Political Economy of the Palm Beach County Biotechnology Research Park

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Among the most rapidly growing and technologically dynamic industries in the U.S. today, biotechnology has captured the imagination of entrepreneurial politicians and investors alike. With a reputation for generating high-wage jobs and highly profitable outputs, particularly pharmaceuticals, this sector has become central to the competitive designs of many states, counties, and cities throughout the United States, and indeed, much of the economically developed world. While there is a rich and insightful literature in geography on "high technology" industries, particularly in light of theories of post-Fordism and flexible production, geographical treatments of biotechnology are sparse (cf. Delaney 1993). As biotechnology has grown economically and diversified geographically, this issue has acquired new significance, particularly in light of the attempts of many Southern states to diversify their economies.

This paper focuses on the economic and spatial dynamics of this industry, using the proposed Palm Beach County Biotechnology Research Park in Florida as a case study. It opens with an overview of locational clustering and regional competitiveness, including the importance of tacit knowledge in the formation of agglomerative complexes. Second, it turns to the geography of the U.S. biotechnology industry, focusing on its critically important relations with the venture capital industry and public policy. Third, the paper examines the biotechnology sector in Florida, emphasizing the catalytic role of universities. Fourth, it delves into the specifics of the proposed biotechnology park in Palm Beach county, site of heated political controversy. The conclusion appraises the competitive viability of new complexes of biotechnology in the face of heated competition from older, existing ones, a theme used to demonstrate the contingency inherent within economic landscapes.

Locational Clustering and Regional Competitiveness

A long tradition in economic geography, stretching as far back as Alfred Marshall in the 1890s (Harrison 1992), has recognized the tendency of many types of industries to form dense clusters of inter-related activities. An interdisciplinary body of research concludes that dynamic, internationally competitive industries tend to concentrate geographically in distinct agglomerations or clusters of firms (Antonelli 2000; Porter 1990, 2000). Clusters arise from the numerous inter-connections of people, goods, services, and information that suture individual entrepreneurs, firms, their supplier networks, ancillary services, as well as government agencies and offices, public/private partnerships, trade associations, universities, legal services and patent attorneys, accounting firms, specialized advertising firms, and related ancillary services.

Multiple factors contribute to the generation of regional clusters, but arguably the most important is access to skilled pools of labor, including in particular technical and engineering talent. Highly competitive industries tend to be knowledge-intensive, embodying large quantities of human capital in the production process. Thus, most industrial clusters include well known universities, which play important roles as partners in development initiatives, including the expansion of human capital, technology transfer, and outreach programs. Traditional product-cycle models hold that innovative firms tend to cluster in metropolitan areas, where firms rely extensively upon urban agglomeration economies (Audretsch and Feldman 1996b). Agglomeration economies refer to the lowering of costs that occurs when firms are concentrated together, and take the forms of a shared infrastructure, low transport costs for backward and forward linkages, a common pool of labor, and specialized circuits of information. By clustering and entering into networks of reciprocal relations, firms lower costs and raise productivity.

The process of innovation generally occurs within so-called "knowledge regions" in which innovation is a continuous and sustained phenomenon (Howells 2000; Maskell 2001). Proximity of firms that are both rivalrous and cooperative is essential to the generation of an entrepreneurial and creative dynamic. The process of

discovery and innovation is closely related to collaborative relationships, networking, and tight spatial linkages among firms and individuals (Antonelli 2000; Freel 2003). The formation of knowledge spillovers relies on frequent, repeated, and sustained interactions among individuals and firms in a given local milieu (Grossman and Helpman 1991). An important outcome of this process is the creation of synergies, i.e., interactions that generate benefits that would not be possible if actors operate in isolation of one another. The synergistic benefits of agglomeration are often labeled "positive external economies of scale" in that they lower production costs in ways that would not be possible if firms and workers were geographically dispersed (Stigler 1952). In short, in order for individuals and industries to generate positive externalities and synergistic interactions, they must be grouped in close proximity to one another.

Formal and informal linkages among individuals are key to the creation and sustenance of knowledge spillovers (Saxenian 1996). A critical part of this process is the creation of trust among actors through repeated personal ties, often in informal settings (Gertler 1995). In order for personnel in competitive, dynamic, knowledge-intensive sectors to be productive and creative, they must be engaged in frequent, collegial interaction with one another and develop interpersonal bonds. This requirement arises in large part from the sheer complexity of the production process in high technology sectors, in which large, difficult problems are addressed by teams of people working together. Many observers link such "untraded dependencies" to the local cultural context: drawing upon Granovetter's (1985, 1991) notion of embeddedness, this line of thought emphasizes cultural factors as being equally important to putatively "economic" factors in the formation of economic regions (Storper 1997).

Two types of knowledge play an important role in economic activity, particularly innovation (Polanyi 1967; Howells 2000). Explicit knowledge refers to written, standardized forms of information that are easily transmitted from one person to another, including quantitative data, publicly known rules and standards, and orderly records. Tacit knowledge, on the other hand, includes information

that is generally unwritten, unstandardized, changes rapidly, is heavily context-dependent, and subject to informal rules of organization that make it difficult to transmit from one situation to another, and is critical for innovation to take place. The production and exchange of tacit knowledge frequently occurs through dense interpersonal networks with a narrow spatial range in which face-to-face contact is critical; often such contacts are formed through personal ties such as friendships, i.e., interactions "off the job" as well as on the job.

Locational Dynamics of the U.S. Biotechnology Industry

Biotechnology may be defined as the application of molecular and cellular processes to solve problems, develop products and services, or modify living organisms to carry desired traits. Arising in the 1970s, particularly after the discovery in 1973 of recombinant DNA, biotechnology has been a rapidly growing industry worldwide, with extensive linkages to agriculture, health care, energy, and environmental sciences. In 2003, the U.S. biotech industry consisted of 1,473 firms that employed 406,000 people, generated $64 billion in output, and spent $17.9 billion in research and development. There is a wide range in the size of firms in this industry, including single proprietorships and firms of more than 500 employees; the average firm has 275 employees; the mean national annual salary in the industry is $62,500, which makes it pay well above average. Pharmaceutical firms, which tend to be much larger than biotechnology companies, form the major market for biotechnology products. Other applications are found in agriculture, industry, and veterinary medicine.

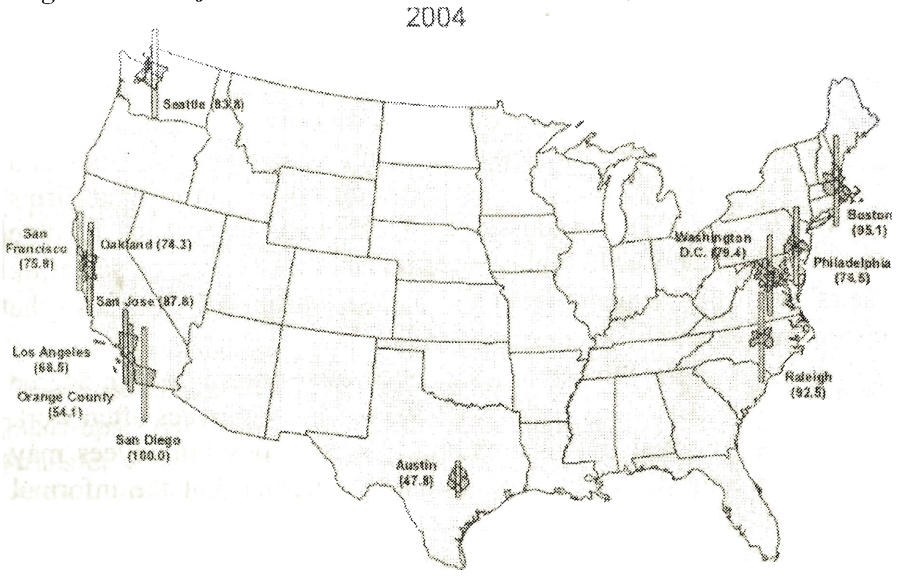
Venture capital is critical to making basic research in biotechnology commercially viable. Most small biotech firms lose money, given the high costs and enormous amounts of research necessary to generate their output and the long lag between R&D and commercial deployment. Only 1 in 1,000 patented biotechnology innovations leads to a successful commercial product, and it may take 15 years and as much as $800 million to reach that point (Somers 2004). The vast majority of start-ups go bankrupt within a few years as venture capital runs out, indicating the need for a constant supply of new business ventures to keep the cluster vibrant. In 2003, the biotech

industry attracted $3.33 billion in venture capital, which comprised 20% of all venture capital in the nation; the bulk of these funds both originated in and went to established firms in California and Boston. Venture capitalists may invest in many biotech firms, and one biotech firm may receive funding from several venture capitalists. Venture capitalists look for an experienced management team when deciding in which companies they are willing to invest. Venture capitalists provide advice and professional contacts, and serve on the boards of directors of young biotech firms (Jaffe et al. 1993; Zucker et al. 1998). As a biotech firm survives and prospers, venture capitalists gradually withdraw from day-to-day direct management. Many investors sell their stocks when the firm offers its Initial Public Offering.

There has been extensive public involvement in establishing biotechnology complexes since the industry began. The survival and success of biotechnology firms is heavily affected by federal research funds, primarily through institutions such as the National Science Foundation and National Institute of Health as well as the Small Business Technology Transfer, Small Business Innovation Research, Environmental Protection Agency, and the Food and Drug Administration. Federal policies regarding patents and intellectual property rights, subsidies for medical research, and national health care programs are all important. State level determinants are also critical, including regulatory policies, educational systems, taxation, and subsidies.

Biotechnology firms commonly tend to cluster in distinct districts, and place-based characteristics are essential for the industry's success in innovation (Bagchi-Sen and Scully 2004). Europe, for example, hosts the BioValley Network situated between France, Germany, and Switzerland (Claassens 2004). In Britain, Cambridge has assumed this role (Smith 2004). Similarly, Denmark and Sweden formed Medicon Valley (Coenen et al. 2004). Geographically, the U.S. biotechnology industry is dominated by a small handful of cities, particularly Boston, San Diego, Los Angeles, San Francisco, New York, Philadelphia, Seattle, Raleigh-Durham, and Washington, DC, which together account for ¾ of the nation's biotech firms and

Figure 1: Major U.S. Clusters of Biotechnology, 2004.



Source: DeVol et al. 2004.

employment (Figure 1). These cities have excellent universities with medical schools, state-of-the-art infrastructures (particularly fiber optics, airports), and offer an array of social and recreational environments.

Biotechnology firms agglomerate for several reasons. In a highly competitive environment in which the key to success is the rate of new product formation, and in which patent protections lead to a "winner take all" scenario, the success of biotechnology firms is closely related to their strategic alliances with universities and pharmaceutical firms (Delaney 1993; Deeds and Hill 1996). Although many biotechnology firms engage in long-distance partnering, these tend to be complementary, not substitutes for, co-location in clusters where tacit knowledge is produced and circulated face-to-face, both on and off the job (Mytelka 2004). Because pools of specialized skills and a scientifically talented workforce are essential to the long process of research and development in biotechnology, an essential element defining the locational needs of biotech firms is the location

of research universities and institutions and the associated supply of research scientists (Zucker et al. 1998). Most founders of biotech companies are research scientists with university positions. Because knowledge is generated and shared most efficiently within close loops of contact, the creation of localized pools of technical knowledge is highly dependent upon the detailed divisions of labor and constant interactions of colleagues in different and related firms (DeVol et al. 2004). Successful biotechnology firms often revolve around the presence of highly accomplished academic or scientific "stars" with the requisite technical and scientific skills but also the vision and personality to market it.

Work in the biotech industry is characterized by a high degree of uncertainty (Eaton and Bailyn 1999), and its employees often work long hours. Formal linkages among biotechnology employees may occur over long distances, e.g., using the Internet, but the informal ones essential to the creation of synergistic economies of scale necessitate geographic proximity (Audretsch and Stephan 1996). Thus, issues of employment in biotechnology cannot be considered separately from those of housing and lifestyle. For a well-educated labor pool in a rapidly growing industry with considerable locational mobility, quality-of-life issues cannot be divorced from those pertaining to work and productivity.

Florida's Biotechnology Sector

In 2004, Florida was host to roughly 33,000 companies in the broad domains of biotechnology, medical devices, pharmaceuticals, and health care, which together employ more than 600,000 people. Within the specific sector of biotechnology, however (i.e., excluding health care and medical device companies), Florida is relatively small compared to other states. The state hosted 53 biotechnology firms in 2004 (although other biotech workers may be in hospitals or universities).

Florida has targeted biotechnology as a priority growth sector in several ways. Enterprise Florida, the state's public and private partnership for economic development, lists life sciences as one of five "strategic technology sectors." The state established a $150 mil-

lion biomedical research trust fund, which includes $30 million for a Technology Development Fund that created two centers of excellence in three universities; two of these are biotechnology-related, including the Center of Excellence in Regenerative Health Biotechnology at the University of Florida in Gainesville, established to facilitate technology transfer in biotechnology, and the Center of Excellence in Biomedical and Marine Biotechnology at FAU at Boca Raton, designed to facilitate the commercialization of new medicines from marine resources.

Florida's universities play a major role, including research centers and developing the infrastructure to generate the requisite human capital that would make the state attractive to biotechnology start-ups. All major universities in the state have created technology transfer offices. The University of Florida has been instrumental to Gainesville's growing status in regenerative health biotechnology. Progress Corporate Park in Gainesville, now privately owned, started via the University of Florida and now hosts the Sid Martin Biotechnology Development Incubator, including the McKnight Brain Institute, and the Gainesville Technology Enterprise Center. This complex has generated 28 biotech spin-offs since it was founded in 1995. Similarly, Florida State University developed the cancer-fighting drug Taxol, a venture that generated the spin-off company Taxalog in 1997. Similarly, research parks with bioscience orientations are located at the University of South Florida, Florida State University, the University of Central Florida, and Florida Atlantic University. The University of South Florida is building a $40 million Center for Biological Defense. NASA funding, matched by the State of Florida, has created a Space Life Sciences Laboratory at the Kennedy Space Center in Cape Canaveral. Florida Atlantic University offers a Certificate in Biotechnology, funding by a $2.3 million grant from the Department of Labor, which graduates about 100 students annually, while FAU's College of Engineering offers the nation's first Bioengineering Graduate Certificate Program. UCF and USF offer a $1 million annual Industry Matching Research Program in this field. Several community colleges have started associate degree programs in biotechnology laboratory technology and bioinformatics. Florida's

health care facilities offer research centers pertinent to biotechnology. including the Cleveland Clinic, Florida (Weston and Naples), H. Lee Moffitt Cancer Center and Research Institute at USF, Mayo Clinic (Jacksonville), M.D. Anderson Cancer Center and Walt Disney Memorial Cancer Center (Orlando), Shands HealthCare (Gainesville), and the University of Miami Jackson Memorial Hospital (Miami).

In 2004, Florida attracted $364 million in venture capital (up from $230 million in 2003), which funded 57 firms (new and existing). Of these, 15 were start-ups, one-half of which were in biotechnology. Venture capital is highly mobile geographically, but Florida does have significant numbers of local venture capitalists with experience in biotechnology, such as the Tampa investment bank Athena Capital Partners, Draper SI Ventures, in Fort Myers, and Inflexion Partners, which will invest $250,000 to $1 million each in 10 to 12 Florida biotech start-ups over the next three years (*Florida Trend* 2003). BioFlorida, the biotech trade association, plays an important role in fostering venture capital for the industry.

The Palm Beach County Biotechnology Research Park Project Plan

The Palm Beach County Biotechnology Research Park plan reflects many facets of how to achieve the synergistic effects of agglomeration. The project site is planned to comprise approximately 1,919 acres that include a variety of land uses related to biotechnology and biomedical research. Palm Beach County will act as the master developer, and The Scripps Research Institute will be the primary initial tenant. The project will include: The Scripps satellite university campus, with 28 faculty and 2,000 graduate students; a biomedical science research and development district with offices and laboratories; a town center district of commercial, retail, office, and residential uses; and a neighborhood center district with housing, parks, and community-serving commercial uses. It may also include a magnet high school for 2,500 students and a 90-acre pedestrian mall, and public open space. Palm Beach County had 2,782 biotechnology workers in 2002 (Pounds 2003). Direct employment at the Palm Beach Scripps facility will be 545 after seven years, the entire park's employment is expected to rise to 6,466 after 15 years

(Hopkins 2003). Thus, the proposed park will roughly triple the county's employment in biotechnology.

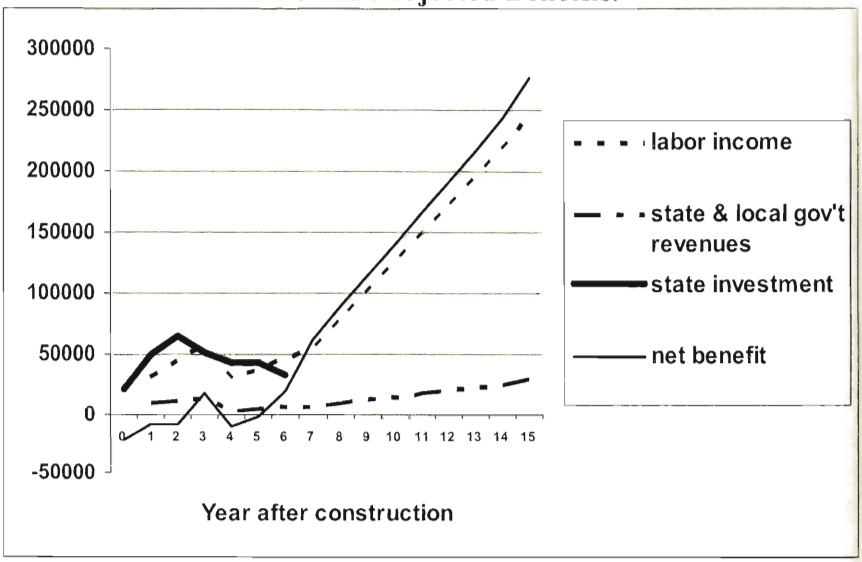
The Washington Economics Group (Hopkins 2003) estimates that in the 15 years after construction begins, and including its multiplier effects (indirect and induced), the facility will attract 499 firms with an average of 88 employees, and will generate a total of 44,300 jobs, $396 million in wages and salaries, and add $594 million annually to the state's gross output. The 15-year time horizon is consistent with the broader observation that biotechnology firms have a long start-up period and that biotech complexes do not emerge instantaneously. Average salaries for jobs there will be well above the state's relatively low average ($54,000 v. $31,000 state-wide in 2003). Figure 2 portrays the distribution of the project's projected costs and benefits over time, indicating that although the net economic benefits are negative for the first five to eight years, following this period it will generate a steady positive flow of labor income and state and local government revenues. Over the first 15 years, the project will generate approximately $6 billion in labor income, $536 million in state and local revenues, and $8.9 billion in gross state product.

Palm Beach County has provided Scripps Florida with $137 million (exclusive of land improvements) for two laboratories and one office building totaling 364,000 square feet. The State of Florida's $310 million economic stimulus package includes $50 million in start-up equipment. Operating costs in Palm Beach county are lower than those faced by equivalent biotechnology centers elsewhere (CB Richard Ellis Consulting 2004). The average annual cost to operate a firm there is estimated to be $9.9 million, including $2 million leasing expense (Pounds 2004a).

Given what is known about the locational dynamics of the biotechnology industry, to what degree will a Florida campus of the Scripps Research Institute in Mecca Farms succeed as the nucleus of a successful biotechnology cluster? Several factors contribute to the research park's potential success.

Infrastructure: Like most high technology industries, biotechnology is very information-intensive, and high capacity fiber op-

Figure 2: Temporal Distribution of Palm Beach Biotechnology Park State Investments and Projected Benefits.



Source: compiled by author from Hopkins 2003.

tic lines are essential. West Palm Beach is well endowed with a fiber optic network. The Palm Beach and Ft. Lauderdale-Hollywood International Airports provide adequate air access, and the site is close to highways such as I-95 and the Florida Turnpike. The design of the Mecca site indicates a substantial internal capture of trips, which minimizes demands placed on the neighboring road network, unlike the typical low-density sprawl often found in such areas.

Universities: The significance of universities to the biotechnology industry is abundantly evident. Palm Beach County universities include Northwood University and Palm Beach Atlantic College, while nearby Boca Raton hosts Florida Atlantic University, and its Center of Excellence in Biomedical and Marine Biotechnology. FAU, with 200 doctoral students in life sciences, is creating a new doctoral program in integrated biology (Pounds 2003); FAU already has 20 students enrolled in a Certificate in Biotechnology program, funded by a $2.3 million grant from the Department of Labor. Scripps Florida is currently occupying temporary lab space on the

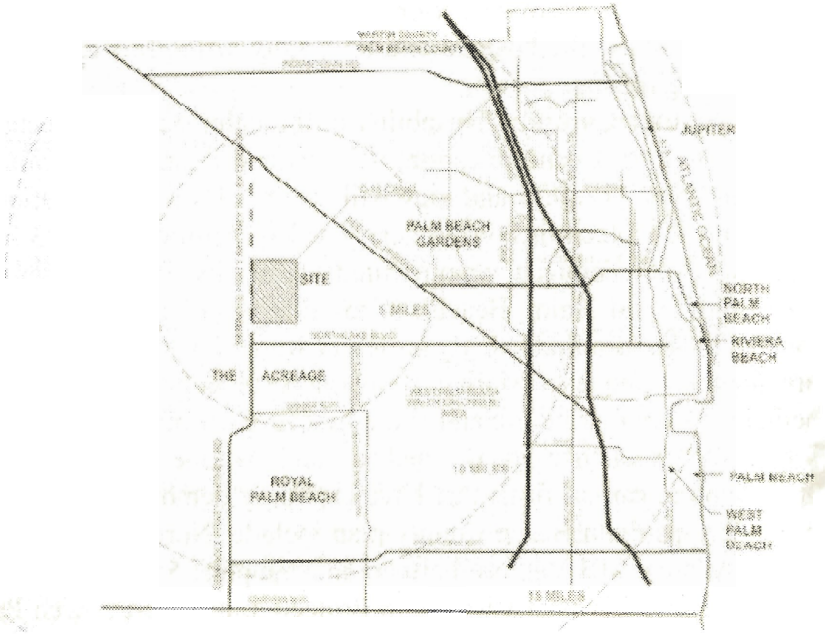
Jupiter campus of FAU. Scripps Florida will establish a Ph.D. program with 28 full-time faculty members, which includes opportunities for students to study at Oxford University through a partnership program. Finally, the hospital and university at the Mecca site will offer training on-site.

Venture Capital: The ability of the Palm Beach Biotechnology Park to attract venture capital will test and illustrate the validity of the principle "Build it and they will come." Dyadic International, a 25-year old biotech firm in Jupiter, raised $6.7 million in 2003 from Bioform, a new biotech venture fund started by Stephen Warner, founder of West Palm Beach's CrossBow Ventures (Singer and Pounds 2004). Similarly, FAU professor Russell Kerr and collaborators founded Tequesta Marine Biosciences in 2004, which creates medicines from marine life and is the first firm to come out of FAU's Center of Excellence in Biomedical and Marine Biotechnology. Other venture capital firms that have explicitly demonstrated interest in the Scripps Palm Beach County plan include: Noro-Moseley Partners in Atlanta; MB Venture Partners in Memphis; 5AM Ventures in San Francisco; Cardinal Partners in Princeton; and Three Arch Partners in Portola Valley, California.

Amenities: Florida's warm climate, the relative proximity of beaches and the oceans, and Palm Beach County's positive public reputation all contribute to the facility's likely success in this regard, phenomena that played a role in the formation of San Diego's biotechnology complex and the ability to recruit skilled talent. The campus-like atmosphere will be attractive to skilled professionals and offer short commutes. The City of West Palm Beach is relatively close and offers abundant golf and tennis as well as galleries and theaters within a 20-mile radius (Figure 3). Within a 20-minute drive there live roughly 120,000 people, and within a 30-minute drive, about 430,000. Proximity to the Everglades may be attractive to scientists working within the biological sciences. The proposed site thus offers a unique blend of rural and urban amenities.

Housing: A distinctive feature of the Mecca Farms project plan is the integration of residential units in the complex. Housing proximate to the laboratories and offices will minimize commuting

Figure 3: Location of Mecca Farms Site Relative to West Palm Beach Metro Area.



Source: CB Richard Ellis Consulting 2004, p. 30.

times and impacts on the regional transportation system, and include non-automobile alternatives. As Eaton and Bailyn (1999) note, professionals in biotechnology tend to favor residences relatively close to work, an aspect of the Mecca project plan. The presence of a range of affordable housing units, in a county in which the 2004 median housing price was $235,000, is significant in order to attract workers of modest financial means, including post-doctoral fellows and graduate students who often occupy entry-level niches in the academic scientific world or semi-skilled technicians.

Networking Possibilities: Local development initiatives include an aggressive technology transfer program designed to maximize interactions among Scripps personnel and other institutions, including universities. In addition to such formal channels, there is an infrastructure to facilitate informal ones. The Mecca site, designed as a multiple land use facility in which scientists, technicians, students,

and other personnel will work and live in relatively close proximity to one another, lays the groundwork for the repeated, fortuitous, face-to-face encounters that lie at the heart of competitive regions and synergistic spin-off effects. The site plan offers a critical mass of research facilities. The presence of housing, as well as supporting commercial and retail functions, at the Mecca site is conducive to the formation of informal relations and the exchange of tacit knowledge that is key to the creation of regional synergies.

Conclusions

Biotechnology epitomizes the entrepreneurial, knowledge-intensive, and networked firm that characterizes much of the American economy today. Critical variables that underpin the location of biotech firms include skilled scientific labor and access to venture capital. Biotechnology firms are currently concentrated in a handful of metropolitan regions that offer ready access to pools of skilled labor, specialized services, and venture capital. Geographic proximity, both on the job and off, is important to the generation of knowledge spillovers and the synergistic effects that these complexes generate. Because many of the contacts among scientists, researchers, and other workers are informal, a mixed land-use facility that includes both housing and recreational facilities as well as labs and offices necessary to the generation of the creative synergies that lie at the heart of successful biotechnology complexes.

Regions without an established advantage in biotechnology must be exceptionally entrepreneurial in order to gain a foothold in this sector. Florida has aggressively targeted the industry for growth, laying the groundwork for a skilled regional supply of scientific labor, including community college programs and university Centers for Excellence, which have already generated spin-off firms. While venture capital is difficult to predict, experience to date indicates that the potential exists to attract local and national investors. Unlike existing centers of biotechnology, which emerged without a conceptual plan to integrate the essential components for optimal economic growth and minimal side effects, the Palm Beach complex would be planned from the beginning, allowing it to draw upon the lessons

learned elsewhere and to minimize many of the market failures and negative externalities that accompany unchecked growth in existing regions (e.g., traffic congestion, unaffordable housing). Moreover, the current mix of land uses is designed to maximize possibilities for collaborative interactions that lie at the heart of the creation of synergies and external economies of scale.

The Mecca site, which is situated within striking distance of the city of West Palm and greater Miami, offers the locational prerequisites to build a successful biotech complex. The Mecca site offers access to the necessary infrastructure, universities and human capital, venture capital, and cultural environment that lead to synergistic interactions. The very presence of Scripps at the Mecca site as a large, successful, and experienced anchor tenant will validate the location in the eyes of other biotech entrepreneurs and venture capitalists. The site offers access to universities such as FAU that have tailored their curriculum to meet the needs of the industry. The on-site housing of the Mecca site is a unique feature and presents the milieu that leads to formal as well as informal interactions among firms and employees.

With so many states pursuing biotechnology firms, can Palm Beach County successfully compete? Three other factors are worthy of consideration. First, established centers, such as Boston and San Diego, suffer from the problems of earlier rounds of growth, including expensive housing, congested transport networks, and long commuting times that already are encouraging some biotech companies to examine alternative locations. Second, Florida offers amenities not available to many other competing locations, including an attractive climate and low tax rates. Florida's government has been unusually aggressive in pursuing this industry, and the state's educational infrastructure has changed to accommodate the biotech industry's human capital requirements. Third, the biotech industry is widely projected to enjoy rapid growth in the future. The industry has been energized by the human genome project and the potential of stem cell research, and may well be one of the nation's driving catalyst industries of the 21st century. Employment in the industry rose 12% annually over the last decade. Biotechnology revenues have tripled since 1995, and there is little reason to expect that future earnings will not be sus-

tained at similar rates of growth. This growth must go somewhere, and there is no *a priori* reason that new clusters can not attract the venture capital and skilled labor that underpin local growth. Historically, clusters have emerged and disintegrated over time; there is no iron law of economics that maintains that only successful regions will succeed in the future.

The strategic implications of the Palm Beach biotech park for the state are significant. Florida's economy is dominated by relatively low-wage, low skilled industries and occupations such as tourism, and the presence of a biotechnology cluster would help to diversify the state economy with relatively skilled, high paying jobs. Florida has seen other major centers dot its landscape over the years, including Disney World and the NASA Kennedy Space Center; thus, the formation of a Palm Beach biotechnology park would not be the first time the state has witnessed the rise of a new industry with significant propulsive effects on the state.

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