park in suburban Wauwatosa, UWM will be a prime contributor, through its investment decisions, to amplifying the three-decade long economic decline of the city of Milwaukee. This from an entrepreneurial university touted as a "game changer" for the local economy.

Whither UWM?

The UW-Milwaukee story is a classic tale of the false promise of the entrepreneurial university. Every trope of academic commercialism has been on display in Milwaukee: university research as the "engine" of local economic development; visions of lucrative patents and licenses generating revenues to fill university coffers; the building of a technology research park; and forging partnerships with local business "clusters." Nationally, as we saw in the first part of this essay, the claimed benefits of university entrepreneurialism have been overhyped and oversold – and the potential costs to the very fabric of universities have been minimized or ignored. Yet, in Milwaukee, the case for the entrepreneurial university has been promoted with little analysis or serious debate, the presumed benefits accepted at face value.

Touting the university as the engine of a new Milwaukee economy has become UWM's calling card. But, as we've seen, the evidence from around the country illustrates the limited efficacy of entrepreneurial universities in revitalizing regional economies; and the two economic development initiatives at the center of UWM entrepreneurialism –the suburban technology park and the water hub fantasy—are deeply flawed. On the flip side, the perils of academic commercialism – the financial burdens, the cozy ties to corporate interests, the potential undermining of open science and the intellectual commons-- have been documented at all types of universities. But these dangers are especially palpable at mid-tier universities such as UWM, which lack the resource base and the depth and breadth of scientific research of a Yale, Stanford, Berkeley, Johns Hopkins, or UW-Madison, and thereby risk a major mission distortion when the "entrepreneurial sector" of the university is put on steroids.

Recall the admonition of Michael Crow quoted earlier: mid-tier universities, spouting economic development "rhetoric" and trying to be the next Stanford in the next Silicon Valley, risk becoming "job shops," "industry-driven enterprises" that in the end "won't be a university" (Washburn, 2005, 187-188). Certainly, in realigning resources internally for "economic development," pledging to hire faculty to "work with business," ticketing the lion's share (if not the entirety) of the university's augmented capital budget for construction of a suburban technology park and a local water industry headquarters, and enhancing business influence over the university in the name of "partnerships," UWM risks transformation into a glorified R&D arm of corporate Milwaukee. Perhaps that is what the chancellor meant when he spoke of "aligning" university research with the economy – thinking of the university "almost as a consultancy," in the approving words of a local editorialist (Haynes, 2008).

Ironically, the UWM plans have been presented as an upgrading of the university's stature as a research institution. But conflating "research" with a new primary mission of running an economic development "consultancy" for local businesses may, in the end, undercut the open, blue-sky, peer-reviewed research that is the true fount of scientific breakthroughs. And it does nothing to support the myriad of research areas of liberal arts universities that have nothing directly to do with business development. Yet, in many of these areas, UWM has already established national and even international research eminence that may be threatened by overall budget cuts and a reallocation of resources towards the entrepreneurial sector of the university.

One of the extraordinary features of UWM's entrepreneurial turn has been the degree to which this radical reshaping of the university has occurred without extensive internal campus debate and with minimal public scrutiny. The local Milwaukee media have been particularly vociferous and uncritical boosters of UWM's entrepreneurial agenda. In the five years since Carlos Santiago became UWM's chancellor, Milwaukee's one daily newspaper, the *Milwaukee Journal Sentinel*, has run over 200 articles and editorials touching on UWM "research" and "growth plans" -- far more than in the entire preceding *decade*. Almost without exception, these articles enthusiastically backed every aspect of the university's plans, accepted virtually all the university's claims at face value, and manifested no discernible inquisitiveness over whether the plans were likely to produce the economic impact claimed by boosters, or whether there might be unacknowledged and unacceptable costs to the university's plunge into academic commercialism.

This lack of journalistic probing was all the more surprising given the newspaper's growing reputation for "watchdog" coverage of major public institutions during this period, culminating in 2008 with a well-earned Pulitzer Prize for local reporting. Lapses of this sort, of course, are not unique to Milwaukee: as science journalist Daniel Greenberg notes, the academic commercialism "that routinely thrives on America's campuses receives overwhelmingly laudatory attention in the popular press, with little or no skeptical scrutiny or inquiry about the actual profits and losses, in dollars and academic and scientific values" (Greenberg, 2007, 64). But it has not helped the larger Milwaukee community to weigh the costs and benefits of the UWM initiatives when the region's only daily newspaper, in editorials and editorializing articles, promotes rather than vets those policies.[85]

Insufficient scrutiny and debate on the radical reshaping of a critical, multi-million dollar public institution is serious enough under normal circumstances. But it took on added significance in 2009 when UWM, like virtually all U.S. universities, faced major budgetary compressions in the wake of the recession-induced state government fiscal freefall. The university incurred across the board budget cuts, including hiring freezes in most departments, obligatory salary "concessions" by faculty and staff, and layoffs of some instructional staff. Students faced tuition hikes, larger classes, and fewer available courses. And at a university purporting to raise its research profile, UWM's administration slashed the library acquisitions budget, eliminating vital subscriptions to scholarly journals.

Yet, with cuts occurring throughout the university, UWM's "Phase I" entrepreneurial activities – including the hiring of twenty engineering faculty— continued unimpeded. And notwithstanding the fiscal crisis, the university moved ahead with plans to build a technology park in the suburbs, an initiative not only of questionable scientific logic and oversold economic impact, but one that could be a financial albatross constraining UWM's budget for years to come.

"Phase II" of the entrepreneurial plan –another $10 million for faculty hiring and new program development in engineering, public health, and freshwater sciences—did fall victim, at least in the 2009-2011 budget cycle, to the state's fiscal constraints. Nevertheless, the fiscal crisis of 2009 accelerated the restructuring of UWM and, I would argue, the skewing of the university's priorities. While most UWM departments and programs, many with national and international research reputations, were incurring serious budgetary reductions, major expenditures continued in the "entrepreneurial" activities -- all on the chimerical premise that academic commercialism in these targeted units would be a tonic for Milwaukee's troubled economy and boon to UWM's finances. Ironically, by cutting the university's core while earmarking expenditures for things like an suburban technology park, UWM's leaders not only ignored how a university truly contributes to community economic well being, but also put the very mission of a vital public institution at risk.

Conclusion: Beyond the Entrepreneurial University

I have argued in this essay that the entrepreneurial university model is both wrongheaded and shortsighted. As a strategy of urban and regional economic development, it is naïve and empirically unsupported. As an approach to university finance, it is unsound. As a way of advancing research and science, it is flawed and counterproductive. And as a concept of the place of the university in society, it is narrow and parochial. Former Harvard president Derek Bok puts it well: "There's a lot more to a liberal education than improving the economy. I think that is one of the worst mistakes that policy makers often make – not being able to see beyond that" (Cohen, 2009). In her 2007 inauguration speech, Drew Gilpin Faust, Harvard's current president, offered a soaring vision of universities as places for "where learning and knowledge are pursued 'because they define what has over the centuries made us human, not because they can enhance our global competitiveness'" (Rimer, 2007).

That said, however, there is an important role for universities, properly understood, in the economy of cities and regions. Academic commercialism is narrowly premised on what might be called the "technology push" argument: "if the university can just push more innovations out the door, those innovations will somehow magically turn into economic growth" (Florida, 1999, 72). Yet, as Florida observes, this is "a naïve, partial, and mechanistic view of the way the university contributes to economic development" (72). The university is not so much an engine of economic development as a "crucial piece of the infrastructure of the knowledge economy," generating talent and ideas (Florida and Cohen, 1999, 590). This was the profound insight of Powell's study of Boston's knowledge economy, which placed much more emphasis on open science, the intellectual commons, and a culture of collaboration and exchange, than on the value of proprietary science and university technology transfer. In this regard, as I have argued, far from propelling economic development, the entrepreneurial university may, in fact, jeopardize long-term innovation and growth. As Dasgupta and David put it:

> Policies intended to promote greater transferability of basic science findings by eradicating the open science culture in order to forge "a more perfect union" between academic and corporate researchers may indeed be successful in capturing some immediate economic rents by more intensively exploiting the extant stock of basic scientific knowledge, but risk fragmenting the networks in which tacit elements of that knowledge base resides, and so are likely to jeopardize not only the future growth of basic knowledge, but also the flow of economic benefits derivable from the existing stock of knowledge (Dasgupta and David, 1994, 516).

In a similar vein, Richard Lester criticizes the "one-size-fits-all approach to technology transfer," with its emphasis on "patenting and licensing discoveries made in university laboratories" (Lester, 2005, 30). In fact, argues Lester, "in most cases the indirect support provided by universities for local innovation processes is likely to be more important than their direct contributions to local industry problem solving" (30). And the most important of these "indirect contributions" is, of course, education.

As the work of Glaeser, Goldstein, and others have shown, the local stock of human capital –educated residents—is, by far, the best predictor of local economic development success (e.g. income or employment growth) – much more important than levels of university patents or even research funding. It logically follows, therefore, that expanding access to higher education and improving learning are the truly crucial ways in which universities contribute to local economic growth. Thus, when universities like UWM increase the tuition burden on students and slash core areas of research and teaching, while simultaneously investing in what Irwin Feller calls "niche technology areas" in the name of entrepreneurialism, they are, in fact, undercutting the university's central contribution to economic development. William G. Bowen and collaborators' important recent study calls attention to the distressingly low (less than 60 percent) graduate rates at U.S. flagship public universities (Bowen, Chingos, and McPherson, 2009); strategies to raise this rate would do much more to promote local economic growth than the standard arsenal of academic commercialism.

In Milwaukee, the UWM six-year graduation rate rests at only 48 percent, and although the majority of UWM graduates remain in the region, the urban core has experienced a significant net out-migration of college-educated residents in recent years, the vast majority moving from the central city to outlying suburbs (see Table 18). In Milwaukee and in troubled cities across the country, universities need to be part of a comprehensive strategy to generate, attract, and retain human capital in the city; generating *talent*, not patents and licenses, is how universities most effectively contribute to local economic development.

Table 18

The Migration of College-Educated Residents
in Metropolitan Milwaukee: 1995-2000

COUNTY	IN-MIGRATION	OUT-MIGRATION	NET MIGRATION
Milwaukee	25,091	38,823	-13,732
Ozaukee	5,894	3,486	+2,408
Washington	4,349	3,424	+925
Waukesha	21,498	14,077	+7,421
Metro Milwaukee (excluding intra-regional migration)	35,775	38,753	-2,978

Source: U.S. Bureau of the Census, 2000 Census, Migration Tables

Universities also contribute mightily to local economies as investors, employers, and real-estate developers, and as institutions *engaged* in community problem-solving. In recent years, urban institutions such as Penn and Yale have led the way in using university investments to bolster local economic development, through such programs as purchasing preferences for local, minority-owned businesses and joint university-city development projects in troubled neighborhoods (Rodin, 2007). Penn's "West Philadelphia Partnership" has become a model for how an *engaged* university can mobilize a wide range of resources, including research from departments across the campus, to improve neighborhood housing, schools, health care, and business formation. In cities like Milwaukee, suffering from chronic disinvestment and an outflow of capital, jobs, and population to the suburbs, the university can be a crucial anchor of central city revitalization. Investing $150 million in a university technology park in the suburbs, supposedly in the name of research-driven economic development, not only squanders the opportunity of university investment to nurture urban growth, but in fact contributes to city decline by spearheading a further outflow of capital and workers. In a very real way, this kind of entrepreneurial university, insensitive to the true nature of the economic challenges in its community, becomes part of the problem, rather than part of the solution.

Local economic development is a public policy field with a checkered history, prone to fad chasing and a "herd mentality" among decision-makers and often dominated by powerful business interests. Over the past three decades, for example, despite overwhelming evidence from academic studies that such projects yield little community economic benefit, cities and states have invested billions in convention centers and sports stadiums as "engines" of local economic development. In many ways, the entrepreneurial university is the "next new thing" in this long line of oversold economic development fixes. In Buffalo, for example, economic development officials call plans to make the SUNY-Buffalo campus more entrepreneurial "the single most important economic development project for this region" (Carlson, 2009). In Milwaukee, a bipartisan collection of metro area state legislators has declared, "One of the driving economic engines for Milwaukee will be a research-based UWM" (Schmid, 2009c). But these are the latest local economic policy sound bites and slogans, not the product of serious analysis or debate by decision-makers. As we have seen, the evidence shows that academic commercialism rarely functions as the engine of economic development; and what's worse, in recent years most state governments have been underfunding and slashing outright public support for the core activities of universities that truly matter for community well being, while funneling dollars into "niche technology areas." As a funding strategy, entrepreneurial university leaders promote academic commercialism and "growth agendas" as a way of selling the value of the university to economic development-minded governments. But this is shortsighted and counterproductive: in the long run, the strategy has not shored up university finances. Rather than offering the false economic promise of academic entrepreneurialism, university leaders need to more effectively to make the case for adequate funding based on the true importance of higher education in their communities and in a democratic society.

Entrepreneurial university leaders like to cast themselves as "change agents," shaking up hidebound, traditional universities, adding "economic development" to the mission of their institutions, and bringing universities into contact with the "real economy" of the "global" era. UWM's leadership, advocating a new "culture of risk," certainly is portrayed that way. In Buffalo, to take another example, the president of the SUNY campus is another self-styled entrepreneurial change agent, with a "bold" vision to "lift up the entire region" (Carlson, 2009). "What we are trying to do," he says, "is chafe at that status quo…The status quo is what has put this university in a long, slow, downward trajectory" (Carlson, 2009). His vision: essentially the standard entrepreneurial "public-private" emphasis on economic development, implemented chiefly through deregulation and privatization of the Buffalo campus from a state university system he derides as "a socialistic enterprise" (Carlson, 2009).

But turning universities into academic extensions of corporate R&D, or institutions engaged in a casino-like search for jackpot patents or licenses, is hardly the kind of change such institutions or their communities need. Almost a century ago, the great economist Thorstein Veblen wrote scathingly of the damage done to science and scholarship at universities by "business principles" and the criterion of "pecuniary" gain (Veblen, 1957)—the kinds of marketplace values that dominate entrepreneurial universities. "It is possible," writes Chris Armbruster, that universities can "commercially exploit a patent, conduct an initial public offering of shares, and grow very wealthy indeed. But would that organization not be better described as a firm

(Armbruster, 2008, 77)? As we have seen, the "change" embodied in academic commercialism threatens the mission of universities, and generally fails to deliver on the economic development promises of proponents. The alternative is clear: reaffirmation of the vital place of the university in a democratic society as, above all, a place for discovery, understanding, public science, blue-sky research, and social problem solving – an *engaged* university, not a patent and licensing machine.

Scientific research and the advancement of knowledge thrive on what University of Virginia microbiologist Martin A. Schwartz has felicitously called "productive stupidity." "One of the beautiful things about science," he writes "is that it allows us to bumble along, getting it wrong time after time, and feel perfectly fine as long as we learn something each time...The more comfortable we become with being stupid, the deeper we will wade into the unknown and the more likely we are to make big discoveries" (Schwartz, 2008). The values of the entrepreneurial university –"aligning" university research with the profit-maximization economic interests of regional businesses, privatizing science, and turning universities into quasi-"consultancies"-- are inimical to the "productive stupidity" that is at the heart of discovery, the thing that makes universities special places. In the end, those entrepreneurial values will damage the core mission of universities and undermine the true contribution universities make to their communities and to society.

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Endnotes

[1] Bartik and Erickcek conclude, after reviewing the literature, that the "human capital effects of eds expansion are modest in the short-run, but loom larger in the long-run. There is some question about the exact mechanism by which these human capital effects occur, that is whether they take place through encouraging entrepreneurship or by making workers more productive" (Bartik and Erickcek, 2007, 57).

[2] Bartik and Erickcek re-estimate Shapiro's analysis of the impact of college graduates in a regional economy (Shapiro, 2006), pointing out that Shapiro's estimates for 1940-1990 include a long period in which average educational achievement was much lower than today. Using 1980 as a base year, they use Shapiro's data to calculate that an increase in the local percentage of college graduates of 3.26% will increase a metro area's employment after ten years by 1.38% (Bartik and Erickcek, 2007, 33).

[3] I say "implicitly" because, as Goldstein and Renault point out, "beliefs" about the importance of university technology transfer and entrepreneurialism "tended to be based upon neither sound empirical evaluations nor theoretical arguments. Instead, they emanated from a few well-known and celebrated 'success' cases, such as Silicon Valley in California, Route 128 in Massachusetts, and the Research Triangle in North Carolina" (Goldstein and Renault, 2004, 734).

[4] The contribution of endogenous growth theory was to highlight the role of knowledge, technology, ideas, and innovation in the growth process. The theory does not specify a privileged *mechanism* of technology transfer (e.g. publication of university research vs. patents and licenses), or even an explicit role for universities as opposed to other knowledge-creation institutions – this has been an extrapolation by proponents of the entrepreneurial university.

[5] For a thoughtful critique of the "competitiveness" trope, see Bristow, 2005.

[6] The "triple helix" label is obviously an *hommage* to Crick and Watson's path-breaking and world-changing work on DNA that is the building block of biotechnology. Ironically, however, as the distinguished historian of science Steven Shapin points out, Watson "did not cross the line into identifying commercially consequential entrepreneurship as central to [the scientific] life. Indeed, when Watson was heading the Human Genome Project in the early 1990s, he exploded in anger at the idea that gene sequences might be patented, saying it was 'sheer lunacy'" (Shapin, 2008, 221-222).

[7] The classic argument on science as a "communal," public, and open enterprise is Robert Merton's: that the "scientific ethos is incompatible with the definition of technology as 'private property' in a capitalist society" (Merton, 1973, 268).

[8] On the other hand, Hall, Jaffe and Trajtenberg, (2000) argue that patent citations are correlated with the market value of knowledge and, as such, are reliable indicators of innovation.

[9] Of the total 313 MSAs in Goldstein-Drucker's analysis, 105 are "large" (over 200,00 employment); 100 are "medium" (between 75,000 and 200,000 employment); and 108 are "small" (under 75,000 employment).

[10] A possible explanation for this variation is that the benefits of patenting are likelier to "leak" out of medium-sized MSAs that lack the larger economic infrastructure to bring inventions to market. However, this hypothesis is undermined by Goldstein-Drucker's results for small MSAs (employment under 75,000), in which they find a reasonably strong positive relationship between university patents and regional wage growth (35). The incoherence of these results suggest that either Goldstein-Drucker's dependent variable (regional earnings growth) or the way in which they measured the independent variable of university entrepreneurialism (university patents in one year –1986) is flawed. In my view,

both indicators are problematic. Earnings growth is one among many plausible indicators of regional economic performance, and can be strongly distorted simply by the sectoral composition of the local economy. Taking patent counts in just one year can also be distorting; one year may be atypical. Aggregating patents through the entire period of analysis (1986-2001), or at least over some multi-year time period, would be a more reliable way of accounting for entrepreneurial activity.

[11] This employment, however, is highly skewed towards the largest research parks. According to AURP, each of the seven largest research parks employ more than 10,000, and together they constitute 54 percent of the total research jobs in North American university research parks (Battelle, 2007, 6). Put another way, there are lots of university research parks – the majority-- with very modest employment. According to AURP, the median university research park employs 750 persons.

[12] Earlier employment projections on the park were even more outlandish; during the planning phase, predictions were made of 50,000 jobs in the park and another 100,000 spinoff jobs. As Wallsten wryly puts it, we've still got a few years to go before 2020, but "it does not look promising" (Wallsten, 2004, 4).

[13] These 55 MSAs represent a sample of medium and large regions: essentially, the list comprises largest metropolitan areas in the U.S., adjusted to include geographic variety and sufficient balance of regions with and without research universities, and with varying types (top tier and lower tier) of research universities.

[14] The NSF "FY Survey of Research and Development Expenditures at Universities and Colleges" collects data on the separately budgeted R&D expenditures in science and engineering fields reported by universities and colleges. In addition to the total university R&D reported, the NSF survey provides breakdowns on the sources of R&D, including federal, state, industry, and institutional, as well as breakdowns by fields (life sciences, engineering etc.).

[15] Many state university systems, for example, report patents on a system-wide basis, precluding break out by individual universities and hence by city or region. Thus, we have patent data for 47 of the 55 metro areas.

[16] Licensing data are limited by the fact that not all universities respond to the AUTM survey. Moreover, some state universities report on a system-wide basis, precluding break out by individual universities and hence by city or region. Consequently, we are able to analyze data on 38 of the 55 metro areas for this variable

[17] The obvious exception is the rather unimpressive rate of metro area GDP growth reported in San Francisco and Boston since 2001.

[18] A few explanatory points on this table:

- As noted earlier, since some universities report patents on a system-wide basis, state university patent counts for metropolises in California, New York, Tennessee, and Nebraska are unavailable. The patent count for Chicago universities in this table is also understated, as it does not include patents generated by the University of Illinois-Chicago, which were included by the USPTO under the broader category of "University of Illinois," and not broken down by campus.
- The Detroit calculations in this table include the University of Michigan, which is located outside the Detroit PMSA but within a distance (43 miles) claimed by proponents as falling within the impact zone of an entrepreneurial university (Goldstein and Drucker, 2006, 30).
- Calculations for the Newark region include Rutgers University and Princeton University, both located close enough to Newark to fall within the supposed entrepreneurial university "impact zone."
- Allocations to specific metropolitan areas of total academic research expenditures for certain Bay Area universities (chiefly, Stanford and the University of California-Berkeley) was done as

follows: 1/3 to San Francisco; 1/3 to Oakland; and 1/3 to San Jose. All R&D expenditures of the University of California-San Francisco were allocated to the San Francisco PMSA.

- The indicator "university patents per 100,000" is calculated for the 1990-1999 period, to facilitate comparison with the "metropolitan area patents" indicator, which are only available from the USPTO on an aggregated basis for the 1990-1999 period.

[19] The time periods used for the economic performance indicators are, in part, shaped by data availability. City job data, made available by HUD through special tabulations of County Business Patterns data, are available from 1992-2004. BLS "employed resident" data, for both cities and metropolitan areas, are available on a monthly basis from 1990 to present. I have used the "annual average employment" figures for the calculations in this table. Finally, the BEA provides inflation-adjusted metro area GDP data from 2001 to their latest release, which is for 2006.

I calculated academic R&D per capita by aggregating academic research expenditures of local universities between 1985 and 2006, and dividing that total by the metro area population in 2000.

[20] This should especially be true in small to medium-sized cities and regions such as New Haven, Rochester, Buffalo, and Birmingham, where the university is a more influential local institution than in more economically diverse and complex larger regions. However, as we shall see, university entrepreneurialism has not been a "game changer" in these smaller cities and regions – other factors are more decisive in shaping the local economy.

[21] This ranking is artificially slightly high, as patent counts are unavailable for metro areas such as San Francisco, San Jose, Oakland, Los Angeles, and San Diego, among others, because of the way in which patents are registered by certain state university systems. Nevertheless, the data do suggest that Baltimore is among the metro area leaders in university patenting.

[22] Again, the licensing data is skewed by the absence of figures for individual universities in the University of California or State University of New York systems.

[23] In 2007, Lyme sold its holding in Science Park to BioMed Realty Trust, a San-Diego-based real estate investment trust.

[24] According to a recent report from the Milken Institute, only two metropolitan areas – New York and Los Angeles—reported more than 10,000 workers employed in biotechnology in 2007 (DeVol et al, 2009, 93). Nationally, biotech employment is estimated at only 200,000. According to BioAbility, a consulting firm, only 43 biotechnology companies in the United States employ more than 1,000 people (Dewan, 2009). On path dependency: Cortright's 2002 study, relying on 1990s data, identified only nine metropolitan areas as true "biotechnology centers." The same nine topped the biotechnology "location quotient" rankings compiled by the Milken Institute in 2007.

[25] Astonishingly, given the millions invested by states and cities in chasing biotechnology as an economic development holy grail, "profit levels essentially hover close to zero throughout the life of the industry. Furthermore, the picture becomes even worse if we take the largest and most profitable firm, Amgen, out of the sample. Without Amgen, the industry has sustained steady losses throughout its history" (Pisano, 2006, 114).

[26] Yale president Richard C. Levin said that the acquisition of the labs would enable Yale to attract top scientists and undertake research programs that the university would not have had the space to develop for a decade or more. "It's an exciting opportunity for Yale to accelerate its progress in the sciences and medicine," said Levin. "We want our university to be among the very best in the world in advancing scientific knowledge and we see great potential with this expanded space for contributing to humanity's struggle against disease" (Christofferson, 2007). It remains to be seen how the substantial erosion in Yale's finances after 2008, flowing from a 30 percent decline in the university's endowment, will affect these plans.

[27] In a bracing historical irony, the University of Rochester's emergence as an eminent academic institution in the 1960s was due in no small measure to a sudden infusion of wealth from the growing value of shares held by its endowment in the city's two stalwart companies: Eastman Kodak and Xerox (Fox, 2009, 161). Now, in effect, the university was being called upon to replace these companies as the driver of Rochester's economy.

[28] Data available from the "Pittsburgh Indicators project" provide another nugget on the somewhat mythical narrative of Pittsburgh's newfound economic dynamism: on average, since 2002, university-fueled Pittsburgh has registered a rate of new business formation around *half* that of regions with modest academic R&D, such as Milwaukee, Kansas City, and Denver. This is a rather inconvenient fact for boosters of the "Pittsburgh model" of academic entrepreneurialism. See: http://www.pittsburghtoday.org/web/datatable.jsp?type=graph&id=3_7_2&gr=mcya_cb_n

[29] The misapplication of the "lessons" of Stanford and Silicon Valley – or the lessons of other "success stories"— without conducting systematic analysis of the *complexities* surrounding the replicability of the cases, is an excellent example of what Nassim Nicholas Taleb calls the "narrative fallacy." "We like stories, we like to summarize, and we like to simplify, i.e. to reduce the dimension of matters…The [narrative] fallacy is associated with our vulnerability to overinterpretation and our predilection for compact stories over raw truths. It severely distorts our mental representation of the world…" (Taleb, 2007, 63). In other words, we construct a narrative about the role of Stanford as an "engine" of growth in Silicon Valley-- or MIT, Texas, or the RTP in their respective regions-- and then "impose" that often-simplistic narrative on all research universities and all regions.

[30] A study of universities across the country has found evidence that the increasing preoccupation of public universities with tech transfer has not translated in local spillovers. "There is little in the [regression] results to conclude that public university commitment to their states is definitely reflected in the geography of their research spillovers" (Hedge, 2005. 382).

[31] These "historical flows of government funding" include: 1) Massive defense contracts – Boston has consistently ranked near the top regions in the country in prime contracts received since the 1950s (Markusen et al, 1991; Leslie, 1993; Rosegrant and Lampe, 1992); by the 1980s, Boston ranked consistently in the top 3 regions in defense contracting, and averaged over $7 billion annually in prime contracts (Levine, forthcoming); 2) Major public infrastructure investments, including the $3.9 billion cleanup of Boston Harbor (a 24 year project completed in 2000), and the $15 billion "Big Dig," completed in 2007, which "provided new transit lines, moved Boston's central highway underground, replaced a 1950s-era elevated highway with an expansive green boulevard, and opened access to the city's much cleaner shoreline" (Schneider, 2009); and 3) Over $17 billion in federally funded R&D expenditures at Boston universities since 1985. Explanations of Boston's economic trajectory that focus exclusively or even primarily on academic commercialism and ignore these factors –as well as the role of open science and human capital development in Boston—are seriously deficient.

[32] Even in the case of Boston, it is unclear how much weight to place on university entrepreneurialism, as opposed to the general level of human capital development in the region and *interaction* between knowledge generation (mainly through "open science") and a "culture" of human capital. Several scholars put emphasis on the latter factors, rather than academic commercialism. See Glaeser, 2003; and Porter, Whittington, and Powell, 2006.

[33] This expectation of industry funding for entrepreneurial universities flies in the face of recent trends. In real dollars, industry support for university R&D actually declined between 2000-2006. And since 2000, the industry share of university R&D funding has dropped from 7.2 percent to 5.4 percent (although it remains higher than the 3.9 percent of 1980, the final year of the pre- Bayh-Dole era. All calculations are from data in the NSF academic research expenditures survey).

[34] Mowery's analysis of tech licensing in the University of California system –one of the leading recipients of licensing revenue in the country—is instructive. Between 1999-2003, according to Mowery, the UC system took in $75 million in *gross* licensing revenue; however, once legal and operating expenses were subtracted, as well as payments to the inventor, *net* licensing income was only $15 million. This amount represented a small fraction (less than one percent) of the annual research budget of the UC system. See Mowery, 2004, 13. As Chris Armbruster has written: "If the UC system is not making a significant profit from its IPR [Intellectual Property Rights], then it is very unlikely that universities ever will" (Armbruster, 2008, 384).

[35] The *mean* expenditures were much higher, but since there is quite a skewed distribution in both TTO expenditures and revenues, using the median figure is probably the fairest way of analyzing the costs and revenues of TTOs (so the overall analysis is not skewed by the relatively small number of blockbusters – or exceptionally high spenders).

[36] I have also calculated these licensing returns using the 2007 AUTM survey, the most recent AUTM data available. In 2007, almost 40 percent of universities responding to AUTM reported licensing revenues less than $1 million (30 percent reporting under $500,000). Thus, just taking the Thursby and Thursby 2004 calculation for median TTO expenses ($1.1 million), almost 40 percent of universities in 2007 were net TTO losers (and, of course, this understates the percentage of net losers as the 2007 median TTO expenses are likely to be somewhat higher than the 2004 figure). Another 15.6 percent of university TTOs generated between $1-2 million in 2007; some of these were net losers as well. In short, there is little indication from the more recent data that a licensing "gold rush" is sweeping university tech transfer operations.

[37] I have calculated the 2007 data from the publicly available AUTM survey. The 2000 data, also from the AUTM survey but no longer publicly available, can be found in Graff (2002).

[38] Bulut and Moschini (2009) calculate the net" yield from commercial licensing –licensing income as a percent of research expenditures—at 4.25% for private universities with a medical school; 2.80% for private universities without a medical school; 2.06% for public universities with a medical school; and a paltry 0.43% for public universities without a medical school.

[39] SUNY Albany is the one institution without a medical school that made the leap into the NSF top 100 in academic R&D during this period. However, two-thirds of the increase in Albany's research expenditures came from institutional reallocation and targeted state funding; only a small fraction resulted from an increase in federal grants secured.

[40] George Low, the entrepreneurial president of RPI in the 1980s, also recognized that only a select few universities would have the *depth* of essentially Nobel-level science necessary to do effective tech transfer. "An institution which heavily focuses on research and graduate training but does not achieve Nobel quality might become a bucket shop, being forced to do whatever anyone is prepared to pay us for, resulting in a loss of standards and quality" (Leslie, 2001, 243).

In this regard, the history of the University of California-San Diego is instructive. UCSD stands with Stanford, MIT, and the Duke-UNC-NCState combination as an entrepreneurial university success story. But, as Smilor et al. point out, the UCSD entrepreneurial success was built on a foundation of massive public investment and top-tier research excellence. "Revelle's approach [Richard Revelle, the architect of the UCSD] to creating scientific and technologic excellence was brazen. He wanted the best researchers in the world for an institution without a single student. He recruited Nobelist Harold Urey, physicists Keith Brueckner and James Arnold, and geneticist David Bonner…If the university did not have the money to hire the best professor in a particular field, the university went without that department until it could afford the best" (Smilor et al., 2007). Ultimately, UCSD created top-ten departments across the university (from political science to biomedical engineering), something wannabe entrepreneurial universities today rarely have the resources to accomplish.

[41] In a more rigorous way and with a different optic, Hill and Lendel (2007) lend support for this "top 15" argument. Their data suggest that research universities with top ranked (by NRC surveys) bio-life science and engineering doctoral programs have an impact on local economic development. But, they point out that it is difficult for universities to "jump rank," to radically improve the quality and reputation of science and engineering doctoral programs. "Jumping rank is expensive and requires consistent long-term strategic investment" (238).

[42] Crow didn't exactly follow his own insights upon becoming president of Arizona State University. Despite telling Washburn in his interview that he was concerned about the "economic development" expectations for his presidency at ASU, he immediately launched series of entrepreneurial initiatives, promising to turn ASU into "the New American University" doing "cutting-edge research and entrepreneurship to drive the new economy." (Lewin, 2009; Rosen, Aspinall, and Cheng, 2009). By 2009, however, in the midst of the national economic crisis and the popping of Phoenix's real-estate bubble, "Mr. Crow's plans have crashed into new budget realities, raising questions about how many public research universities the nation needs, and whether universities like Arizona State, in their drive to become prominent research institutions, have lost focus on their public mission to provide solid undergraduate education for state residents" (Lewin, 2009). In March 2009, Crow slashed 500 jobs, closed 48 programs, and announced widespread employee furloughs.

[43] As Deresiewicz notes, "scientific fields less amenable to the new mission of technology transfer – astronomy, paleontology—find their institutional fortunes declining, to say nothing of the humanities and social sciences" (Deresiewicz, 2009).

[44] Hollingsworth offers the apposite example of Crick and Watson's work on DNA – a breakthrough scientific discovery with little economic payoff in the short-term, but which reaped considerable dividends decades later.

[45] A powerful and revealing statement along these lines was offered by one of the scientist "informants" in Steven Shapin's detailed study of the changing "vocation" of science in the 20th century (Shapin, 2008). The informant, a distinguished computer scientist who eventually resigned from his university, offered the following observation on the dangers of commercialism: "With respect to research, I believe our attention has become confused about the relative roles of the INTELLECTUAL PURSUIT OF QUESTIONS worthy of research and the FUNDING necessary to pursue them. Most research costs something and funded research plays a pivotal role in the support of graduate students. But it is not an end unto itself. During my time here I have seen this confusion deepen and expand, to the point that activities appropriate within a university and those typical of a commercial setting are almost interchangeable. Involvement with commercial enterprise has gone from anomaly to commonplace to a badge of honor It is no wonder "conflict of interest" has become a confused, artificial charade. Worse, our research agenda is being skewed towards questions that can be connected to "thrusts" of a short-term economic consequence. University research must retain its focus on difficult, long-term research questions of foundational consequence; innovations that will make someone money will happen on their own (p.238-239, emphasis in original).

[46] Eisenberg's explanation for this trend, though, hardly constitutes a ringing endorsement of academic commercialism: "Within the academy, scientists generally ignore patents and rarely face patent enforcement. Perhaps this reflects the continuing vitality of sharing norms in academic science, or perhaps patent owners conclude that enforcement of patents against academic researchers is not worth the cost" (Eisenberg, 2008, 1098).

[47] UWM's federal share of research expenditures peaked at 50.3 percent in 2003. See Table 12.

[48] Zimpher's embrace of academic commercialism followed her signature initiative at UWM: the "Milwaukee Idea," which was wide-ranging effort to enhance the university's *engagement* with the

community, in areas such as education, public health, sustainable development, and neighborhood economic revitalization. For Zimpher's own account of the engagement initative, see Zimpher, Percy, and Brukardt, 2002.

49 An alternative "research park" proposal, favored by some state government officials, was to have a tech park/business incubator, perhaps jointly owned by UW-Milwaukee and UW-Madison, located on the western periphery of metro Milwaukee, to encourage synergy between Milwaukee industries, nascent UWM entrepreneurialism, and Madison's strengths in research commercialization. This plan went nowhere and quietly was abandoned. See Berquist and Gertzen, 2000; Trewyn, 2004.

50 In June 2009 Zimpher left Cincinnati to become chancellor of the State University of New York (SUNY) system.

51 Santiago also left a misleading impression in interviews with local media, presumably to bolster his "crisis" narrative, that not only was UWM's research spending declining prior to his arrival, but that research expenditures were "already so low that UWM is at the bottom of most national rankings" (Schmid and Twohey, 2006). In fact, in 2006, when this interview ran, UWM ranked, according to NSF tabulations of academic R&D expenditures, 190th of 640 U.S. colleges and universities and 214th of 637 institutions in the all-important federally funded research expenditures – not top-tier, but hardly the "bottom" of the rankings. Among a peer group of institutions, the so-called "Urban 13" (which actually consists of 21 universities), UWM ranked 13th of the 20 for whom research expenditures were published by NSF in 2006; and all but three of the "Urban 13" ranked ahead of UWM were institutions with medical schools.

52 Santiago presented no analysis to support this assertion. There are, of course, myriad variables other than "academic research" explaining differences in the economic fortunes of Milwaukee compared to Madison and Chicago over the past decades. State capitals, for example, have done much better economically than other cities over the past two decades; to what extent is Madison's performance mostly a manifestation of this "state capital effect?" (Levine, forthcoming). And identifying "academic research" as the central causal factor differentiating Milwaukee and Chicago's economic trends made little sense. First, as Table 2 shows, among the metro areas studied in this paper, Chicago ranked 32nd in academic R&D per capita between 1985-2006, while Milwaukee ranked 37th – hardly a major disparity. And on the key measure of regional economic performance – real GDP growth—Milwaukee has actually grown slightly more rapidly than Chicago since 2001 (although neither metro area ranks particularly high on this indicator).

53 As for Santiago's astonishing statement that the "quality of life" for the citizens of entire state of Wisconsin depended on building an entrepreneurial university in Milwaukee – needless to say, he presented no evidence or analysis to support that assertion. In fact, his argument seems contradictory on the face of it. The University of Wisconsin-Madison is acknowledged as one the country's great research universities and a powerhouse of academic commercialization, ranking near the top of all lists of academic R&D, patenting, and licensing. If UW-Madison's entrepreneurialism has been insufficient keep the "quality of life" in Wisconsin from declining, why did Santiago believe that his self-acknowledged "much more modest than UW-Madison" (Santiago, 2008a) approach to entrepreneurialism at UW-Milwaukee would be decisive?

54 The "evidence" for this connection, presented by former UWM research dean Abbas Ourmazd, was a graph charting increased R&D funding at Georgia Tech and GMP growth in Atlanta (Ourmazd, 2006, 9). Needless to say, there are countless variables beyond Georgia Tech's research funding that have influenced Atlanta's growth over the past two decades; Ourmazd's single-variable anecdotal "analysis" was simplistic and unpersuasive. In fact, Margaret Pugh O'Mara's rich historical analysis suggests a quite modest impact of Georgia Tech's entrepreneurial activities in shaping the Atlanta economy – certainly nothing akin to the presumed impacts of Stanford or MIT on their regional economies. See O'Mara, 2005, 182-224.

55 This is, of course, a national trend at public universities. "While no public college is likely to free itself entirely from fiscal ties to its state, many of the nation's largest public institutions, like Michigan, have evolved to operate nearly like private colleges. Public research universities in Colorado, Montana, New Hampshire, Oregon, and Vermont are so reliant on tuition that students are paying, on average, for more than 70 percent of the cost of their education, compared with a national average of 51 percent" (Kelderman, 2009).

56 And even these universities, as we've documented, derive a relatively trivial share of their university revenues from commercialized research activities.

57 The one exception is the University of Oregon, which reported over $5 million in gross licensing income in 2007.

58 I have included the RGI grants in psychology in this category, since most are in the areas of physiological psychology and biologically based neuroscience, and all deal with health. On UWM's organizational chart, though, the Department of Psychology is part of the division of the Social Sciences in the College of Letters and Science.

59 Data are from the UWM Graduate School web site. Figures on the dollars expended are available only for the first two rounds of RGI; but, since we know that only 6 of the 69 RGI grants in rounds three and four were outside these "science and tech" related fields, it seems certain that the dollar allocation has remained constant, at the very least, and perhaps has become even more skewed towards science and technology fields. See: http://www.graduateschool.uwm.edu/research/growth-initiative/

60 Another, somewhat indirect way to gauge the reallocation of resources at UWM in support of science and technology research: as the NSF data arrayed in Table 11 shows, 58 percent of the increase in research expenditures at UWM between 2004-2007 came from growth in "institutional" outlays and state funds ($6.7 million of the $11.8 million increase). Presumably, these increased institutional outlays reflect resources taken from other areas of the university budget and devoted to science and engineering research. It seems reasonable to assume that these state and institutional figures will rise in the 2007-2009 tabulations as the "Growth Agenda" allocations are included.

61 An interesting indicator of the intent of RGI as well as the audience of Milwaukee's business elite to whom the chancellor was trying to appeal with his restructuring of UWM: the first round of RGI awards was announced not to the higher education reporter at the local newspaper whose daily beat involved covering UWM; rather, the announcement went to the newspaper's business reporter and was covered in the *Milwaukee Journal Sentinel's* business pages. I'll have more to say about the role of the *Journal Sentinel* as an unabashed and uncritical booster of UWM entrepreneurialism later in this paper.

62 Technically the bonding authority was for $240 million; but UWM was required to raise $60 million from private sources for capital improvements, which would then be matched at a 3-1 ratio by the state government (making the state funding amount equal to $180 million).

63 For a more systematic and rigorous analysis of the relationship between concentrations of scientists and engineers and rates of urban growth, see Beckstead, Brown, and Gellatly, 2008. Their regression analysis of 242 North American metropolitan areas shows a positive relationship between scientists/engineers and urban growth, but chiefly through "interaction effects" between scientists and engineers and other forms of human capital. In other words, confirming Glaeser's analysis noted earlier, the key factor explaining urban growth is a large stock of human capital, not the specific presence of any one occupational group, such as scientists and engineers.

[64] The most recent (and now outdated) National Research Council program rankings are from 1995. For what they are worth, the 2008 U.S. News rankings place all of these institutions in the top 20 biomedical engineering programs. The one exception is Yale University, which notes: "We are a young department – founded in 2003—but we build on decades of research and education in medicine and engineering at one of our nation's oldest and most distinguished universities." See http://www.seas.yale.edu/departments-biomedical.php

[65] As the pioneer scientists in biotechnology quoted earlier made clear, "aligning" a university program with the interests of specific companies might, in fact, have the perverse impact of *inhibiting* innovation and long-term breakthroughs in the field. "Breakthrough" science, as Hollingsworth, Berg and others noted, thrives when short-term, profit-seeking interests are *not* in the equation. Yet, UWM's explicit plan was "to hire faculty to work collaboratively with area biomedical and healthcare corporations," an approach that sounded dangerously like the "bucket shop" model (as opposed to basic science-driven model) warned against by leaders such as RPI's George Low that I discussed earlier. Moreover, the economic rationale of "aligning" UWM research with a company such as GE Healthcare, questionable enough in terms of the impact on university science, has become especially dubious, as "GE is in the throes of the steepest decline in its medical businesses since it began making X-ray tubes in Milwaukee in 1947." By 2009, GE was making deep cuts in its Milwaukee-area employment, and, once based in suburban Waukesha, had already moved in 2004 its corporate headquarters to London (Schmid, 2009). All things considered, GE seemed hardly a promising corporate partner on which to bet the future of the university.

[66] Sometimes the exuberance of the water boosters went even further. Recently, Richard Meeusen, the CEO of Badger Meter and co-chair of the M-7 water council gushed: "Actually, Milwaukee has *always* been the Silicon Valley of water technology. The problem is that we've forgotten it" (Gunn, 2009). Emphasis added.

[67] Perhaps the most amusing variant of this argument in Milwaukee is the uncredited repetition in the media and by local boosters –as if it is a profound intellectual discovery—of a line from the James Bond movie *Quantum of Solace*, that water will be the world's most precious resource in the 21st century, that "water is the new oil." (This insight is then usually coupled with the equally profound observation that Milwaukee is located on Lake Michigan, as if this geography will accord Milwaukee in the 21st century the same resource advantage that sitting on the world's largest oil reserves bestowed upon Saudi Arabia in the 20th century). For an (unintentionally) risible version of this sloganeering and boosterism by the city of Milwaukee's commissioner of city development, see Rocky Marcoux, "Milwaukee's Fresh Coast Advantage" (accessed at: http://www.getsim.com/about-sim.cfm?id=63).

[68] GE and Pentair, headquartered elsewhere but with a significant presence in suburban Milwaukee, were listed in the Goldman Sachs report as leading companies in the filtration subsector. However, as we examine below, Minneapolis-based Pentair's commitment to Milwaukee appeared to flag significantly in the 2009 recession, and GE's major investment in a "water hub" in 2009 was not in Milwaukee, but in Singapore.

[69] The identification of "120 water-related companies" was from a paper prepared for the M-7 Water Council by Sammis White of UWM (White, 2008). However, in the Water Council's 2009 directory of active companies, only 76 were listed (Milwaukee 7 Water Council, 2009a).

[70] It is "Economic Development 101" to conduct a scan of the competitive environment before targeting any industry in a local strategy, to see how the "home" city or region stacks up against other places. That this was not done in the case of the Milwaukee water initiative speaks volumes about the degree to which rhetoric, business interests, and politics, as opposed to research and analysis, drive the strategy.

[71] I use the term "headquarters city" here, but, in fact, most these companies' U.S. headquarters are located in suburbs, exurbs, and small towns of metropolitan areas –in places like Warrendale, PA

(Pittsburgh), Naperville, IL (Chicago), Edina, MN (Minneapolis), Trevose, PA (Philadelphia), or Chesterfield, MO (St. Louis). This is a typical tendency for water technology companies, not only in headquarters locations but also in the location of all offices and plants. The locational dynamics of water technology companies do not favor big cities.

72 Even this observation understates the geographic dispersion of water technology companies in the U.S., as it includes only big firms. If we drill down to the small company, highly entrepreneurial level, we're likely to find water companies scattered even more widely across the country. For anecdotal evidence of this, see Bluestein, 2008.

73 Technically, U.S. Patent and Trademark Office patent class 210 – liquid purification and separation.

74 These metro area data, however, track closely the place of Wisconsin in state-level USPTO data, which are available through 2008. Thus, there is every reason to believe that Milwaukee's place in these metro area rankings has not improved significantly in the past decade.

75 This is true in Milwaukee as well; two-thirds of the "water-related" companies listed in the M-7 Water Council directory are located outside the central city, as is over 70 percent of water industry employment in metro Milwaukee.

76 It is unclear precisely how Jones and others arrive at the oft-quoted and exaggerated figure of 20,000 total employment, but it appears that they include all employment at Rockwell Automation (which, according to Goldman Sachs' analysis derives about 4% of its revenues from water-related activities), employment at the Kohler Company (mainly a plumbing fixtures producer, located *outside* metropolitan Milwaukee, in Kohler/Sheboygan, WI), and perhaps, by mistake, some of the non-Milwaukee employment of companies such as Siemens, GE, Pentair and Veolia that have Milwaukee operations.

77 Presumably, A.O. Smith did not invest in the engineering facility in Johnson City because that's where the "talent" is, in comparison to, say, Milwaukee. According to the U.S. Census Bureau, a mere 16.6% of Johnson City adults possess college degrees, compared to 28% in metro Milwaukee.

78 The gap between rhetoric and reality was equally striking with Rich Meeusen at Badger Meter. On the same day that an article appeared in the local business newspaper about Badger Meter's plans for send more jobs from Milwaukee to Mexico, an interview with Meeusen was aired on local television in which he said: "My dream is that some day, some kid is going to be at the kitchen table and say, 'I'm thinking about starting a water technology company,' and his grandmother is going to reach across the table with her cane and smack him along the head, and say, 'Get to Milwaukee. That's where you belong'" (WISN.com, 2009).

79 This comment betrays a stunning lack of self-awareness, coming from the CEO of a company that had just built an R&D facility in Johnson City, Tennessee, and employs the vast majority of its workforce far away from Milwaukee.

80 Apparently, not only is water technology research not unique to Milwaukee, but neither are branding campaigns and exaggeration.

81 However, further confirming the geographic "leakage" of technological innovation we discussed earlier, and the consequently limited impact of university-generated commercial development on local economic development, Oasys has left New Haven and is now located in Cambridge, Mass. The interests of science and perhaps world water policy certainly benefit from Yale's research here; it remains unclear, however, how much economic benefit the city of New Haven will ultimately have derived.

[82] Meeusen further argued against building the SFS building at the site of UWM's existing university water science facility on Greenfield Avenue, in an industrial area near the Port of Milwaukee. "Milwaukee's going to be a center for water technology and we're going to build our keystone structure down by the coal piles on Greenfield Avenue? Makes no sense to me. It has to be right there in the heart of the city" (Kirchen, 2009). This from the co-chair of a Water Council whose directory reveals that over two-thirds of Milwaukee-area water companies are located *outside* the city entirely, and very few "in the heart of the city." And Meeusen himself is CEO of a company whose headquarters are located not in the city, but in a Milwaukee suburb, employs the majority of its workforce in not in Milwaukee but in Mexico, and, as we've seen, is planning to shift more Milwaukee jobs to Mexico in the near future.

[83] The university's hope was that federal dollars might be available from the American Recovery and Reinvestment Act (the "stimulus package") to pay for refurbishing and expansion of the Greenfield Avenue research facilities.

[84] In a February 2009 letter, Wisconsin's Department of Natural Resources (DNR) expressed such reservations about the Water Council's presence on the proposed lakefront site: "In general, office suites for private, non-governmental or governmental organizations (including DNR) are not public trust uses, and are not appropriate to be located on public lakebed" (Kaiser, 2009).

[85] In some ways, the newspaper actually went beyond the university's own hyperbole, describing the entrepreneurial strategy as a "game-changer," "economic driver," "economic piston," "hothouse of patents and innovation," and an "idea hatchery." And sometimes the boosterism went beyond simple hyperbole. For example, a *Journal Sentinel* headline in April 2009 declared: "U.N. names Milwaukee a water technology hub" (Schmid, 2009a). In fact, the U.N. did nothing of the sort: it approved an *application* by Milwaukee to become a participant in the U.N.'s "Global Compact City" program, and Milwaukee's proposal centered on a series of water quality projects. The U.N. designation had nothing to do with whether, compared to other cities or other university programs, Milwaukee had been independently evaluated and designated a global water "hub." Other cities in the U.N. program pledged to work on projects such as climate change, sustainable tourism, health care delivery, and traffic safety. Jinan, China, for example, is working on traffic safety; by the *Journal Sentinel's* logic, Jinan must be the U.N. designated traffic "hub." Participating cities, by the way, pay an "engagement" fee for this U.N. designation.

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