

**The Presbyterian Health Foundation Research Park:
A Major Oklahoma City Asset**

**Prepared for
The Greater Oklahoma City Chamber**

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Contents

| | |
|--|----|
| Executive summary..... | 1 |
| I. Introduction..... | 3 |
| A. Background | 3 |
| B. Plan of Report..... | 6 |
| II. The Evolution of a Cluster: The Oklahoma Health Center..... | 9 |
| A. Economic Advantages of Industrial Clusters..... | 9 |
| B. The Early Years at the Oklahoma Health Center: Medical Education, Hospitals, and Research..... | 10 |
| C. Expansion, Variety, and Momentum at the Oklahoma Health Center..... | 12 |
| D. Linkages to MAPS and the Renaissance of Oklahoma City’s Central Core..... | 14 |
| III. The Nexus between Biotechnology Research and Commercialization..... | 17 |
| A. The PHF Research Park Origins and Support..... | 17 |
| B. Biotechnology Defined..... | 19 |
| C. Capitalizing on Research at the Oklahoma Health Center..... | 21 |
| D. The Biotech Industry in National and Oklahoma Settings..... | 23 |
| IV. The PHF Research Park and Its Tenants..... | 26 |
| A. Starting a Business: A Generic View..... | 26 |
| B. Starting a Biotech Firm: Special Legal and Regulatory Constraints..... | 29 |
| C. The PHF Research Park as an Incubator..... | 32 |
| D. Biotech and the Economic Importance of an Incubator..... | 37 |
| E. Research Park Tenants: A Quick View..... | 38 |

| | |
|--|----|
| V. The Economic Impact of the PHF Research Park in the Short Run..... | 47 |
| A. Measuring Economic Impacts..... | 47 |
| B. Selected Biotech Impact Analyses..... | 49 |
| C. PHF Research Park’s Impact 2007..... | 51 |
| VI. The Economic Significance of the PHF Research Park in the Long Run | 57 |
| A. Long Run Prospects for Biotech Products and Services..... | 58 |
| B. The PHF Research Park and Value Added Economic Development..... | 63 |
| C. The Economic Significance of the PHF Research Park: A Summary..... | 65 |
| D. The Need for Continued Local Support..... | 68 |

Tables

| | |
|---|----|
| 1. The Oklahoma Commercialization Model..... | 28 |
| 2. U.S. Food and Drug Administration Review Process..... | 31 |
| 3. Presbyterian Health Foundation Research Park Tenants, 2008..... | 39 |
| 4. Oklahoma Statewide Employment Impact, Scientific Research and Development Jobs, PHF Research Park, 2007..... | 54 |
| 5. Oklahoma Statewide Labor Income Impact, Scientific Research and Development Jobs, PHF Research Park, 2007..... | 56 |
| 6. Projected Employment Growth, Selected Health-Related Industries, United States, 2006-2016..... | 60 |

Executive Summary

Measuring the impact of a dynamic entity like the Presbyterian Health Foundation Research Park is about far more than the straight economics. The Foundation and its Research Park are making a lasting civic, cultural, economic and quality of life impacts that begin on the campus of the Oklahoma Health Center and radiate throughout the world in the lives touched by its work. It all starts with the Park's 30-plus bioscience firms and another 20-plus related tenants.

The success story of the Presbyterian Health Foundation Research Park is inextricably linked with the history of the University of Oklahoma Health Sciences Center (OUHSC) and the Oklahoma Health Center cluster of health-related entities including the Oklahoma Medical Research Foundation (OMRF). The combination of visionary business leaders, results-oriented governmental leadership, good decisions at the right time, and constant collaboration has allowed all three to flourish. In particular, it has given the Presbyterian Health Foundation the opportunity to lead the commercialization of bioscience research in Oklahoma and to create an environment for continued growth.

This report details the evolution of the Oklahoma Health Center, the birth and life of the Presbyterian Health Foundation and the synergistic relationship between these entities. The Presbyterian Health Foundation is the organization that has allowed the original vision for the Oklahoma Health Center to be fully realized – by facilitating the commercialization of research being completed within the Oklahoma Health Center, including work at Oklahoma Medical Research Foundation

The economic impact of the Presbyterian Health Foundation on Oklahoma City is, in itself, significant. Founded in 1985 following the sale of Presbyterian Hospital to the HCA Corporation, the Foundation had an initial endowment of \$62 million. From the beginning, the Foundation's goal was to support medical research in Oklahoma to save and enhance life. This support of biomedical research and technology transfer has been the catalyst for both discovery and job growth, with the most significant step in that process being the creation of the 27-acre PHF Research Park with 650,000 sq. ft. of lab, office, and support space.

The direct economic impact of the 1,300 people employed at the Foundation's Research Park is \$93.8 million each year. Indirect impacts net another \$45.6 million for the local economy. Additionally, the \$109 million spent by the Foundation to construct the Research Park, matched by \$12.9 million from Urban Renewal for a total construction budget of \$122.5 million bring another \$184.3 million in construction impact. Outside of these measurable economic and construction impacts, the Foundation had made grants totaling \$106.2 million from inception through Sept. 2007. These grants provide seed and bridge funding that is vital to the research which is the basis for generating future bioscience companies, along with funding endowed faculty chairs that

attract research and researchers critical to the continued development of the bioscience cluster.

Even more significant are potential impacts on the long term economic growth of the local and state economies. Nurturing new biotechnology start-up firms in the PHF Research Park's incubator facilities has already created substantial economic value and promises to create even more in the future. The development of new medicines based on biotechnology promises the creation of amazing economic value. Two of the PHF Research Park's original business tenants have been acquired by larger entities – each for about \$200 million. Moreover, acquiring firms continued activities at the Park. And the researchers who founded the two companies continue to give back, through new cutting edge research and development, and new company creation.

The report also covers the challenges for growing and developing bioscience firms that must meet the regulatory demands of the Food and Drug Administration. The cost savings flowing from the environment of the Research Park is critical to the survival and growth of such bioscience firms. There is much more to the Research Park's Class A wet labs than simply the provision of a scientific space. Park tenants may access a variety of specialized equipment needed to carry out scientific work. Equally important to the start-up entrepreneur is assistance in the administration of intellectual property rights, accessing financial capital and government grants, and receiving counsel concerning best management and marketing practices as firms survive and mature. Both OUHSC and OMRF maintain technology transfer offices at the Park, and key state government agencies and other entities such as OCAST, i2E and the new Oklahoma Bioscience Association, promoting entrepreneurship and economic development, are also housed at the Park.

Finally, and perhaps even more significant is the synergy resulting from interaction among the Park's scientific entrepreneurs and academic researchers as they share experiences. Tenants' communication worldwide is facilitated by the Park's high-tech Conference Center; by access to the state's fiber optic network, as well as the National LambdaRail Network; and through networking at the Park's Pavilion Food Court space, where tenants share ideas in an informal environment.

All told, the impact of the Presbyterian Health Foundation is significant, in the medical research it supports, the lives it improves and in the economy of the city. A strong vision and faithful adherence to the mission has made this organization a leader in creating a better future for Oklahoma.

The full report, entitled "The Presbyterian Health Foundation Research Park: A Major Oklahoma City Asset" was prepared for the Greater Oklahoma City Chamber of Commerce by: Larkin Warner, Professor Emeritus of Oklahoma State University; and Robert C. Dauffenbach, Associate Dean, Price College of Business, University of Oklahoma.

Section I. Introduction

The purpose of this report is to examine the economic significance of the Presbyterian Health Foundation (PHF) Research Park for the development of Oklahoma City and especially for the city's central core. The specialized cluster of bioscience activity at the Research Park, and the broader cluster of health-related activity at the Oklahoma Health Center represent economic forces which are currently substantial and which promise to become even more important in the future. In this context, the PHF Research Park is viewed as a major Oklahoma City asset.

At the outset, it is noted that this report contains only a brief summary of the PHF Research Park's tenants (Table 3). No effort is made to review in detail the individual characteristics of the firms located at the Park and how they engage in commercialization of the results of bioscience research. This is accomplished very effectively in a 2008 publication of the Presbyterian Health Foundation entitled *A Walk in the Park*. This attractive, well-illustrated publication contains an extensive set of reviews of the remarkable research and development activities of the Park's tenants.

I. A. Background

Since the mid-1990s, the 27-acre Presbyterian Health Foundation Research Park has become Oklahoma City's major site for a cluster of science-based business firms—both emerging and well-established. Also located at the Park is a selection of other entities specializing mainly in bioscience, education, and health-related activities. The Park has provided a site for local scientists to take advantage of recent science-driven changes in the structure of the pharmaceutical industry permitting the entry of small

biotech enterprises. It also serves, de facto, as an Oklahoma City accelerator for these firms and provides incubator space.

The PHF Research Park's seven main buildings are architecturally standardized, and their placement provides an aesthetically striking addition to Oklahoma City's skyline linking its Central Business District to the Oklahoma Health Center (OHC). Located strategically between the city's central core and the state capitol complex, the OHC is a 300-acre broad business cluster containing 30-plus member organizations engaged in interrelated health care, education, and research activities.

In early 2008, about 10 percent of the OHC's 13,000 jobs were located at the PHF Research Park. Two-thirds of the Park's 50-plus tenants were biotechnology and other science-based business firms.¹

When the Park's seventh building is completed in late 2008 or early 2009, there will be 650,000 sq. ft. of lab and office space, with total capital investment approaching \$125 million. A master plan calls for ten buildings and one million square feet. Research Park tenants have the advantage of extensive common facilities. Specialized equipment reduces unit costs for the small operations—whether it is a start-up firm requiring incubator facilities and services, an expanding independent business, or a subsidiary of a larger, multi-facility firm. The lease cost of Class A wet labs and offices space is quite low in comparison to similar facilities around the nation—in some cases as low as one-third the cost for a superior facility. The PHF Research Park campus also includes parking garages, a high-tech conference center, and an attractive food court. In addition, the tenants benefit from ready access to various kinds of organizational support such as legal counsel, managerial and marketing advice, and assistance in obtaining financing.

Perhaps even more important to the PHF Research Park's scientist-entrepreneurs, the opportunity to interact informally with other tenants enhances the creativity of the entire cluster. Moreover, the setting for scientific synergy is much broader than the Research Park itself. Most of the science-based businesses located at the Park are biotechnology firms whose scientific concepts originated with R&D activities at the OHC's two principal research institutions, the University of Oklahoma Health Sciences Center (OUHSC) and the Oklahoma Medical Research Foundation (OMRF). In fact, both institutions maintain technology transfer offices at the park and provide continuing support for firms linked to their research personnel.

The Park and its 1,300 employees have a significant immediate economic impact. As various supplies and equipment needed at the Research Park are purchased locally, and as employees at the park spend their incomes locally, the current impacts ripple throughout the Oklahoma economy. Estimated overall 2007 impacts on statewide employment and labor income are impressive with the Park's direct employment generating another 1,873 jobs, and the Park's annual labor income of \$93.8 million leading to another \$45.6 million statewide.

Even more important are the impacts of the Park on the long run economic growth of the local and state economies. Nurturing new biotechnology start-up firms in the PHF Research Park's incubator facilities has already created substantial economic value and promises to create even more in the future. Most of the Park's 30-plus profit-oriented business tenants are engaged in value added commercial activity based on research initially developed at OUHSC and OMRF. The development of new medicines based on biotechnology promises the creation of amazing economic value. The presence of the

Park's facilities means that Oklahoma City's start-up biotech entrepreneurs located at OUHSC and OMRF do not have to seek out distant locations in which to initiate commercial applications. In effect, the PHF Research Park provides key physical infrastructure needed to "round out" the already diverse mix of health-related activities at OHC.

I. B. Plan of Report

Section II focuses on the Oklahoma Health Center as provider of a fertile setting for the creation of the PHF Research Park. The importance of the decision by community leaders in the mid-1960s to create the OHC cluster cannot be overemphasized. The Park could probably not have developed as a geographically stand-alone facility. Most of the firms located at the Park are engaged in various stages of commercialization of scientific concepts developed by the researchers at OUHSC and OMRF. After a brief reminder of the basic economic advantages of industry clusters for regional economic development, the discussion in Section II treats the evolution of OHC and the significance of this cluster to the central core of Oklahoma City.

Section III reviews the development of the PHF Research Park and how the Park represents a value added economic extension of the research activities underway at OHC. Around 1986 a decision was made by the leaders of the Presbyterian Health Foundation to begin constructing a facility to provide an efficient nexus between research and commercialization. While the OHC provided a favorable location for the Park, remarkable developments in science also created a favorable environment for start-up bioscience firms. A virtual revolution in knowledge of molecular biology has changed

the structure by which new medicines and treatments are developed. This change has worked to the advantage of small, start-up bioscience firms—firms that in an earlier era could not have entered the industry in competition with giant pharmaceutical firms. Section III concludes with a discussion of this broader economic environment of the bioscience industry in Oklahoma and the nation.

Section IV emphasizes the PHF Research Park's role as a business incubator, with discussions of the special difficulties for new business formation in the bioscience field. Extensive development challenges result from the regulatory frameworks of the federal Food and Drug Administration. Emphasis is placed on the long gestation period required for regulatory approval, and the resulting critical importance of assistance provided at the Research Park. A brief introduction to the Research Park's current tenants emphasizes the dynamic R&D activities current underway at the Park. Of special interest is the fact that the Park's tenants include several large, well-established bioscience firms as well as start-up enterprises. A number of the government and nonprofit agencies located at the park are able to provide significant services to the Park's business tenants.

Estimates of the short term economic impact of the Park's tenants on the local and state economies are presented in Section V. The secondary impacts of the Park on employment and income ripple throughout the Oklahoma economy. The estimated extent of these impacts is consistent with earlier estimates for OHC and OMRF.

The report's Section VI reviews the favorable long term prospects for the nation's health sector and for the products and services of bioscience firms. Value added commercialization will continue to capitalize on the OHC's base of research activity.

This will mean a growing economic significance for the activities at the PHF Research Park, and for the role of the Park as a major asset of Oklahoma City.

Effective community leadership has been a major force behind the growth of the OHC cluster and the PHF Research Park. There has been strong and continued support from Oklahoma City's local business community, nonprofit sector, and municipal government. Resources from the federal and state governments have also facilitated development. Section VI concludes by speculating that local support will become even more important in the future as federal and state governments face increasing fiscal stress.

II. The Evolution of a Cluster: The Oklahoma Health Center

The economic significance of the PHF Research Park must be gauged in the context of the evolution of the cluster of health related activities at the Oklahoma Health Center. Community leaders played key roles at critical junctures in the creation of OHC and the Park. OHC has evolved into one of the most important economic forces driving the recent renaissance of downtown Oklahoma City and the further diversification of the entire city.

II. A. Economic Advantages of Industrial Clusters

Michael Porter defines a cluster as “a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities.”² Characteristics of a cluster include the following:

- The use of related technologies such as those characterizing the field of biotechnology.
- Suppliers of specialized inputs, including labor, services, and physical infrastructure; the attraction and retention of a concentration of specialized labor skills is especially important.
- Vertical integration with activities extending downstream to related productive activity and to common intermediate and final markets.
- Offices of government and other institutions specializing in the particular field in which the cluster operates.
- Development and adoption of improved technology and new products stimulated by networking and day-to-day interaction of researchers and entrepreneurs; attraction and retention of a “creative class.”
- Specialization into sub-clusters within a broad functional economic area. (Core areas of specialization at OUHSC involve cancer, diabetes, neurosciences/vision,

and infectious diseases/immunology; specialization at OMRF includes arthritis and immunology; cardiovascular biology; free radical biology and aging; immunobiology and cancer; and molecular, cell and developmental biology.)

Organizations and business firms operating within a cluster experience lower costs—not only because some achieve economies of scale, but also because of external economies flowing from the synergy of the cluster.

In recent years, regional economic development policy has recognized the economic advantages of clusters. For example, Florida's statewide economic development organization, Enterprise Florida, Inc., has identified five major clusters in which the state's strengths lie.³ One of the clusters applies to the life sciences industry with sub-clusters in biotechnology, medical device manufacturing, pharmaceuticals, and health care. The Federal Reserve Bank of Dallas has empirically identified the leading industry clusters in Texas.⁴ Pennsylvania has identified nine targeted industry clusters and emphasizes the importance of cluster specification in the design of efficient workforce development strategies.⁵ Oklahoma's planned billion dollar endowment for support of research and technology transfer ("Oklahoma's EDGE, Economic Development Generating Excellence") emphasizes key industry clusters in aerospace, energy (including a Bioenergy Center), weather, logistics, biotechnology, and food production.⁶

II. B. The Early Years at the Oklahoma Health Center: Medical Education, Hospitals, and Research

The cluster of health related functions at today's OHC got its start in 1917 when the Oklahoma Legislature set aside 16.6 acres of state-owned land southeast of the state capitol building for educational facilities and a hospital for the University of Oklahoma

School of Medicine. Two years later a new University Hospital was dedicated.⁷ By 1965 the cluster had grown only modestly to 24 acres. The complex included two additional institutions—the Oklahoma Medical Research Foundation (OMRF) and a U.S. Veterans Administration hospital. OMRF had been created in the late 1940s to expand the severely constrained state-funded research capabilities at the university.

The years 1964 and 1965 were critical for the creation of the Oklahoma Health Center cluster. The physical facilities of the University Hospitals and the College of Medicine were judged to be inadequate and overcrowded, and action was required.⁸ The groundwork for OHC was laid in 1964 with the creation with the City of Oklahoma City of an urban renewal plan for the University Medical Center. In 1965, the university joined with the business leadership through the Oklahoma City Chamber of Commerce to commit to a much broader concept of the scale and scope of the Health Center. In the spring, a group of the city's top leaders made a site visit to the Texas Medical Center in Houston.⁹ Following the lead of Houston's M.D. Anderson Foundation, an umbrella organization, the Oklahoma Health Sciences Foundation, Inc., was created later in the year to guide the development of the center. Its functions included the attraction and assistance of health-related institutions dedicated to patient care, health science education, and biomedical research. The institutions were to locate in a "functional geographic relationship" and operate as a "cooperative and coordinated multi-institutional center called the Oklahoma Health Center."¹⁰ In effect, the city and business leaders, along with the University, determined to create an extensive cluster of health related activity.

City government's application of a new tool of urban redevelopment was a key to the Oklahoma Health Center Complex. State government had recently approved legislation enabling municipalities to take advantage of this federal program. The concept underlying urban renewal starts with the proposition that a blighted urban area with many small properties will take on enhanced value if the area is consolidated under one ownership (an authority), and the land is cleared of the old, low-value property. The authority can then sell the property to owners developing new capital assets on the formerly blighted area. If things work out well, the revenues from the sale of the renewed area and the resulting increased tax revenues can be plowed back into improving other blighted areas. Urban renewal and the resulting Tax Increment Financing tools have allowed this complex to become what it is today.

One of the first and most important assets of the OHC cluster was a result of the decision in the mid-1960s to relocate the old and inadequate Presbyterian Hospital facility with a new facility.¹¹ Oklahoma City's municipal government helped with the financing of parking and other improvements around the new hospital with a \$4.5 million federal Urban Development Action Grant.¹² The close association between the new hospital and OHC was later to play an important role in the creation of the Presbyterian Health Foundation.

II. C. Expansion, Variety, and Momentum at the Oklahoma Health Center

A snapshot of the OHC four decades after its 1965 conception illustrates the center's dramatic past and prospective growth. In 2007 the center's overall dimensions had grown to 300 acres and current capital investment was estimated at \$2.5 billion.

Approximately seven million square feet of buildings had been constructed since major expansion began in 1971. A Master Plan for 2007-2020 anticipated another \$1.5 billion of capital investment involving 92 projects.¹³ In early 2008 the University of Oklahoma Health Sciences Center had nearly \$400 million of new capital projects in the immediate pipeline. The Oklahoma Medical Research Foundation was planning a new, eight-story, 195,000 square-foot, \$125 million research tower which will permit that organization to hire 75-100 additional principal researchers.¹⁴ Ground-breaking is expected in 2009.

The financial base for the OHC cluster has involved a wide variety of public and private sources.

- **Oklahoma City’s municipal government** has played a significant role in developing and financing OHC. The OHC was the very first project of the Oklahoma City Urban Renewal Authority (OCURA)—using federal money and local matching dollars to acquire property in the extensive blighted area now at the heart of OHC. Urban renewal has played a continuing role in the development of OHC. Federal Community Development Block Grant (CDBG) funds have also been used. In 2006, the Oklahoma City Redevelopment Authority (associated with OCURA) implemented a Tax Increment Financing (TIF) district at the PHF Research Park. (The TIF district is discussed in detail below.)
- **The University of Oklahoma’s Health Sciences Center** and its base of state government support is at the heart of the complex. In FY 2007, for example \$97 million in state appropriated funds were allocated for this organization—with the great bulk of the funds allocated to the activities at OHC. While underfunded by national and regional standards, this is important to the stable growth and development of the complex.
- **Other state agencies** with principal offices at OHC include the Oklahoma State Department of Health, the state’s Department of Mental Health and Substance Abuse Services, the Oklahoma State Regents for Higher Education, the Oklahoma Center for the Advancement of Science and Technology and its subsidiary i2E, Inc., and the Oklahoma School of Science and Mathematics. While not in OHC proper, the state’s main economic development agency, the Oklahoma Department of Commerce, is located in an adjacent facility.

- **Health services** provided at hospitals and clinics are financed from private charges, and from federal and state resources—especially Medicare and Medicaid.
- **Federal government support** for hospital construction and equipment has been important in the past, while federal support for biomedical research continues to be critical for the concentration of research activity at the University of Oklahoma Health Sciences Center and OMRF.
- **The Oklahoma City Chamber of Commerce** and key business leaders have provided funds at critical junctures in OHC development. For example, the Chamber-related Urban Action Foundation had a key role in getting urban renewal up and running in the early 1960s.¹⁵ In 2005 the Chamber funded a major study by Battelle examining the characteristics of the bioscience sector of central Oklahoma and making strategic development recommendations for the sector.¹⁶
- **Private charitable donations** have provided funds for many of the OHC's organizations. Examples of recipients include the Red Cross, the Dean A. McGee Eye Institute, the Oklahoma Blood Institute, and the Oklahoma Medical Research Foundation. The greatest single focus of charitable contribution is in the form of the real assets of the business park provided by the Presbyterian Health Foundation. The value of these assets is approaching \$125 million.

II.D. Linkages to MAPS and the Renaissance of Oklahoma City's Central Core

In the mid-1960s, what was to become the OHC was not the only grand conception being developed by the city's leaders. The urban renewal tool was also to be used to recreate the city's downtown area. The world famous architectural firm of I.M. Pei was hired to develop a plan for the complete redesign of the downtown. This plan required the demolition of the great majority of the old downtown structures with only a small number of historical structures being spared. While the evolution of the OHC during the 1970s and 1980s did not always proceed smoothly, it did, nevertheless, proceed. Meanwhile, a substantial amount of land in the downtown area was cleared, with only a modest number of new buildings replacing the old structures. Actual development had, for multiple reasons, substantially failed to live up to the expectations

generated by the Pei Plan. It should be noted that, during the same period, ambitious comprehensive plans for downtown renewal faced similar fates in many other metropolitan areas.

In the early 1990s, the city's leadership committed to the substantial redevelopment of the downtown area through the creation of a limited number of prominent capital projects. In 1993 the city's voters approved a sales tax-financed \$350 million menu of major new and refurbished facilities, most of which were located in the downtown area. These MAPS (Metropolitan Area Projects) capital facilities were completed by 2004 and created a totally different environment for the city's central core. Included in the new assets were a new minor league ballpark, a refurbished convention center, a new arena, a totally reconstructed music hall, a new library, and a San Antonio-type canal. Close by and to the south was a major MAPS project of dams and waterway segments on the Oklahoma River. Substantial private investments followed in the form of an entertainment district (Bricktown), hotels, and upscale residential units were associated with MAPS.

Similar initiatives were approved for public schools and for upgrading the arena to NBA standards. In 2001 the voters of Oklahoma City and the Oklahoma City Public School District approved "MAPS for Kids." This was a \$700 million program of capital improvement for the area's schools financed by the city sales tax and by the property tax. In March 2008, \$122 million of city sales tax revenues were approved for the arena project. It should be noted that, with the exception of \$180 million in school bonds, these projects were financed on a pay-as-you go process without debt financing.

While the \$350 million MAPS projects were being brought on-line with substantial public anticipation, new capital investment in OHC was growing by a roughly similar amount--\$375 million during 1992-2005.¹⁷ OHC and the city's central core had developed a complementary economic relationship—a relationship which includes, for the first time in decades, a substantial amount of new residential construction downtown and in the area between downtown and the OHC. By 2008, a group of leading organizations had redefined what is considered to be “downtown.” The City of Oklahoma City, the Greater Oklahoma City Chamber, the Oklahoma City Urban Renewal Authority, and Downtown Oklahoma City Incorporated are now specifying a downtown area to include both the OHC to the east and an area south of the Central Business District extending to the newly developed Oklahoma River.

Although not part of OHC, the substantial new investment at and around St. Anthony Hospital just north of the downtown area further emphasizes the importance of a health sector cluster to the viability of Oklahoma City's central core. In 2008, St. Anthony was in the midst of a ten-year, \$220 million expansion and renovation project. St. Anthony is the center of the renaissance of another formerly blighted “midtown” area. The city is promoting a “health corridor” along 10th street between St. Anthony and OHC.

Section III. The Nexus between Biotechnology Research and Commercialization

The creation in the mid-1960s of the concept of the Oklahoma Health Center implied a further commitment to support medical research at OUHSC and OMRF. The economic significance of this decision for the central core of Oklahoma City cannot be overestimated. Another major decision resulted in the creation of the PHF Research Park with its first main building opening in 1995. Start-up biotech firms based on research at OUHSC and OMRF have located at the park. There is great economic significance in the fact that the Park now facilitates the *local* capture of the benefits of *local* R&D work. Value added commercialization complements already valuable research.

There is, of course, no doubt that the Park's creation could not have taken place had it not been for its location within, and fundamental linkage to, the other activities at OHC. Concepts with commercialization potential are created at OUHSC and OMRF. However, it is also probable that the creation of such a bioscience research park providing incubator services to multiple small bioscience firms could not have taken place without a major change in the structure and performance of the drug industry—a change driven by a paradigm shift in scientific knowledge. This shift and its impact on the biotech industry are examined. A roughly definable bioscience industry has developed nationally and at the state level.

III. A. The PHF Research Park Origins and Support

It was a momentous decision by community leaders in the mid-1960s to create the Oklahoma Health Center as an extensive cluster of health related activities. As discussed

above, that decision was backed up by the municipal government's supportive use of the tools of urban renewal.

Another critical decision affecting OHC's economic significance occurred following the 1985 sale of the Presbyterian Hospital to the for-profit HCA Corporation. That sale permitted the creation of an initial \$62 million endowment for the Presbyterian Health Foundation with a mission to promote medical education, the delivery of high quality patient care, medical research and technology transfer at the Oklahoma Health Center, and to promote church/medical partnerships such as pastoral education.¹⁸ Within a year or so, the possibility of losing a significant developing local bioscience firm to Colorado pointed to the need for adequate infrastructure for such firms. The decision was made by the Foundation to create a PHF Research Park at the south edge of the OHC complex. The local firm did not migrate to Colorado and instead occupied a portion of the Park's first major building which was opened in 1995. Building the Research Park has proved to be a truly visionary decision by the PHF Foundation.

As with the mid-60s commitment to the creation of a major health related cluster, the City of Oklahoma City backed up the creation of the Research Park through its urban development policies. These included urban renewal, the establishment of a Planned Urban Development (PUD) subdivision arrangement, \$4 million in the city-controlled federal Community Development Block Grant (CDBG) funds, and the creation of a Tax Increment Financing (TIF) district. The PHF Research Park's current boundaries were included within the city's Harrison-Walnut urban renewal area when the area was specified in 1981.

The TIF district arrangement permitted access to financing which speeded up the Research Park's commercial development. TIF is an innovative federal program enabling a local jurisdiction to take advantage of new tax revenues generated by growth within a bounded district. Increases in property taxes are expected to flow from anticipated developments. The new revenues are then "captured" to help finance the developments themselves, along with the needed improvements in municipal infrastructure including streets, utilities, and parking facilities within the district boundaries. The property tax increments are pledged to service a loan used to help the development, so that funds are available when needed in the early stages of the development. Since the development would not have taken place without the TIF financing, the impact on local jurisdictions' budgets is neutral. The community as a whole benefits from the new development.

With a stream of income flowing from its investments, the Presbyterian Health Foundation could have eventually financed all of its planned expansions. However, the use of TIF financing permitted a faster rate of development with benefits flowing to the community sooner rather than later. This proved to be very important in attracting a particularly desirable tenant. TIF played a critical role in the timely financing of a separate building for Cytovance Biologics, one of the Research Park's major tenants. (The Park's tenants are introduced in Section IV below.)

III. B. Biotechnology Defined

The PHF Research Park contains a cluster of biotech and other science-based research and commercial developments. Scientific developments in biotechnology have been critical to the park's creation and development. It is important, therefore, to attempt

to define what is meant by biotechnology or biosciences. The contemporary significance of biotechnology research is captured in an appealing motto used by the Oklahoma Medical Research Foundation: “A Cure is Out There.” The last half of the 20th Century witnessed massive advances in the knowledge of molecular biology and commercial applications thereof.

A textbook definition of biotechnology applies to “the use of cells and biological molecules or cellular and biomolecular processes to solve problems and make useful products.”¹⁹ An even more succinct definition is “the commercialization of cell biology.”²⁰

“Biosciences” is another term often being used to describe a broad sector of R&D activities based on biotechnology and biochemistry. In a study undertaken for the nationwide biotechnology trade association, Battelle defines the biosciences as “a diverse group of industries and activities with a common link—they apply knowledge of the way in which plants, animals, and humans function.” Four subsectors which Battelle includes in the biosciences are: agricultural feedstocks and chemicals; drugs and pharmaceuticals; medical devices and equipment; and research, testing, and medical laboratories.²¹

Herein, the terms “biotechnology,” “biotech,” and “biosciences” are used interchangeably. This loose use of language glosses over the technical distinction between “drugs” which are chemically synthesized and “biologics” which are derived from living sources such as humans, animals, and microorganisms.²² In point of fact, virtually every medicine of every type is today being analyzed within the framework of molecular biology. Drugs mass produced and consisting of chemical compounds may have varying impacts on individuals with different genetic make-ups. The trade

association of the big drug companies, the Pharmaceutical Research and Manufacturers of America (“Big Pharma”), bills itself as representing the country’s leading pharmaceutical research *and biotechnology* companies.

For the lay person, the important point is that scientists have now figured out a great deal about the basic systems underlying living organisms. And knowledge about these systems has developed relatively recently and rapidly. The systems have orderly structures that are subject to actual and virtual manipulation in order to improve the organisms’ performance. Medicines and mechanical devices can be produced and applied effectively. Possibilities even exist for tailoring medicines to deal with unique characteristics of diseases such as cancer in specific individuals. There are also significant developments in “predictive medicine” in which individual’s genetic characteristics can be used to predict, say, the likelihood of breast cancer. Genetic information can also be used to predict individual responses to drugs of all sorts. In principle, a *cure is really out there* if the proper underlying research and development takes place. If there are ultimate limits to potential developments in biotechnology, they are more likely to lie in the social, ethical, and political arenas than in the laboratory.²³

III. C. Capitalizing on Research at the Oklahoma Health Center

Rapid scientific advances in molecular biology and biotechnology further energized research and development activities at the University of Oklahoma Health Sciences Center and at the Oklahoma Medical Research Foundation. The contemporary extent of research at OHC is reflected in a 2007 report of grants awarded by the National Institutes of Health. In that year, the OUHSC had \$44 million in NIH funding, while

OMRF had \$21 million.²⁴ Three of the PHF Research Park tenants received another \$2 million.²⁵ This total of 67 million represented a substantial injection of money from outside the city and state with economic impacts rippling throughout the area. The statewide pattern of NIH funding is a further illustration of the importance of the cluster of health-related research at OHC. In 2007, OUHSC and OMRF, plus the three tenants at the Research Park, accounted for 87 percent of NIH grant funds in the entire state of Oklahoma. The NIH funds were obtained through competitive application processes and reflect the high level of research competence and national prestige achieved by the institutions at the OHC.

With so much biological research being undertaken at OHC, it is not surprising that discoveries occur fortuitously that have commercial applications, or that scientists are led into areas of research by the likelihood of commercialization. At OUHSC the interest in commercialization is particularly strong among relatively young faculty members. Perhaps more important is the fact that since the mid-1990s, scientists at OHC have followed with interest the continued expansion of facilities at the PHF Research Park and have watched colleagues become involved in commercialization using the Park's extensive facilities and services.

Historically, OUHSC faced a special set of constraints controlling relationships between state government and private enterprise. These populist era constraints retarded the ability and motivation of university researchers to develop projects leading to commercialization. Fortunately, changes to the Oklahoma Constitution were made in 1998 permitting state higher education resources to be used in commercially oriented

R&D. The changes also enable universities to have ownership interests in firms using technology based on campus research.

III. D. The Biotech Industry in National and Oklahoma Settings

Rapidly evolving science has had a profound impact on the competitive structure of firms involved in the discovery and commercial development of prescription medicine. It is unlikely that a facility such as the PHF Research Park with its relatively small science-based entrepreneurs could have developed twenty-five years ago. The overall industry has changed from one dominated by a few large firms producing drugs and achieving extensive economies of scale. There are now opportunities for the small firm that did not exist before the new science. Biotech R&D can proceed efficiently from the scientist's university or research foundation laboratory to initial commercial development stages. Large-scale commercial research laboratories and production facilities are not required. Many small biotech firms have been able to enter the industry, and Big Pharma is increasingly reliant on smaller biotech firms for basic research and innovation. It has been estimated that 25-40 percent of the big firms' sales were from drugs originating in this biotech sector.²⁶

By 1993, commercial developments in biotechnology had proceeded so far that there existed a roughly definable national biotechnology industry which created its own trade association, "**Bio**-Biotechnology Industry Organization." A recent report of the **Bio** association presented an overview of the economic significance of biotechnology.

Included in the overview were four especially significant observations:²⁷

- "Market capitalization, the total value of publicly traded biotech companies (U.S.) at market prices, was \$410 billion as of Dec. 31, 2005."

- “The biotechnology industry has mushroomed since 1992, with U.S. health-care biotech revenues increasing from \$8 billion in 1992 to \$50.7 billion in 2005.”
- “Biotechnology is one of the most research-intensive industries in the world. The U.S. biotech industry spent \$19.8 billion on research and development in 2005.”
- “The average annual wage of U.S. bioscience workers was \$65,775 in 2004, more than \$26,000 greater than the average private sector annual wage.”

In spite of its newness, the industry has provided a fertile ground for the growth of several relatively large-scale companies. In 2004 there were eight “biopharmaceutical” firms with net sales in excess of \$1 billion:²⁸

| <u>Company name</u> | <u>Net Sales (\$ million)</u> |
|---------------------|-------------------------------|
| Amgen | 10,550 |
| Genentech | 4,621 |
| Serono | 2,458 |
| Biogen-IDEC | 2,212 |
| Genzyme | 2,201 |
| Chiron | 1,605 |
| Gilead | 1,325 |
| Medimmune | 1,141 |

As a result of an acquisition of an early tenant, one of these large firms, Genzyme, has a presence at the PHF Research Park and several of the other tenants are units of relatively large firms.

In a 2006 report, **BIO**-Biotechnology Industry Organization reviewed the status of bioscience initiatives in each of the 50 states.²⁹ Reported in the review of recent initiatives are important developments led initially by the Greater Oklahoma City Chamber. These include the preparation of a strategic plan for the promotion of the bioscience sector in a multi-county area including the Oklahoma City MSA, and ancillary areas in central and southern Oklahoma where substantial bioscience activity occurs (Stillwater with Oklahoma State University, Norman with the University of Oklahoma,

and Ardmore with the Noble Foundation.)³⁰ The Chamber’s focus on biotech is further emphasized by the creation of a staff position of “Business Development Manager, Bioscience.” The Chamber has also supported its funding through “Forward Oklahoma City III”—an initiative which, among other economic development activities, created a program area to provide support for bioscience businesses.

Led by the Greater Oklahoma City Chamber and the Oklahoma Department of Commerce (ODOC), along with a group of sponsors, Oklahoma has advertised its biotech sector by presenting exhibits at the national *BIO*-Biotechnology Industry Organization’s annual international convention beginning in 2004.³¹ A byproduct of this promotional effort and part of its strategic plan has involved the creation of a new statewide bioscience organization “OKBio” (The Oklahoma BioScience Association). By the time of its official kickoff in the spring of 2008, OKBio could report ten “Sustaining Members,” each of which pledged four-year commitments of at least \$25,000 annually in cash and in-kind support. Another six “Investors” had made multi-year commitments to OKBio.³² During its start-up period ODOC lent one of its top administrators half-time to manage the new association. The new organization’s offices are being located within the PHF Research Park.

Section IV. The PHF Research Park and Its Tenants

With seven major buildings (and another three planned), 650,000 square feet of office and Class A Wet Lab space, 50-plus tenants with 1,300 employees, and a \$125 million capital investment, the Presbyterian Health Foundation Research Park is having a significant impact on biotechnology R&D at the Oklahoma Health Center. The Park's economic significance is embodied in the science-based business firms that have been making increasing use of the facility since it first began operations in the mid-1990s. During the five years, 2003-07, the Research Park has, on average, added a science-based tenant every 60 working days.³³

Section IV first introduces the generic challenges faced by any start-up business. There is a brief review of how a biotechnology concept may be transformed from a scientist's laboratory to a series of stages at an incubator facility, on to full-fledged production and marketing. Given the many hurdles faced by the new biotech entrepreneur, the incubator services offered at the PHF Research Park have special economic significance for start-up firms in the biotech sector. Most of these services are also significant for the Park's well-established tenants. The section closes with an overview of the Park's current tenants—an overview which begins to illustrate the synergy flowing from such a cluster of business enterprises and related entities.

IV. A. Starting a Business: A Generic View

The science based start-up firms using the PHF Research Park incubator facilities are, of course, private businesses facing a set of challenges common to start-ups in other sectors of the economy. In spite of their complex scientific and technological

foundations, they nevertheless face the ultimate test of earning a positive return on investment.

The generic challenges faced by start-up small businesses are illustrated in a set of highly stylized guidelines prepared by one of the Research Park's own tenants providing assistance to new businesses. That tenant is the state-funded private corporation, i2E, Inc. (Turning Innovation to Enterprise),” formerly the “Oklahoma Commercialization Center.”

Table 1 contains a summary of a generic life-cycle of a start-up business which i2E has labeled “The Oklahoma Commercialization Model.” The table suggests six stages in the business lifecycle: investigation, feasibility, development, introduction, growth, and maturity. Adequate sources of capital are critical to the start-up company which naturally faces an initial period during which the firm experiences losses. The commercialization model emphasizes this by referring to the first four stages—and particularly stages two and three—as the “valley of death.” This is a reminder that the success rate for start-up small businesses tends to be relatively low. Nationwide, for firms established in 1998, one-third were no longer in business after two years, and 56 percent had not survived beyond four years.³⁴

The Commercialization Model understates the complexity of kinds of financial resources that firms turn to in the early stages of their development. Business grants from foundations and government agencies should be emphasized. Government financed support is often important. This includes resources from the Oklahoma Center for the Advancement of Science and Technology (OCAST), and related support from federal programs including the Small Business Administration's Small Business Innovation

| Table 1 The Oklahoma Commercialization Model | | | |
|--|--|-----------------------------------|------------------------|
| The Business Lifecycle | Description | Sources of Capital | Profit Status |
| I. Investigation | The business concept is developed | Friends, founders, family | Negative |
| II. Feasibility | The economic feasibility of the business is determined | Friends, founders, family, angels | Very negative |
| III. Development | The business functions are established and a trial product is marketed | Angels, grants, bootstrap | Very negative |
| IV. Introduction | A product is introduced and revenues are generated | Venture capital | Negative |
| V. Growth | The business reaches break even and even profitability | Equity markets, banks | Positive |
| VI. Maturity | The business is well established in the target market | Equity markets, banks | Positive and sustained |
| Source: Tom D. Walker, <i>The Oklahoma Commercialization Model</i> , Oklahoma City: i2E, Inc., Oklahoma Commercialization Center, 2006 | | | |

Research Program (SBIR) and Small Business Technology Transfer Program (STTR). Of course, friends and family may provide support throughout much of the early years of a new enterprise. Start-up biotech firms in Oklahoma have taken advantage of the Oklahoma Life Sciences Fund I, LLC (\$5.1 million) and the Oklahoma Life Sciences Fund II, LLC (\$10.5 million). These funds provide equity investment for early stage life sciences companies not yet able to attract venture capital. The Presbyterian Health Foundation is a major investor in both funds.³⁵

IV. B. Starting a Biotech Firm: Special Legal and Regulatory Constraints

Added to the generic challenges faced by start-up firms in all sectors of the economy are many constraints specific to biotech firms creating medicines or technical equipment to treat human health problems. These constraints are specific to the United States; a firm marketing in another nation will face other constraints. Three important areas in which constraints exist are (1) intellectual property rights, (2) the extensive approval procedures of the Food and Drug Administration (FDA), and (3) in some cases, the need for approval to market to Medicare and Medicaid recipients.

Intellectual Property Rights—Any firm with a special technical or marketing concept may seek patent, copyright or trademark protection from the federal government. In addition state governments such as Oklahoma have laws enabling firms to protect trade secrets. Due to its complex research-based nature, the biotech start-up firm must pay special attention to its ability to protect its intellectual property from potential

competitors. Protection of intellectual property rights is normally one of the first steps undertaken by a researcher with a concept for a new medicine or device.

Food and Drug Administration—Medicines and medical devices typically must be subject to complex and expensive approval processes by the FDA. The purpose of the process, as summarized in Table 2, is the assurance that the new medicine is safe and effective. Technically, since all medicines have side effects, the judgment is made as to whether the health benefits of the new product outweigh risks of adverse reactions. The FDA and its policies are often controversial and often in the news. The agency is challenged by regulating both food safety and drug safety. With inadequate staff and financial resources, the FDA is often caught in the politics of social idealism. Difficulties in the medicine approval process may be exacerbated by a shifting policy environment.

Working through the approval process for a drug or biologic is both difficult and time consuming. The FDA estimates that, on average, it requires 8.5 years to study and test a new drug before it is approved for the public. The biotech trade association, *Bio*—Biotechnology Industry Organization, takes an even more daunting view of the process as requiring 10-15 years and \$800 million for a new medicine. That cost estimate includes an allocation of the costs of failed efforts.

Standards set by the FDA must be also be maintained when the bioscience sector becomes involved in manufacturing. The agency has established a set of “Current Good Manufacturing Practices (cGMP)” including regulations about organization, personnel, buildings and facilities, packaging and labeling, and laboratory controls.

| Table 2 U.S. Food and Drug Administration Drug Review Process | |
|---|--|
| Stage in Process | Description |
| Discovery | 2-10 years |
| Preclinical Testing | Lab and animal testing; safety for testing on humans |
| Phase I | 20-30 healthy volunteers used to check for safety and dosage |
| Phase II | From a few dozen to 300 patients with targeted disease; comparison with control group usually receiving placebo; check for efficacy and side effects |
| Phase III | Several hundred to 3,000 subjects; different populations receive different dosages; monitor reactions to long-term use |
| FDA Review and Approval | Evaluation of results, do benefits outweigh risks? |
| Phase IV | Commitment by company for postmarketing testing |
| Source: Minnesota Department of Employment and Economic Development, <i>A Guide to Biotechnology Finance</i> , 2005, pp. 115-21; U.S. Food and Drug Administration, "The FDA's Drug Review Process: Ensuring Drugs are Safe and Effective," [www.fda.gov/fdac/special/testtubeto patient/drugreview.html]. | |

Marketing Challenges: Medicare and Medicaid—A big share of the market for medicine results from the newly-created Medicare Part D drug benefits. The ten-year cost of this program alone is estimated to be \$700 billion. Medicaid drug benefits nationally in 2004 were \$36 billion. The sheer volume of expenditures on these two programs makes it important for the manufacturer of a new drug to get on the Medicare/Medicaid approved list of medicines. This approval often involves the government making a comparison of drug cost as compared with effectiveness.³⁶

IV. C. The PHF Research Park as an Incubator

As discussed above, there are various advantages to focused development occurring in an industrial cluster. Arguably most important for a fledgling biotech entrepreneur—and also for an established firm—is geographic, intellectual, and even social proximity to others in the same field. A popular coffee shop or lunch counter may be one of the cluster’s most important assets. Two such facilities are provided at the PHF Research Park with a spacious centrally placed food court.

The incubator services provided at the Park may be classified as “hard” or physical services and “soft” services involving assistance in the organization and management of the park’s fledgling businesses. In many incubators around the nation, the organization owning and running the installation provides both types of services. At the PHF Research Park, the park organization itself generally provides the hard services, while other entities provide soft services.

“Soft” Incubator Services—The fundamental biotech research underway at OHC is occurring at the facilities of the University of Oklahoma Health Sciences Center and the Oklahoma Medical Research Foundation, along with some of their lab facilities at the PHF Research Park itself. The extensive research resources at the two institutions generate a steady flow of findings with potential for commercialization. As indicated below, the great bulk of the science-based tenants at the PHF Research Park are developing concepts originating with OUHSC and OMRF.

Further assistance in R&D at OUHSC is provided through an Office of Technology Development, and OMRF staffs a Technology Transfer Office. OMRF, for example, assists its researcher/entrepreneurs in a variety of areas ranging from patent law and licensing to business management and marketing. OMRF’s direct interest in intellectual property rights associated with the work of its scientists is illustrated by the fact that in the fiscal year ending June 30, 2006, the organization itself received \$2.2 million in income from royalties and licensing.³⁷

A perpetual challenge in providing assistance is the need for the researcher to realize early-on the importance of personnel with competence in business management. A brilliant and accomplished biochemist is unlikely to be simultaneously skillful in business organization and strategy. A scientist with an MBA is unusual—but not unheard of.

Three entities providing soft assistance are located within the park. These include the Oklahoma Center for the Advancement of Science and Technology (OCAST); a contractor of OCAST, i2E, Inc.; and the state’s newly planned billion dollar R&D endowment, EDGE (Economic Development Generating Excellence).

Located directly adjacent to the north edge of the PHF Research Park is the Oklahoma Department of Commerce (ODOC), the state government's economic development agency. Among its many functions is assistance to small business. Specific aid to businesses in incubators is provided by ODOC through its program of certifying incubator facilities for the state government's program under the Oklahoma Small Business Incubators Incentives Act. This act provides a ten-year exemption from state income taxes for tenants of certified incubators.³⁸ The PHF Research Park was one of 46 certified incubators throughout the state in 2007—with certain floors of its buildings specified as incubators.

Management consulting is a principal function of two of the park's commercial tenants, Alpha BioPartners, and Southwest Management Consultants (see below). Special assistance is available from one of the park's major tenants, Cytovance Biologics, for firms working their way through the FDA approval process and ultimately requiring access to custom manufacturing.

The Presbyterian Health Foundation's support for technology based economic development is broader than the provision of the bioscience infrastructure at the Research Park. Between its founding in 1985 and the close of its 2007 fiscal year, PHF grants have totaled \$106.2 million—including \$68.9 million to the University of Oklahoma (mainly OUHSC) and \$8.2 million to OMRF. Other entities at the OHC received \$14.8 million.³⁹ These grants have helped build up bioscience research capacity at OUHSC and OMRF. Included have been grants supporting specific researchers whose work has led to commercialization. For example, William Hildebrand of the OUHSC's Department of Microbiology and Immunology has been the beneficiary of PHF support through grant

funds and through the creation of an endowed faculty position which he occupies.

Hildebrand is also the Chief Scientific Officer of Park tenant firm Pure Protein.

The entrepreneur-tenant at the park is in a site within easy walking distance of OCAST, i2E, EDGE, ODOC, and PHF; the main research facilities of OUHSC and OMRF are also a short walking distance away within the 300-acre Oklahoma Health Center Complex.

“Hard” Services—The Park’s overall design is oriented toward the comfort, convenience, and efficiency of its tenants. For both offices and labs, the structures are essentially brand new offering the most advanced designs and technology. Floors can withstand very heavy weights, and the buildings’ air conditioning and ventilation systems are especially powerful with HVAC systems capable of exhausting room air twelve times an hour.

The PHF Research Park’s facilities are spacious and attractive. The main buildings with multiple tenants are virtually identical in basic design. The Oklahoma County Assessor’s 2007 estimate of market value places the buildings at about \$11 million each. This value does not include the “business personal property” or equipment within the buildings. A companion building is under construction and will open in 2009.

Both science-based start-up firms and other specialized entities require office space. At current rates of \$16-18 per sq. ft., the PHF Research Park’s high quality office space is priced at a very competitive rate compared with Class A office space in downtown Oklahoma City. In fact, requests for space from potential tenants are turned down because they do not conform to the health research related mission of the Park—

which mission is also specified in the city's official Planned Unit Development (PUD) for the Park.

Given the high density with which land is utilized throughout OHC, the availability of parking is very important. The Park's fully completed parking garages have 1,980 parking spaces. Monthly parking rates are the same at the Park as are the rates throughout the OUHSC--\$50 for reserved parking and \$20 for non-reserved parking. These rates compare very favorably with the \$75-90 range charged at the city's downtown parking facilities. Another 165 spaces of surface parking are available.

The PHF Research Park provides a wide range of specialized infrastructure for bioscience research. The Park's Class A wet labs are leased for \$23-25 per sq. ft. This is one-half to one-third the rates often encountered elsewhere in the nation. On a typical floor, the space is arranged so that a large, interior wet lab (typically 1,600 sq. ft.) is surrounded by corridors with offices facing exterior walls. Included in a wet lab common area is much more than the water that makes the lab wet. Also included is gas, vacuum outlets, hoods for fumes, darkrooms, autoclaves, walk-in coolers, and a room for working with isotopes. Buildings have emergency generators to protect critical testing and data equipment.

Small conference rooms are available for tenants in each of the buildings. For larger meetings, a well-equipped conference center is located in one of the buildings. This state-of-the art facility handles advanced audio visual technology, and is designed for video/teleconferencing. This capability is important for such purposes as

communication between start-up firms in the Park and venture capital firms on the two coasts.

Telecommunications throughout the entire Park complex are facilitated by the services of one of the Park's own tenants, OneNet. This is the state government's communications system with a major fiber optic network and access to the Internet and the National LambdaRail systems. The latter system is owned and controlled by the U.S. research community.

IV. D. Biotech and the Economic Importance of an Incubator

In an interview with the *Wall Street Journal*, Kevin Sharer, CEO of Amgen, the nation's largest biopharmaceutical firm, made the following statement. "I think that the development of a biopharmaceutical medicine is the most difficult thing that anyone in commerce undertakes."⁴⁰ This statement from the head of a \$14 billion company serves to emphasize the critical importance of the incubator services and facilities outlined in this section—given the significant hurdles faced by a small start-up biotech firm described in Section III. Without the substantial nurturing provided by an incubator, many of the science-based tenants of the PHF Research Park described in the following section would have had more difficulty getting started. They would have had difficulty affording the capital cost of commonly available R&D infrastructure and they would have faced greater challenges in obtaining the park's readily available soft services. Moreover, the firms got started within the Oklahoma Health Center where the original research took place; they did not have to leave Oklahoma City. Recruitment of firms in

this field is both difficult and rare. For the most part, this is a “grow-your-own” strategy tied to the knowledge in the local scientific community.

The PHF Research Park is not only an incubator; given its linkages, it is also a *university* research park with services to both start-ups and well-established firms. The economic significance of university research parks is also recognized in Norman and Stillwater—the sites of the main campuses of the University of Oklahoma and Oklahoma State University, respectively. As with the case of the PHF Research Park, municipal governments and local business leaders have been instrumental in creating university research parks. Neither the Norman nor the Stillwater facilities begin to match the intensive capital investment in biotechnology R&D at the PHF Research Park. Thus the Oklahoma City facility is likely to continue to dominate the local and statewide biotech commercialization scene.

IV. E. Research Park Tenants: A Quick View

In early 2008 the Presbyterian Health Foundation reported 55 tenants at the Research Park. These tenants are described briefly in Table 3 and are presented in detail in a 73-page publication of the PHF Research Park entitled *A Walk in the Park* (2008). The tenants are adding an important economic dimension to the overall cluster of health related activities at the Oklahoma Health Center. In the following discussion, the tenants are placed into three categories: profit oriented business tenants, private non-profit tenants, and government tenants.

| Name of Establishment | Description | Local Research Link | Type |
|---|--|----------------------------|--------------------|
| Advancia | Analyze, design, develop, implement systems or services, mainly for govts. | | Business |
| Alpha BioPartners, Inc. | Management consulting for developing business plans, finance, etc. for biotech firms | OMRF, OUHSC | Business |
| Analytical Research Laboratories | Testing using state-of-the art instrumentation; problem solving for pharmaceutical industry | OUHSC | Business |
| Altheus Therapeutics | Medicines to reduce flare up of inflammatory bowel diseases | OUHSC | Business |
| Biolytix Pharmaceuticals, Inc. | Research to create an antibiotic peptide to treat hospital acquired infections | OUHSC | Business |
| Center for Biosecurity Research | Unit of OUHSC College of Public Health; administer interdisciplinary research teams developing underlying science to deal with threats from terrorism | OUHSC | Government |
| Charlesson, LLC | OUHSC prof. and associates develop eye drops for diabetes effects and macular degeneration | OUHSC | Business |
| Children's Medical Research Institute | Nonprofit 501(c)(3) corporation to raise funds for pediatric research and education at OUHSC | | Private non-profit |
| Choncept, LLC | Firm focuses on improved technology for production of chondroitin | OUHSC | Business |
| CoMentis, Inc. | R&D leading to products to treat Alzheimer's, macular degeneration, cognitive disorders; earlier firms Zapaq and Athenagen | OMRF | Business |
| Cytovance Biologics | Assist biotech firms in producing and testing products as they move from bench through clinical development; FDA Phase I, II; custom manufacture of biologic medicines | OUHSC | Business |
| The DaVinci Institute | Nonprofit 501(c)(3) promotes improved education, creativity, cultural awareness | | Private non-profit |
| DNA Solutions | DNA testing for humans, plants, animals | OUHSC | Business |
| EDGE Policy Board | Administration of state's planned billion dollar research endowment promoting science based economic development | | Government |
| Genzyme Glycobiology Research Institute | Unit of Genzyme Corp. to discover and develop products and services to improve lives of patients with debilitating diseases | OUHSC | Business |
| Hyalose, LLC | Hyaluronic acid produced under license from OUHSC; many applications to prevent disease and for cosmetic wrinkle removal | OUHSC | Business |

| Table 3 continued | | | |
|--|--|----------------------------|--------------------|
| Name of Establishment | Description | Local Research Link | Type |
| i2E, Inc. | Technical assistance in organizing, financing, and managing advanced technology companies in Oklahoma; contractor of state's Oklahoma Center for the Advancement of Science and Technology; technically a private non-profit | | Government |
| Oklahoma IDEa Program | Operates NIH grant for statewide coordination in biomedical research and bioinformatics; key institutions are OUHSC, OMRF, OU Norman, OSU, U of Tulsa plus regional universities | OMRF <i>et al.</i> | Private non-profit |
| ICX Nomadics | International company developing advanced sensor technologies; apply to chemical, biological, radiological, nuclear, and explosive threats | Oklahoma State University | Business |
| InnovAlarm | Patented security, safety, and health monitoring via home computer and internet; helps seniors to live alone; manufacturing and system service | | Business |
| Inoveon | Provides medical services detecting diabetic eye disease, macular degeneration, and glaucoma | OUHSC | Business |
| InterGenetics, Inc. | Development and application of genetic predictive test for breast cancer; possible genetic treatment for cancer | OMRF, Noble Foundation | Business |
| LabCorp Co. | Large, nationwide clinical laboratory network; cancer and genomic testing technologies for diagnosis, treatment, monitoring | OUHSC | Business |
| Lipid and Lipoprotein Laboratory, (OMRF) | Laboratory with research on human plasma lipoproteins; applications to heart and circulatory disease especially associated with diabetes | OMRF | Private non-profit |
| Lupus Multiplex Registry and Repository | Collection of biologic and other information about lupus patients and their families; tracking genetic linkages; NIH sponsored and administered by OMRF | OMRF | Private non-profit |
| OrthoCare Innovations | Research and development of advanced technology for prosthetics | | Business |
| MedEncentive | Consulting service for doctors and patients providing guidelines for best treatment; incentives to improve care and reduce cost | | Business |
| Nexus Media | Prepare and maintain custom systems of digital display media for organizations | | Business |
| Nova Ventures | Office of worldwide company manufacturing and supplying electrochemistry products, flow analysis and services | | Business |
| Oklahoma Bioscience Association (OKBio) | Statewide membership organization to advance state's bioscience cluster | | Private non-profit |
| Oklahoma Blood Institute | Regional blood center serving 114 hospitals; educational outreach programs | | Private non-profit |

| Table 3 continued | | | |
|---|--|----------------------------|--------------------|
| Name of Establishment | Description | Local Research Link | Type |
| Oklahoma Center for the Advancement of Science and Technology | State government agency facilitating and funding technology based economic development | | Government |
| Oklahoma Health Care Workforce Resources Center | State government entity coordinating efforts to meet supply and demand needs for Oklahoma's health care workforce | | Government |
| Oklahoma Health Center Foundation | Coordinates and plans activities and development of 20 member facilities on 300 acre complex in OKC | | Private non-profit |
| Oklahoma Medical Research Foundation | Office (or laboratory) of major biomedical research institute with main operations elsewhere in OHC | | Private non-profit |
| Oklahoma State Regents for Higher Education (OSRHE) | Headquarters of coordinating board of control of Oklahoma state system of higher education | | Government |
| Oklahoma University Health Sciences Center | Small offices, labs, for 5-6 principal investigators in basic research | | Government |
| Oklahoma University Health Sciences Center | Office of Technology Development | | Government |
| OneNet (subsidiary of OSRHE) | State telecommunications and high speed fiber optic provider for state government and education | | Government |
| PanCagen, Inc. | Start-up company with R&D on use of natural products to diagnose, treat, prevent pancreatic cancer | OUHSC | Business |
| Presbyterian Health Foundation | 501(c)(3) foundation making grants in health fields, developing and managing research park | | Private non-profit |
| PHF Executive Conference Center | Advanced technology conference facilities for rent; advanced computer equipment, videoconferencing capacity | | Private non-profit |
| Productive Technologies | Client services for software and web development, includes solutions based on radio frequency identification | | Business |
| Pure Protein, LLC | Immunology tools for diagnostics; drug and vaccine development and high-yield protein production | OUHSC | Business |
| RiGEN Riley Genomics, Inc. | Diagnostic services to physicians managing rheumatologic diseases | OMRF | Business |
| Rural Enterprises of Oklahoma, Inc. | Comprehensive promotion of economic development emphasizing rural areas; manufacturing, trade, housing; administering federal grants & contracts | | Private non-profit |
| Selexys Pharmaceuticals | Research on and medicine for treatment of inflammatory and thrombotic diseases; uses Cytovance in production of cell line | OMRF, OUHSC | Business |

| Table 3 continued | | | |
|---|--|---|-------------|
| Name of Establishment | Description | Local Research Link | Type |
| Siwa Biotech Corporation | Start-up biotech company; technology leading to male contraceptive | OMRF | Business |
| Southwest Center for Public Health Preparedness (OUHSC) | Assessing needs, and training public health personnel in bioterrorism preparedness; | OUHSC | Government |
| Southwest Management Consultants | Support to start-up biotech companies regarding business plans, finance, marketing | | Business |
| Swaasth, Inc. | Development of cell based assays to detect biologically active unconventional (complementary and alternative) medicine agents in body fluids | | Business |
| Therametics LLC | Skin care company using molecular biology research to treat inflammatory skin problems and skin aging | OUHSC | Business |
| Transtimulation Research, Inc. | Project to develop a gastric electric stimulator to treat gastroesophageal reflux disease (GERD) | VA Research & Education Foundation at OHC | Business |
| VigiLink | Development and manufacturing of products to monitor the performance of equipment and systems | | Business |
| United Health Care | Call center provides 24-hour counseling and support services to pharmacists, doctors, and benefit providers | | Business |
| | | | |
| Source: Web sites PHF Research Park and individual firms; PHF Research Park, <i>A Walk in the Park</i> , Oklahoma City, 2008. | | | |

Business Tenants—Thirty-three of the tenants are private, profit-oriented, businesses—the bulk of which are bioscience firms linked to local research activities at OUHSC and OMRF. These firms represent a form of vertical integration extending the impact of largely local research activity. Except for the United Health Care call center, all could be classified as high-technology enterprises. Typically included in their web sites are lists of publications in learned journals by their principal research personnel.

Cytovance Biologics, with the largest of the biotech facilities at the PHF Research Park, has its own 44,000 sq. ft. building devoted to the customized, FDA-approved, manufacturing services for other biotech firms. It is possible that the presence of Cytovance will serve as a magnet attracting firms from elsewhere that need to be close to custom manufacturing services. There is a smattering of other manufacturing occurring at the Research Park. However, most of the biotech and science-based firms are engaged in R&D and in the providing of specialized “niche” services to the bioscience sector such as testing and custom laboratory work.

Even though the business tenants have the benefits of access to the common incubator laboratory facilities, several have substantial capital investment at the Park. Market values in 2007 of business personal property reported by the Oklahoma County Assessor include the following for selected tenants:

| | |
|------------------------|-------------|
| LabCorp (and Dianon) | \$3,179,457 |
| Genzyme | 1,512,784 |
| Inoveon | 1,083,042 |
| Intergenetics | 743,408 |
| Advancia | 690,760 |
| Analytic Research Lab. | 690,760 |

The one facility in the Park occupied by a single firm, i.e. the Cytovance Biologics manufacturing facility, had an assessed market value of \$7.3 million.

As R&D work progresses, the park will experience more vertical integration into manufacturing. It is not anticipated that large-scale manufacturing facilities will develop at the park. However, the Presbyterian Health Foundation owns about eleven acres across from and to the east of its main site on Lincoln Boulevard, as well as potential access to three acres immediately north and west of the existing campus.

Mergers and acquisitions (M&A) are common business events and are even more frequent in dynamically growing industries with many new firms entering and expanding. M&A of business tenants at the PHF Research Park illustrate how successful have been several of the firms that got their start at the Park. Moreover, M&A activity has resulted in expansions of the Park's business capital base. It is also often the case that acquisition by a large firm provides critically needed financial capital for acquired firms to continue costly product development.

Two very significant acquisitions occurred in the cases of the Park's Novazyme Pharmaceuticals by the Genzyme Corporation, and the acquisition of tenant UroCor, Inc., by the LabCorp Company. Each of these transactions was in the neighborhood of \$200 million.⁴¹ Genzyme is a very large firm with annual revenues exceeding \$3 billion and 10,000 employees worldwide. The firm maintained its presence at the Research Park with its Genzyme Glycobiology Research Institute. LabCorp is also a very large enterprise with annual revenues exceeding \$4 billion and 24,000 employees. It, too, has maintained its presence at the Research Park—carrying on cancer and genomic diagnostic activities.

Other examples of M&A activity strengthening PHF Research Park firms include the acquisition of Zapaq by CoMentis, a California firm which again has maintained major research activities at the Park relating to the treatment of Alzheimer's disease. A significant merger event in early 2008 involved the sale of tenant company Martin Bionics to private company OrthoCare. The latter firm will maintain Park activities with its "Advanced Systems Group" continuing to develop high-tech prosthetics.⁴²

Private Non-Profit Tenants—Most of the PHF Research Park's twelve private, non-profit tenants are involved in some aspect of health care and health research activities. Four involve OMRF and two are units of the Presbyterian Health Foundation. Three of the remaining five private non-profit tenants are health related—involving administering OHC, providing blood supply throughout Oklahoma, and raising funds for children's health research. Rural Enterprises is an economic development organization which helped with loans through a federal program (New Market Tax Credits) as the PHF Research Park financed its sixth building. The newest tenant is the Oklahoma Bioscience Association (OKBio) whose purpose is to advance the state's bioscience sector.

Government Tenants—Four of the ten tenants classified as "government" are linked to the University of Oklahoma. OUHSC leases facilities at the park, as does the medical practices of the University of Oklahoma Medical Center. The university-led Center for Biosecurity Research and Southwest Center for Public Health Preparedness both coordinate research and training relating to bioterrorism. These latter initiatives

complement one of the PHF Research Park businesses, ICX Nomadics, which develops sensors to identify terrorism threats.

Three of the government tenants are deeply involved in the promotion of technology based economic development. Twenty-two of the Park's business tenants have received assistance from i2E, and 18 have been helped by the Oklahoma Center for the Advancement of Science. As the EDGE Policy Board expands its dedicated endowment toward its goal of \$1 billion, it is expected that there will be interaction with the park's tenants. Biotechnology is one of the new state agency's areas of focus.

The Oklahoma State Regents for Higher Education (OSRHE) is one of the Research Park's largest tenants. Within that organization is a program (EPSCoR) which assists budding faculty scientists in their searches for funding from federal agencies. The EPSCoR program operates in states such as Oklahoma which generate relatively small flows of federal research dollars. Also linked to OSRHE is the state's high-technology communications network, OneNet. The OSRHE offices are also the location of the state's Education Oversight Board/Office of Accountability. This agency produces extensive annual reports of performance data applying to the state's public school districts and to individual school sites.

Given its variety of health care personnel needs, the health care industry throughout Oklahoma will pay attention to the work of the Park's newly created Oklahoma Health Care Workforce Resources Center.

Section V. The Economic Impact of the PHF Research Park in the Short Run

Previous sections of this report have dealt with the long term processes of economic development at OHC and the PHF Research Park. At the heart of these processes have been a variety of linkages between capital investment decisions by various institutions located at OHC. Critical investment decisions were made by the trustees of the Park and by the Park's commercial tenants described in this report's preceding section. In the present section, the framework is shifted to the immediate economic impact of the PHF Research Park on the economy of Oklahoma with emphasis on employment and income. This impact estimation uses a technique referred to as input-output analysis which accounts for effects which one entity such as the Research Park has on other sectors of the economy.

This section contains an introduction to the measurement of economic impacts, a review of previous impact studies, and a current analysis of the PHF Research Park's impact using IMPLAN, a commercial impact measuring system maintained at the University of Oklahoma's Price College of Business. The analysis applies to the Park's current employment impact and does not attempt to track the effects of construction expenditures since the facility's inception.

V. A. Measuring Economic Impacts

Short run economic impacts are sorted into three components. With respect to employment, for example, the PHF Research Park has a *direct effect* on the economy of Oklahoma involving the jobs directly located at the park. However, the various economic activities occurring at the Park require purchasing of inputs such as office and laboratory supplies from Oklahoma vendors. These vendors, in turn, make purchases

from other local vendors, and so on and on, whose total value generates an *indirect effect* on employment. Finally, the employees at the Park receive income, most of which they spend locally on goods and services. This expenditure has an impact on the employment level of the firms with whom the Park's employees deal, while those firms must themselves purchase needed inputs locally. The *induced effect* of the employee expenditures circulates throughout the economy in the same manner as the effects of the Park's purchase of inputs. The coefficient obtained by dividing the direct effect into the sum of all three effects is called the *multiplier*. In the discussion that follows, the emphasis is on employment and labor income (employee compensation) impacts.

As often applied in input-output analyses, the direct, indirect, and induced employment generated is typically a measure of *gross* rather than *net* impact. This distinction is not important when the establishment being examined is generating most of its revenues from outside the region for which the impact is being estimated. Such a situation is most evident where the subject of analysis is a manufacturing establishment with the great bulk of its sales (exports) outside the region's boundaries. A similar situation occurs with respect to revenues received from federal government grants and contracts or from investment income largely from outside the region. This means that the gross and net impacts of the PHF Research Park are close to identical. An important caveat, however, applies when an economic activity is largely financed from tax sources within the relevant region. Taxes reduce the flow of spending within a region and thus have a negative multiplier effect.

V. B. Selected Biotech Impact Analyses

The economic significance of biotech and the OHC are illustrated by several previous impact analyses, both at the national, state, and local levels. These analyses rely on one or the other, or both, of two nationwide regional impact systems. One of the systems, RIMS II is maintained by the U.S. Bureau of Economic Analysis, and the other is a commercial service, IMPLAN of the Minnesota Implan Group. The latter service is used by the University of Oklahoma's Price College of Business Center for Economic and Management Research.

Battelle's National/State Impact Estimates 2006—A study by Battelle examined the impacts of the “bioscience” sector on the economy of the United States and each of the 50 states. The four sub-sectors included in Battelle's bioscience sector are: agricultural feedstocks and chemicals; drugs and pharmaceuticals; medical devices and equipment; and research, testing, and medical laboratories.

For the nation as a whole, Battelle estimated that the direct employment in the bioscience sector in 2004 was 1,243,110. Indirect and induced effects of this involved an additional 5,790,946 jobs, for a total impact of 7,034,056. Implicit in this analysis was a nationwide employment multiplier of 5.7, given the current structure of jobs among the four sub-sectors.⁴³

Using the same methodology, Battelle estimated Oklahoma bioscience employment in 2004 to be 4,919. This generated a total employment of 15,054—implying a statewide employment multiplier of 3.1. The data indicate an average annual wage for Oklahoma bioscience in 2004 of \$46,039—half again as much as the statewide

average of \$30,451. Clearly, the induced effect *per employee* of this sector is relatively high.

Oklahoma Health Center Impact 2000—This study was prepared for the Greater Oklahoma City Chamber and the Oklahoma Health Center Foundation by the University of Oklahoma Center for Economic and Management Research. The input-output analysis indicated that the OHC’s 12,100 jobs generated another 11,700 within the six-county Oklahoma City Metropolitan Statistical Area—indicating an employment multiplier close to 2.0. The study further indicated a total impact on labor income of \$807 million and \$46 million of state sales tax and individual income tax revenues.⁴⁴ The study reported annual average compensation per employee in 2000 of \$44,421 at OHC and \$29,337 for the entire Oklahoma City metropolitan area—a relationship quite similar to the statewide estimates of Battelle quoted above for 2004.

Included in this report is a section devoted to the PHF Research Park. However, at the time the study was undertaken, the Park consisted of only two buildings and 453 employees. The analysis reported an employment multiplier of 1.7 for the Oklahoma City MSA.

Oklahoma Medical Research Foundation Impacts 1998 and 2004—The first of the two studies emphasized the potential impacts of a \$66 million capital campaign which OMRF was undertaking. This campaign would enable the foundation to expand its employment from 350 to 500. Five hundred jobs would generate a total of 900 jobs throughout Oklahoma—implying an employment multiplier of 1.8.⁴⁵

A second study was undertaken by Robert C. Dauffenbach and Larkin Warner in 2005. In that study, 320 OMRF jobs generated another 89 and 109 jobs in Oklahoma, respectively, through the indirect and induced effects. The resulting employment multiplier was 1.95. Total federal, state, and local tax revenue generated by OMRF was estimated at \$12.4 million.⁴⁶

Bioscience in a Central Oklahoma Corridor 2006—As discussed in Section III above, the Greater Oklahoma City Chamber sponsored a major planning study by Battelle developing a strategic plan for bioscience development in an eleven county area in central and south central Oklahoma. With that plan as a foundation, the Chamber engaged the University of Oklahoma Center for Business and Economic Research to examine the impact of bioscience activity on an eleven-county area in central Oklahoma. In their strategic plan study, Battelle defined “bioscience” more broadly than in some of its other analysis by including hospitals. Total bioscience employment was estimated to be 39,862—generating total employment for the area of 80,163. The resulting employment multiplier was 2.0.⁴⁷

V. C. PHF Research Park’s Impact 2007

Estimated overall 2007 impacts of the PHF Research Park on statewide employment and labor income are impressive:

- The Research Park’s 1,300 jobs generated another 1,873 jobs as the economic impact spread throughout Oklahoma.
- Annual labor income at the Park of \$93.8 million generated another \$45.6 million statewide.

In measuring short run economic impact by feeding data into IMPLAN, it would have been ideal to engage in a detailed survey or interview for each of the Park's tenants concerning employment, wages, and salaries. It was determined that such survey work was not feasible because of the need to convince some of the tenants of the confidentiality of the data, and because of the limited scope and resources of the study. A much less detailed approach was used. This approach, however, generated results consistent with the other local studies discussed above.

The estimate of total employment in 2007 at the Park of 1,300 was based on parking permits issued to tenant employees. In the impact analysis, total employment was then separated between two large tenants and a group of the remaining tenants.

The first of the large tenants is the Oklahoma State Regents for Higher Education (OSRHE) with 156 employees and average annual income of \$57,875. This data was obtained directly from the agency.

The second of the major tenants, with 290 employees, is the United Health Care call center. This establishment's average income of \$43,052 is 2 ½ times the statewide average reported for "Telemarketing bureaus and other contact centers" in the Census Bureau's County Business Patterns (CBP). This installation provides 24-hour counseling and support services to pharmacists, doctors, and health care providers. Its personnel are much more skilled than is the case for the typical call center.

The remaining 854 jobs are largely in the Park's science-based business firms. Two separate estimates of annual earnings were used for this group. The first, \$85,000, is consistent with anecdotal information at the Park; the second, \$55,607, is the statewide figure from the 2005 CBP classification "Scientific research and development services."

In applying the IMPLAN system, it was not possible to find sectors that were exact matches for the first two major employee groups. For OSRHE, the IMPLAN category used was “Management of companies and enterprises” and the call center was “Business support services.” The industry class “Scientific research and development services” is a reasonably good fit for the main group of PHF Research Park jobs.

Table 4 contains an estimate of the statewide employment impact of the “Scientific research and development” jobs reflecting the Park’s principal economic function. This assumes average earnings per employee of \$85,000 and indicates a total employment impact of 2,280 generated from the Park’s 854 jobs. The resulting employment multiplier is 2.67. If the statewide CBP average earnings per worker for this sector of \$55,607 is used, the employment multiplier drops to 2.25.

The two largest industry sectors with *indirect* effects of the R&D sector in Table 4 are in the broad industrial classifications of “Professional-scientific & technical services” (104) and “Administrative and waste services” (204).⁴⁸ This reflects the impact of the Park tenants’ purchases within the state. In terms of total impacts, the sectors most affected by the Park’s R&D jobs are:

- Retail trade
- Real estate & rental
- Professional-scientific & technical services
- Administrative and waste services
- Health & social services
- Accommodation & food services

Given the static input-output relationship of Table 4, it is reasonable to assume that as employment growth occurs at the PHF Research Park, these six sectors of the Oklahoma economy will also be the focus of further growth.

Table 4 Oklahoma Statewide Employment Impact, Scientific Research and Development Jobs, PHF Research Park, 2007

| Industry | Direct | Indirect | Induced | Total |
|--------------------------------------|--------|----------|---------|-------|
| Ag, Forestry, Fish & Hunting | 0 | 5 | 17 | 22 |
| Mining | 0 | 1 | 2 | 4 |
| Utilities | 0 | 5 | 4 | 9 |
| Construction | 0 | 28 | 6 | 34 |
| Manufacturing | 0 | 42 | 21 | 63 |
| Wholesale Trade | 0 | 19 | 29 | 48 |
| Transportation & Warehousing | 0 | 27 | 17 | 44 |
| Retail trade | 0 | 16 | 173 | 188 |
| Information | 0 | 14 | 10 | 23 |
| Finance & insurance | 0 | 17 | 39 | 56 |
| Real estate & rental | 0 | 62 | 36 | 98 |
| Professional- scientific & tech svcs | 854 | 104 | 32 | 990 |
| Management of companies | 0 | 4 | 4 | 8 |
| Administrative & waste services | 0 | 204 | 34 | 238 |
| Educational svcs | 0 | 0 | 15 | 15 |
| Health & social services | 0 | 0 | 161 | 161 |
| Arts- entertainment & recreation | 0 | 5 | 22 | 27 |
| Accommodation & food services | 0 | 24 | 103 | 127 |
| Other services | 0 | 28 | 87 | 114 |
| Government & non NAICs | 0 | 5 | 7 | 12 |
| Total | 854 | 609 | 817 | 2,280 |

Source: University of Oklahoma, Center for Economic and Management Research, IMPLAN Input-Output System.

The IMPLAN modeling system also permits estimation of labor income impact as well as employment impact. Table 5 contains the labor income impact estimates for the Park's R&D jobs—under the assumption of average annual compensation per employee of \$85,000. Direct labor income of \$72.6 million resulted in a total impact of \$107.2 million. The 1.48 income multiplier for this pay scale is substantially less than the employment multiplier of 2.67. That is to be expected because most of the indirect and induced jobs generated by the R&D activity involve earnings per worker substantially less than earnings of R&D workers. If earnings per worker for the R&D jobs are assumed to be at the lower rate of \$55,607, then the total labor income impact is \$73.4 million, with an income multiplier of 1.55.

The IMPLAN exercise suggests a couple of other observations. (1)For the Park's entire 1,300 jobs, employment multipliers are 2.16 using the conservative earnings figure for the science-based jobs, and 2.44 with the higher earnings estimate. After the review of the earlier impact studies described above, it is not surprising to observe employment multipliers in the range of 2.00. (2)The statewide employment multipliers for OSRHE and the call center were 2.14 and 1.93 respectively.

Table 5 Oklahoma Statewide Labor Income Impact, Scientific Research and Development Jobs, PHF Research Park, 2007 (\$)

| Industry | Direct | Indirect | Induced | Total |
|--|-------------------|-------------------|-------------------|--------------------|
| Ag, Forestry, Fish & Hunting | 0 | 15,419 | 51,916 | 67,334 |
| Mining | 0 | 56,229 | 81,248 | 137,476 |
| Utilities | 0 | 339,174 | 300,990 | 640,164 |
| Construction | 0 | 630,371 | 136,781 | 767,152 |
| Manufacturing | 0 | 2,027,328 | 869,058 | 2,896,386 |
| Wholesale Trade | 0 | 828,176 | 1,236,095 | 2,064,271 |
| Transportation & Warehousing | 0 | 1,164,573 | 633,815 | 1,798,388 |
| Retail trade | 0 | 299,941 | 3,242,818 | 3,542,759 |
| Information | 0 | 576,244 | 402,933 | 979,177 |
| Finance & insurance | 0 | 570,472 | 1,228,985 | 1,799,457 |
| Real estate & rental | 0 | 716,379 | 418,553 | 1,134,932 |
| Professional- scientific & tech svcs | 72,589,576 | 3,540,879 | 1,023,098 | 77,153,552 |
| Management of companies | 0 | 249,354 | 224,609 | 473,964 |
| Administrative & waste services | 0 | 3,658,424 | 607,705 | 4,266,129 |
| Educational svcs | 0 | 10,369 | 463,575 | 473,944 |
| Health & social services | 0 | 416 | 4,885,013 | 4,885,429 |
| Arts- entertainment & recreation | 0 | 38,627 | 238,104 | 276,732 |
| Accommodation & food services | 0 | 300,049 | 1,262,156 | 1,562,205 |
| Other services | 0 | 526,390 | 1,171,205 | 1,697,595 |
| Government & non NAICs | 0 | 244,462 | 309,616 | 554,078 |
| | | | | |
| Total | 72,589,576 | 15,793,276 | 18,788,273 | 107,171,124 |
| | | | | |
| Source: University of Oklahoma, Center for Economic and Management Research, | | | | |
| IMPLAN Input-Output System. | | | | |

Section VI. The Economic Significance of the PHF Research Park in the Long Run

This final section presents important propositions about the PHF Research Park and its future prospects. Scientific developments and demographic change will cause the future demand for biotech products and services to expand. As the biotech sector grows nationally and globally, so will competition—especially from well-established and developing geographic clusters of biotech R&D and production.

The PHF Research Park is a particularly desirable target of economic growth policy in Oklahoma City. Its advantages as an economic cluster of biotech activity will grow as the Park and its tenants grow. The Park's backward linkages to research at OUHSC and OMRF involve a symbiotic relationship beneficial to all. Value added activities at the Park based on local research will be increasingly enhanced by forward linkages at the Park into manufacturing and services. The Park's economic significance as an Oklahoma City asset spans several dimensions.

Given future uncertainties in federal and state government budget conditions, the research at OHC and the PHF Research Park will need to rely more heavily on local support and revenues from its tenants. Support by Oklahoma City's business and not-for-profit sectors, along with municipal government, is likely to become even more important in the future than has been the case in the past. For example, the City of Oklahoma City recently established an Emerging Technologies Program of grants to promising entrepreneurial firms. This program is administered by the Greater Oklahoma City Chamber.

VI. A. Long Run Prospects for Biotech Products and Services

A National Perspective—The steady growth in the demand for health care is a familiar feature of the U.S. economy. A few statistics emphasize the increasing importance of this sector. Both overall health care expenditures and prescription drug spending will grow more rapidly than the national economy during the next decade. The biologics component of prescription drug outlays is likely to grow even more rapidly—with small biotech firms growing still more rapidly.

The federal agency responsible for administering Medicare and Medicaid projects the growth rate in national health expenditures to average 6.7 percent per year between 2007 and 2017. During that period health care spending's share of gross domestic product will rise from 16.3 percent to 19.5 percent.⁴⁹

The rapidly increasing number of older persons requiring medical services is an underlying factor causing health expenditures growth. The nation's population 65 and older will grow 36 percent during 2010-2020, while total population will grow only 9 percent. During that period, the older group will grow 14 million.⁵⁰

Prescription drug spending will grow more rapidly than total health expenditures, with an average annual growth rate of 7.4 percent. Moreover, this growth rate will be accelerating during the projection period. Prescription drug spending nationwide will grow from \$231 billion in 2007 to \$516 billion in 2017.

It is likely that the biotech component of prescription drug expenditures will grow even more rapidly. A 2007 study by the National Institute for Standards and Technology points to such a shift within prescription drugs.⁵¹

The dramatic growth in the number of biopharmaceuticals in clinical development can be attributed to exponential growth in our scientific understanding of the biological systems associated with human health and disease. As researchers begin to identify the biological pathways to disease, drug development research will continue to shift focus away from traditional pharmaceuticals toward complex biopharmaceuticals.

This shift in the basic scientific foundations for medicine development bodes particularly well for small biotech start-up firms such as the tenants of the PHF Research Park. In the past two decades the economic structure of the nation's pharmaceutical industry has changed from one dominated exclusively by a small number of large firms to one in which many small biotech firms have been able to enter. The big pharmaceutical firms ("Big Pharma") are increasingly reliant on universities, foundations, and biotech firms for basic research and innovation.

The projected growth in national health expenditures also means that there will be increasing demands for cost control including the need to control the cost of medicine. This too may suggest an increased relative demand for biotech products falling into the "predictive medicine" category such as the breast cancer risk test developed by one of the PHF Research Park's tenants.

The increase in national health expenditures is consistent with an increase in related employment. Table 6 contains the U.S. Bureau of Labor Statistics projected national employment growth for four of the main health related sectors. The four sectors are pharmaceutical and medicine manufacturing, scientific R&D, ambulatory health care, and hospitals. During 2006-2016 these four sectors combined are projected to gain 2,362,700 jobs—an amount equal to 15.7 percent of the entire national projected net employment growth of 15,050,100 jobs.

Table 6 Projected Employment Growth, Selected Health-Related Industries, United States, 2006-2016

| Industry (NAICS) | Employment, 2006 (thousands) | Change in Employment, 2006-16 (thousands) | Annual Average Percent Change |
|---|------------------------------|---|-------------------------------|
| Pharmaceutical and medicine manufacturing (3254) | 292.4 | 69.4 | 2.2 |
| Scientific research and development services (5417) | 593.4 | 55.4 | 0.9 |
| Ambulatory health care services (621) | 5,282.9 | 1,560.6 | 2.6 |
| Hospitals, private and state (622 and n.a.) | 4,427.1 | 677.3 | 1.3 |
| Total, four health-related industries | 10,595.8 | 2,362.7 | 2.1 |
| Total United States | 136,912.2 | 15,050.1 | 1.0 |

Source: Eric B. Figueroa and Rose A. Woods, "Industry output and employment projections to 2016," *Monthly Labor Review*, November 2007, pp. 53-85.

An Oklahoma Perspective—Oklahoma’s expenditures on *personal health care* were estimated at \$17.3 billion in 2004—up from 7.4 billion in 1991. During that period these expenditures grew at an annual rate of 6.7 percent—a rate identical to that of the nation.⁵² (Personal health care expenditures account for about four-fifths of national health expenditures.) Viewed as a share of Oklahoma gross state product, personal health care expenditures grew from 12.5 percent to 15.5 percent during 1991-2004. There is every reason to expect that health expenditures in Oklahoma will continue to track along with the national pattern in the future and grow more rapidly than the state economy.

The above data emphasize that the health sector is a growth sector worthy of emphasis in the design of regional economic development policy. Economic development strategies promise success when they are targeted at job growth in the cluster of health-related activities at the Oklahoma Health Center in general, and in the PHF Research Park specifically.

In Oklahoma, “quality jobs” are a principal component of economic development strategy. The health sector, broadly defined, fits the requirement of both job growth and relatively high rates of earnings. All four of the broad health industry groups listed in Table 6 have earnings per worker above the average for Oklahoma County (the site of the Park). This is especially true for the industry in which the PHF Research Park specializes. The Census Bureau’s County Business Patterns report indicates that the “Scientific research and development” industry in Oklahoma County had 2005 earnings levels that were 195 percent of the county-wide average.

Challenges for Biotech Development—The general and specific business challenges faced by the start-up biotech firm are reviewed above in Section IV. There are also broader environmental challenges.

The PHF Research Park represents a large investment with a relatively important cluster of science-based business firms mostly involved in biotech. However, viewed as part of the United States and global economies, this cluster of biotech is very small. A major source of current news about technology based economic development, including research parks, is found in the weekly reports of the State Science and Technology Institute, *SSTI Weekly Digest* < www.ssti.org/Digest/digest.htm>. For example, a recent issue (March 5, 2008) reported that the University of Mississippi was initiating construction of a Mississippi Biotechnology Research Park. In St. Louis, a \$36.1 million Bio-Research and Development Growth Park was announced by the Donald Danforth Plant Science Center.

Not only is there extensive competition nationally and worldwide with respect to incubator and university research park facilities, the tenants at the PHF Research Park and the OHC's research institutions face massive competition in biotech R&D. There is no doubt that the presence of the Research Park is an important asset in recruiting and retaining scientists with entrepreneurial inclinations. Nevertheless, it remains a constant challenge for OUHSC and OMRF to obtain financial resources sufficient to beat other institutions in the competition for top scientific personnel.

The structure of the pharmaceutical industry has changed in recent years permitting the relatively easy entry of small biotech firms. Nevertheless, new firms still face competitive forces from some very large players—namely Big Pharma. As

important as the research base at OUHSC and OMRF may be, the combined activities are dwarfed by biomedical research clusters elsewhere. It was estimated that by 2004, the worldwide total expenditures on health care R&D amounted to \$100 billion per year.⁵³ Even this figure pales in the face of planned scientific research expenditures worldwide. For example, recognizing the importance of clusters, in 2006 China announced plans to build 30 new “science cities” and increase its research spending toward \$100 billion per year by 2020.⁵⁴

Perhaps the biggest challenge for Oklahoma biotech is that of recognition. Oklahoma did not rate among leaders in a recent multidimensional biotech ranking of institutions and areas by the Milken Institute. The nation’s leading biotech clusters are on the two coasts—Boston, Philadelphia, Washington, DC, Raleigh-Durham; San Francisco, San Diego, San Jose, Oakland, Los Angeles and Orange County, Seattle—with Austin rating a mention in the middle. A worldwide rating of higher education institutions based on biotech patents did not include an Oklahoma institution in its top 50.⁵⁵ The very first on a list of purposes prepared by the newly formed Oklahoma Bioscience Association (OKBio) is to “build the image of Oklahoma as a bioscience leader.”

VI. B. The PHF Research Park and Value Added Economic Development

Table 3 above documents the vertical economic linkage between research at OUHSC and OMRF, and the commercialization efforts of PHF Research Park tenants. Promoters of Oklahoma economic development frequently point to the challenge of developing “value added” economic activities based on the state’s two legacy industries,

agriculture and oil/gas production. Why not, they ask, have more firms engaged in processing the outputs of farms and ranches instead of shipping the raw materials out-of-state? Why not more downstream processing of oil/gas outputs resulting in chemicals and refined products? In recent years development specialists have also decried the state's alleged "brain drain" as its best educated graduates migrate elsewhere.

Exactly the same points should be emphasized with respect to the advantages of a university research park enabling the state's researchers to commercialize the results of their studies and experimentation. The science-based businesses at the PHF Research Park permit the capturing of value added. A related challenge beyond commercializing R&D is the expansion of manufacturing activity to complete the forward integration in order to maximize value added.

An important byproduct of this process of vertical integration involves keeping newly minted scientists from seeking their fortunes elsewhere. Based on Census Bureau estimates, it is clear that Oklahoma is, on average, comparatively short with respect to persons with graduate degrees. In 2006, 9.9 percent of the nation's population 25 and over had graduate degrees; for Oklahoma the share was 7.2 percent.⁵⁶ It would have taken about 60,000 more adult Oklahomans with graduate degrees for the state to just match the national proportion. Recent out-migration of persons with graduate degrees in two subject areas prominent for biotech research has been much higher than the general population of those receiving graduate degrees. For the state higher education system's graduating class of 1999-2000, five years later only 35 percent of the biological science graduates and 29 percent of the computer science graduates were employed in Oklahoma—while 50 percent of the graduates in other fields were so employed.⁵⁷

Beyond keeping bioscience graduates from leaving is the overall need for Oklahoma City's bioscience sector to have access to a large, highly skilled labor force. As discussed in Section II.A. above, a major advantage of any cluster of economic activity is the expanded supply of specialized labor inputs. Bioscience will remain a field in which capturing value added will involve the economic payoff from additional high-pay jobs.

VI. C. The Economic Significance of the PHF Research Park: A Summary

The preceding analyses suggest a set of propositions summarizing the PHF Research Park's economic significance as a major Oklahoma City asset.

(1) A city's *high-tech image* is important in today's global economy. Although there needs to be substance behind image, consider the PHF Research Park's impact on the visitor. When a visitor views the city's skyline from an upper floor of one of the downtown's tall buildings, her eye is naturally drawn to the Park's complex of architecturally uniform buildings on its 27 acre campus. The answer to an inquiry is something like "That's Oklahoma City's major research park."

The high-tech image is further enhanced by a trip past the Park north on Lincoln Boulevard toward the state capitol. This route will take the visitor through the Oklahoma Health Center's 300 acres packed with health service and education related structures. And a few figures about capital investment will further establish the city's high-tech image—a figure approaching \$125 million at the PHF Research Park, and \$2.5 billion at OHC with another \$1.5 billion planned through 2020.

The concentration of over 13,000 employees at the OHC cluster adjacent to the city's central core would be the envy of many. A positive image will be reinforced further by the ongoing construction of upscale residential structures in the space between the downtown and the OHC. High-income jobs at OHC have been one of the important factors behind these residential developments.

(2)The ***biotechnology commercialization emphasis*** at the PHF Research Park goes far beyond image. Science-driven changes in the structure of the pharmaceutical industry opened up opportunities for small-scale enterprises to commercialize the results of biological research. The Park's tenants take advantage of new understandings of the genetic basis for health problems and the creation of medicines based on living organisms. These understandings become intellectual property. The value of intellectual property rights embodied in biotech business firms can be surprisingly great. Two of the Park's tenants were able to sell to larger firms for figures in the neighborhood of \$200 million each.

(3)The short-term ***economic impact*** of the PHF Research Park on the Oklahoma economy is quite significant and reflects a desirable target of economic development policy. The total annual earnings of the 1,300 government, non-profit, and private business workers at the park is estimated in 2007 to be in a range between \$69 million and \$93 million per year.

Anecdotal information suggests that the average earnings of the estimated 854 *scientific research and development* jobs at the park is in the neighborhood of \$85,000 per year. Using the IMPLAN impact model, the University of Oklahoma's Center for Economic and Management research estimated that these jobs generated another 1,426

jobs throughout the Oklahoma economy. This results in an “employment multiplier” of 2.7 for the park’s science-based jobs. A more conservative annual income estimate of \$56,000 yields an employment multiplier of 2.2.

(4)*Local research linked to local development* is fundamental to the PHF Research Park’s success. The bulk of the Park’s 30-plus business tenants are linked to research undertaken at the OHC’s University of Oklahoma Health Sciences Center (OUHSC) and the Oklahoma Medical Research Foundation (OMRF). There are large flows of federal money and state appropriations supporting research at these two institutions. These research dollars alone have significant impacts on Oklahoma City’s economy. The Park provides the opportunity for further value added economic activity based on some of this research. The presence of the Park’s excellent incubator facilities is also a major feature used to attract young scientists to accept positions at OMRF and OUHSC.

Not only is there backward linkage between the Park’s science-based businesses, but forward linkages are evolving in which products are created and services are delivered. These forward linkages range from the custom manufacturing of living organism-based medicines (biologics) to the creation of genetic tests for predicting disease. Business development at the Park based on both forward and backward linkages will generate additional revenue for the Park’s own operations.

(5)The *future demand* for the products and services of biotech firms will grow substantially as science advances and as the population of the United States ages substantially over the next 20 years. Medical expenditures will grow more rapidly than the national economy, and drug expenditures will grow even more rapidly. The biotech-

based component of the drug market will grow still more rapidly. The business firms located at the PHF Research Park are participating in a growth industry.

Not only are there many economic opportunities in this growth industry, there is also substantial global competition. Emerging nations such as China are creating research based clusters of activity at paces exceeding growth within the United States.

VI. D. The Need for Continued Local Support

Throughout the histories of the OHC and the PHF Research Park there have been significant flows of financial resources from federal and state governments. Federal support—particularly that of the National Institutes of Health—has been critically important to building up the research infrastructure and personnel bases of OUHSC and OMRF. The OUHSC’s medical education functions have been funded by the state from the very beginning. A \$15 million grant from state government’s Oklahoma Opportunity Fund is assisting in accumulating funds to construct a new research tower for OMRF. Most of the businesses at the Park have received technical assistance or financial support from state organizations such as the Oklahoma Center for the Advancement of Science and Technology (OCAST) and i2E, Inc. The state’s newly created EDGE (Economic Development Generating Excellence) fund will be in a position to provide substantial support for technology based economic development in Oklahoma. But the latter organization will face substantial challenges in achieving its goal of having a billion dollar corpus.

What are the prospects for continuation and/or substantial relative growth of funding from federal and state sources? Remember that health research and economic

development spending are classed as “discretionary.” This is in contrast to “mandatory” expenditures such as interest on government debt and Medicaid for both federal and state governments, and Social Security and Medicare at the federal level. Because of these latter mandatory expenditures, both Oklahoma state government and the federal government are viewed as facing long-term structural deficits, i.e. budget conditions that cannot be sustained without substantial increases in taxes or cuts in expenditures.⁵⁸ Other states are in the same fiscal boat as Oklahoma.

The unsustainable budget conditions are largely the result of the rapid growth of Medicare and Medicaid expenditures. Increasing fiscal stress suggests the probability that government support for R&D and economic development will be relatively flat to declining. It is ironic that the growing demand for health care causing increasing overall demand for biotech medicines and services will, at the same time, be a principal cause for government structural deficits which are likely to have a negative impact on government funding of biotech R&D and economic development programs.

The logic of the above proposition about federal and state government budgets is clear. *Those communities that are able to foster growth in bioscience clusters will need to expand their reliance on private sector and local government resources.* As this report has emphasized, both the OHC and the PHF Research Park have, over the years, received strong support from the local business community, charitable organizations, and municipal government. Without massive support from a private charitable foundation, the PHF Research Park would not exist.

Oklahoma City’s business leaders and the Greater Oklahoma Chamber have been supportive from the earliest conception of the Oklahoma Health Center cluster in the

mid-sixties to commitment to the newly formed Oklahoma Bio-Science Association in 2008.

Oklahoma City's municipal government has provided sustained support for economic development and tourism. This includes regular contracts with the Chamber for economic development services, and the partial earmarking of the hotel and motel tax for the functions of the Chamber's Convention and Visitors Bureau. And through various urban development programs, the city has provided much support for both OHC and the PHF Research Park.

The economic cluster of health-related activity at OHC and the PHF Research Park would probably not have developed without the city's application of urban renewal. This involved an integrated process of planning for the development of the entire OHC complex beginning in 1963. Redevelopment agreements between the Oklahoma City Urban Renewal Authority (OCURA) and the Presbyterian Health Foundation have provided for a phased development of the Park, with associated phased acquisition by the Foundation of land from OCURA. By mid-2008, the city and its agencies had invested about \$12.9 million in land, utility and street improvements, and security services at the Park. The city created Tax Increment Finance Districts No. 1 and 7 covering the area of the OHC. This has provided an important source of financing which the PHF Research Park has used to construct a major manufacturing facility and parking garage.

On December 11, 2007, the voters of Oklahoma City approved a proposition which provides for the city's issuing as much as \$75 million in bonds to finance economic development incentives for firms to locate or expand facilities within the city.

This appears to grant the city the ability to respond flexibly and creatively to specific development opportunities such as those likely to emerge at the PHF Research Park.

A related initiative is the newly created Oklahoma City Emerging Technologies Program. The Greater Oklahoma City Chamber administers this program on behalf of the City of Oklahoma City. Conditioned on prior approval of support from one of two state government business finance programs administered by Park tenant i2E, Inc., loans of \$50,000 to \$100,000 are made to promising entrepreneurial companies. The debt is forgiven unless the firm is sold or receives substantial investment support during the loan's the five-year terms.

A final note on municipal government's potential significance relates to an anticipated major infrastructure development initiative similar to MAPS and MAPS for Kids. Current discussion of a possible MAPS III initiative is emphasizing a "core to shore" initiative linking the city's central core southward to the newly developed Oklahoma River facility. In this planning process it will be important to remember that the biggest single concentration of quality jobs and capital investment within the city's core is found in the OHC including the PHF Research Park.

There can be no doubt about the commitment to OHC and the PHF Research Park by Oklahoma City's not-for profit sector, business community, and municipal government. There is also no doubt that this commitment will be more important in the future if Oklahoma City is to continue to capitalize on its clusters of economic activity in health and biotech. There is no lack of competition from similar clusters throughout the global economy.

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