ECONOMIC DEVELOPMENT CHALLENGES IN THE CITY OF CAMBRIDGE: THE BIOTECHNOLOGY INDUSTRY

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ABSTRACT

Despite its reputation as one of the most entrepreneurial places on earth and its abundant resources, some firms in the hi-growth biotechnology[1] sector have either left Cambridge[2] or, are considering leaving the City.

The reasons why new biotechnology firms locate in Cambridge are well understood and conform to prevailing location theories; A highly skilled and educated labor force, as well as the proliferation of new technology from MIT, Harvard and mature biotechnology firms. At present, Cambridge is home to 62 of the 240 firms located in Massachusetts. However, over time the City's share of biotechnology firms has dropped from 32 percent to 26 percent.

The scarcity of lab/office space in Cambridge may be among the primary reasons that firms relocate or establish operations in cities other than Cambridge. Of primary interest is how fast growing firms with dynamic demands for lab space negotiate its scarcity. Of particular interest is how firms that have yet to garner a net positive return confront their choices including subletting, incubation and shared labs.

The central hypothesis is that despite Cambridge's overwhelming location advantages, and the near necessity of operating in the City, fast growing, unprofitable firms will actively search outside of Cambridge for flexible lab/office sites.

Thus, this research evaluates the principles that inform the City's relationship with the biotechnology industry, and the ensuing roles Cambridge plays in its viability and the expansion of public goods including jobs and tax revenue. Finally, this thesis endeavors to draw broader principles and conclusions about how cities hosting volatile and fast-growing industries can intervene to prevent displacement of young and dynamic firms.

[1] According to the Massachusetts Biotechnology Council (MBC) biology is the study of living organisms, and biotechnology is the application of technology to this life science. The purpose is to manipulate cellular or molecular information to create new cell types and therapies.
[2] Cambridge Neuroscience and Natural Pharmaceutical, Inc.

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INTRODUCTION

Purpose of Thesis

This thesis is an effort to understand and document how fast-growing, unprofitable biotechnology firms in Cambridge respond to the City's expensive and scarce market for lab and office space. Cambridge biotechnology firms confront an expensive and scarce lab and office market. Included among the choices they face are incubation or subleasing, changing their business models and growth projections, partnering with large mature pharmaceutical firms or leaving the City. A better understanding of the lab/office space needs of fast growing, unprofitable biotechnology firms is to the advantage of both the firms and the City of Cambridge. Further, this thesis endeavors to draw broader principles and conclusions about how cities hosting volatile and fast-growing industries can intervene to prevent the displacement of dynamic and young firms within those industries.

Biotechnology, a dynamic and diverse industry, is challenging existing models of product development. Firms' staff, funding and research needs are unique and volatile, requiring careful and expensive location decisions. The vast majority of firms face long lead times prior to product commercialization and unprofitability.

It is imperative for cities to understand the particular lab/office needs of biotechnology firms in order to develop effective strategies that benefit the city's industrial and job mix, while minimizing the challenges posed by a fast-growing, highly technical and

sometimes controversial industry. Cambridge, which offers biotechnology firms nearly unparalleled research, investor and labor advantages, also poses complex and costly barriers to firms that need to expand.

Cambridge's Interest in Biotechnology

Cambridge's self-image as an entrepreneurial Mecca is prominently featured in its economic development literature. Consequently, the City's ability to attract and retain biotechnology and pharmaceutical firms enhances its reputation as "Genetown", the global locus for biotechnology entrepreneurship. The presence of small and innovative biotechnology firms in Cambridge has been partially responsible for the recent influx of large, mature pharmaceutical and biotechnology firms.

Further, the biotechnology industry is of particular importance to Cambridge because it is one of the fastest growing industries in the City, offering the potential to create high paying jobs and stimulate related industries. Among the industry's advantages is that biotech consists of diverse and evolving market sectors including human therapeutics, industrial materials, agriculture and information systems.

With comparatively minimal direct investments from the City, Cambridge has benefited from investments made by other institutions, such as MIT, the Whitehead Institute and the Federal government. The growth of the industry in Cambridge can be charted through its contributions to the City's treasury. Biotechnology firms' contribution to the

City's real estate assessment leapt from approximately $7 million in fiscal year 1996 to $106 million four years later

In spite of the advantages to the City, the dynamic growth and potential of biotechnology industry is not a free good. The growth of biotechnology intensifies the competition for scarce and expensive space. Further, although biotechnology jobs have grown at an impressive rate for the past ten years, the best paying jobs are at the upper end of the pay and education scale. Thus, whether the industry will provide a broad range of employment opportunities across the City's labor spectrum is questionable. Further, the industry's implosion during the late 1980s and the chronic financial losses of the vast majority of firms suggest that the industry lacks the stability of a preferred corporate citizen. The recent influx of large and mature biotech and pharmaceutical firms may have a profound impact on the mix of jobs and market sectors within Cambridge. These and other factors raise fundamental questions for the City.

Hypothesis

My hypothesis is that, despite Cambridge's overwhelming advantages and the near necessity of locating in Cambridge, given the range of choices available, unprofitable fast-growing biotechnology firms will actively search outside of Cambridge for more flexible lab/office sites due to the difficulties of finding suitable space in the City.

Further, this thesis evaluates the economic development principles that inform the Cambridge's relationship with biotechnology, and the ensuing roles that the City

undertakes. Finally, this thesis examines whether the City's policies address the market failures, information asymmetries and obstacles identified by unprofitable, dynamic biotech firms. Thus, this thesis endeavors to analyze how the City perceives and implements its roles in economic development, and the degree to which it implements programs consistent with those roles.

Motivated by the scarcity and cost of lab/office space, an exodus of fast-growing and innovative firms could hamper the City's prestige, tax assessments and allure to mature and profitable firms. For instance, the districts specifically zoned for biotechnology are nearly fully leased-up, and at present subject to a downzoning petition. Further, most of the East Cambridge district in which some of the largest and most prominent biotech firms are located, is covered by a recently adopted moratorium on development in excess of 20,000 square feet.

Cambridge's strength as biotechnology's "Genetown", has attracted large and profitable pharmaceutical and biotechnology firms which, unlike the small- and mid-size firms, are capable of developing their own lab/office space and competing effectively for scarce rental properties. The relative lack of documented, publicly available information about the space needs of small- and mid-sized biotechnology firms, and my focus upon individual firms' needs and experiences has shaped the methodology.

Methodology

My methodology consisted of randomly identifying Cambridge-based unprofitable, fast-growing biotechnology firms based on the membership of the Massachusetts Biotechnology Council (MBC). With the assistance of MIT's Technology Licensing Office (MIT TLO), the MBC, brokers and public officials, contacts were established with decision-makers who were subsequently interviewed. (See Appendeces 1 & 2)

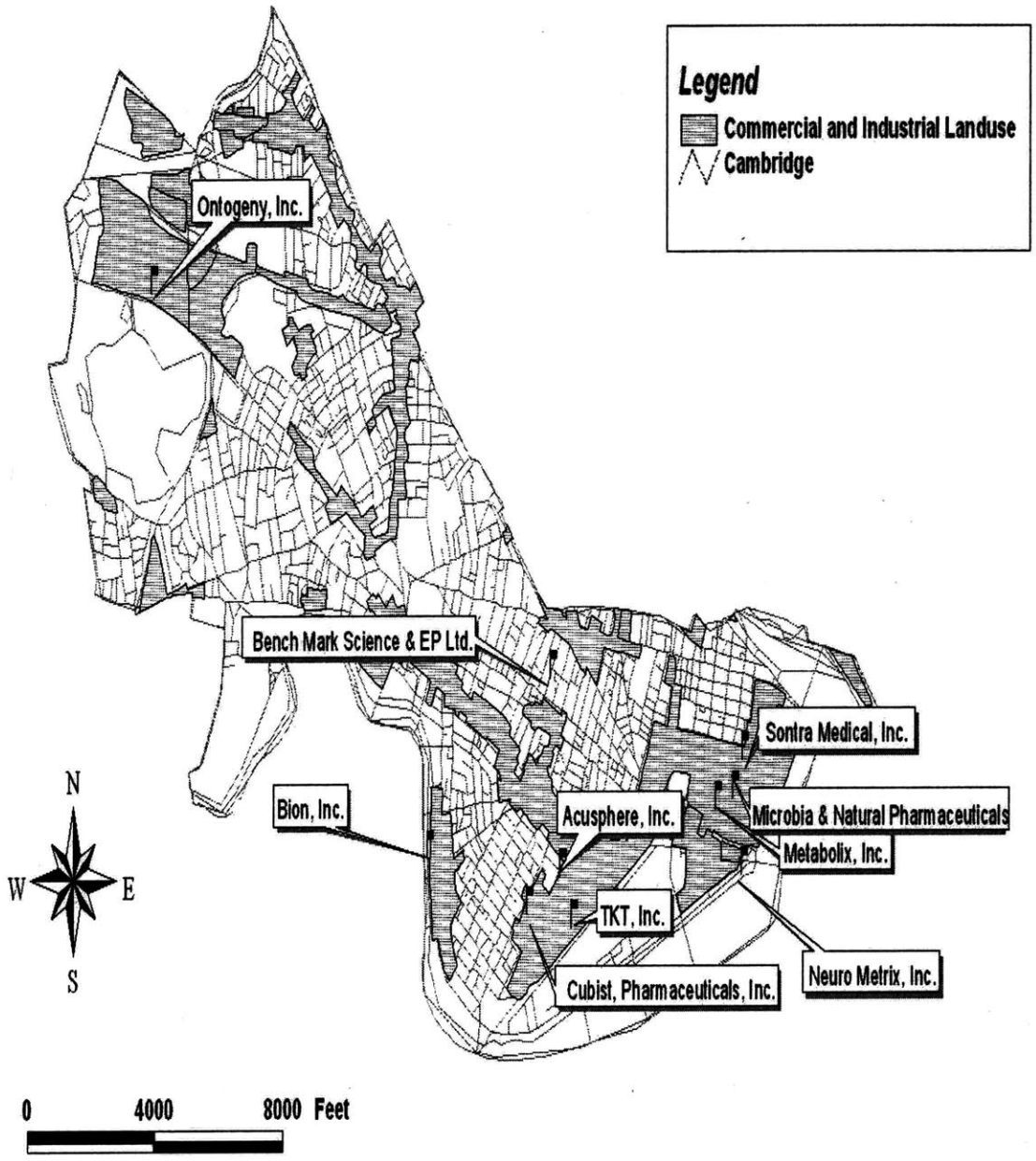
Consequently, the firms that were interviewed represent a broad range of development stages and market segments which, in the interest of testing the hypothesis, is preferable to narrowing the research to one particular stage or market segment whose needs could be unique and unrepresentative of the broader industry. A total of 12 Cambridge firms were interviewed. (Illustration 1) Consistent with prevailing trends in the biotechnology industry, the majority of firms were small and mid-sized. Despite their differences, the firms share in common fast growth, unprofitability and pressure to locate larger lab and office space.

In an effort to identify which factors played the most prominent role in firms' location and relocation decisions, the interviews explored issues other than lab/office space such as amenities, labor costs and transportation in an effort to determine the relative importance of the scarcity of lab/office space.

Illustration1

Cambridge Biotech Companies

Data Sources: MassGIS Tiger Files
MassGIS Landuse Codes, 1991



Further, every effort was made to independently challenge and confirm the observations and opinions expressed by representatives of biotechnology firms. Thus, I conducted interviews with public officials, brokers and developers, and examined public records and private industry reports. (See Appendix 3)

Outline of Thesis

Chapter I provides background on the evolution of the national biotechnology industry. Included in Chapter I is an examination of the ethical controversies as well as the investment challenges that have threatened biotechnology's viability. This chapter includes a discussion of the primary catalysts of biotechnology's growth - demographic trends. Included in this chapter, is a review of the indispensable role of the federal government as both benefactor and regulator, facilitating and circumscribing the growth of the industry, a role that parallels that of local governments.

Finally, Chapter I offers a conceptual framework of the potential roles that local governments and host communities play in nurturing, benefiting from, and regulating this dynamic industry. The goal of providing a conceptual framework is to enhance the reader's ability to envision how cities can benefit from, and influence, the rise of biotechnology, and the complexity of such an undertaking.

Chapter II describes the evolution of, and challenges faced by, Cambridge-based biotechnology firms. This Chapter discusses the unique catalysts to the growth of biotechnology in Cambridge, in particular the role of the City's research institutions

including Harvard, MIT and the Whitehead Institute. Chapter II concludes with an examination of Cambridge's regulatory and political response to the industry's growth. The goal of Chapter II is to illuminate the regulatory and political context within which Cambridge-based biotech firms are operating and growing, and the different roles the City has at its disposal.

Chapter III presents the results of interviews conducted with biotechnology firms, developers, brokers, public officials and others. The Chapter is organized into five broad questions that encompass most of the issues covered in the fifty-question interviews of biotech firms, as well as the interviews with other interested parties, and independent research. The five main questions are:

- What are Biotechnology Firms' Space Needs and Demand for Space in Cambridge?
- What are the Biotechnology Firms' Experiences Meeting their Space Needs?
- How are the Development, Biotechnology and Institutional Sectors Responding to this Demand?
- How has the City of Cambridge Responded to the Specific Needs of the Twelve Firms?
- What are the Obstacles and Market Failures Faced by the Firms?

The purpose of Chapter III is to evaluate the hypothesis, that fast-growing, unprofitable biotechnology firms will look outside of Cambridge for flexible lab/office space and a more elastic real estate market. Further, this Chapter endeavors to draw conclusions about their experiences, location decisions and obstacles, as well as Cambridge's economic development principles, roles and programs.

Chapter IV offers recommendations that the City and the biotechnology sector could consider, including how the City views its roles, programs consistent with that roles and how the City and biotech firms should address the market failures and obstacles faced by the firms.

CHAPTER 1 THE EVOLUTION OF THE BIOTECHNOLOGY INDUSTRY AND THE ROLE OF LOCAL GOVERNMENTS

Section A The National Biotechnology Industry: A Brief History

Scientific Discoveries and Ethical Conflicts

Throughout the last 15-20 years, the biotechnology industry has matured, introduced commercial products and endured scores of well-publicized clinical and commercial failures. During this period of innovation and maturation, the industry has been stricken by significant investor volatility, political controversy and ethical challenges.

In 1953 the structure and purpose of DNA was discovered by Watson, Crick, Franklin and Wilkins. Their discovery of the double-helix structure of DNA, which carries the genetic code, ushered in the modern era of biotechnology. The prospect of genetic engineering, the process of creating new DNA through the combination and manipulation of DNA from different organisms, seemed at last to be plausible, with the invention of recombinant DNA (rDNA) in 1973.

The invention of rDNA precipitated anxious public debates, and efforts by scientists to comprehend the risks of rDNA, and develop mechanisms of self-regulation and accountability. In 1974, scientists agreed to a self-imposed and unprecedented moratorium on rDNA research.

By 1975, however, the leading cellular and molecular scientists lifted the moratorium and developed research guidelines which were approved, and later adopted by the National

Institutes of Health (NIH). It is noteworthy that Government funding of university-based research provided the primary catalyst to the growth of the commercial biotechnology industry, especially during its first two decades.

Continued Growth and Evolution

Despite the clinical failures, regulatory changes and lulls in investor interest, the biotechnology industry has continued to grow, and diversify. In 1982, the biotechnology industry had virtually no products in commercial distribution. By 1998, the biotechnology industry had FDA approval for more than 90 drugs and therapies. As of 1998, there were more than 1,300 public and private biotechnology firms nationally, of which approximately 350 were public.

Despite a lull in investor interest, according to Standard and Poor's 1999 industry survey, biotechnology is expected to increase revenues by 21% over 1998 levels to $21 billion.[3] The number and types of jobs in a biotechnology firm depend on the firm's development stage as well as size. From 1996 – 1997 biotechnology jobs grew from 118,000 to more than 140,000, nationwide.

Demographic Catalyst

The primary catalyst for the continued growth of biotechnology is demographic. As the percentage of the population living longer increases, due to health and medical breakthroughs as well as the aging of the large baby-boom generation, pharmaceutical and biotechnology firms expect the demand for medical therapies to grow. At present

34.4 million Americans, 13 percent of the population is over 65 years old. By the year 2030, the US Census projects that, the number of Americans aged over 65 will double to 70 million, comprising 20 percent of the population. In 1998, nearly half of the nation's $41 billion in prescription drugs were consumed by persons over 50. That figure is projected to leap to 64% within the next twenty years.

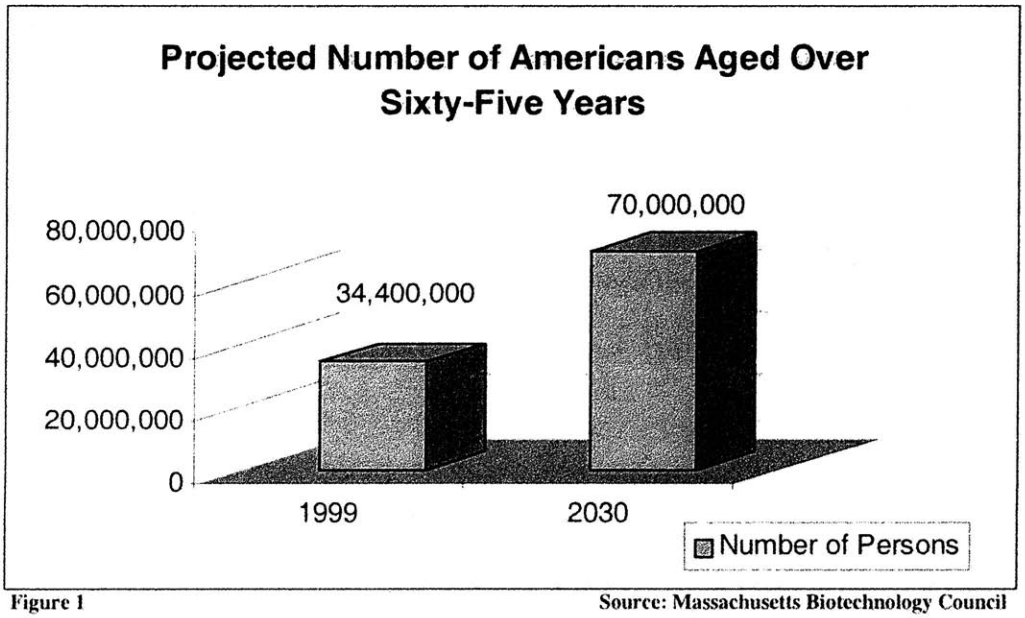


Figure 1 Source: Massachusetts Biotechnology Council

The number and types of drugs being developed by pharmaceutical and biotechnology firms may reflect the pace of medical innovation as well as the aging of the baby boom cohort. For example, from 1995 to 1999, the number of Alzheimer's drugs in development jumped from 14 to 22, and the number of therapies for osteoporosis nearly doubled to 27.[4]

[3] Standard and Poor Biotechnology Industry Survey, 1999, p.1.
[4] Fisher, Larry; *Money Walks* (Forbes May 3, 1999), p.77

While more Americans may indeed live longer than ever before, diseases, genetic as well as environmentally and behaviorally contracted, ensure that drug manufacturers will continue to serve a growing domestic and international market. The World Health Organization (WHO) projects that the over 65 population will expand from just under 400 million in 1997 to more than 800 million by 2025. WHO predicts substantial increases in cancer induced by poor diets, obesity, smoking and lack of exercise, according to Standard & Poor's 1999 biotechnology report. Consequently, the biotechnology and pharmaceutical industries anticipate hundreds of billions of dollars in profits for successful therapies.

Investor Interest in Biotechnology

During the 1980s, the growth in the number and size of venture funds may have fed much of the speculation in biotechnology firms. The investment community's unfamiliarity with biotechnology, and the biotechnology industry's promises of blockbuster drugs, embodied by Genentech's impressive IPO in 1980, attracted significant amounts of venture funding throughout the early to mid 1980s. However by the late 1980s much of the blush had faded from the biotech rose due to the risk, high burn rates and long lead times intrinsic to biotechnology. By the late 1980s, investors abandoned the industry.

Early in the 1990s, biotechnology gradually regained investor confidence. However, as the decade progressed industry losses ($5.1 billion by 1998), widely publicized clinical failures and the advent of the internet economy eventually siphoned off much of the public markets' enthusiasm.

As of late 1998, just 12 out of 350 public biotech firms had positive net earnings, according to Medical Economics.[5] While the average venture fund has 17% return on equity, biotech-focused funds struggle to deliver returns on investment in the high single digits.[6]

During the late 1990s, internet and software stocks siphoned off investors' enthusiasm for biotechnology. To a greater degree than internet, and e—commerce, investors have been ambivalent about the how to properly value biotechnology firms that burn millions of dollars in funding, and for which commercial viability is highly uncertain.

Particularly confusing to investors and the public at large is the profusion of innovation, market sectors and technologies that fall under the rubric of biotechnology. Some biotech firms may remain suppliers of technology and licensees of basic research to large pharmaceutical firms, while others may progressively evolve into fully integrated research, production and commercialization entities much like present day

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[5] Mangan, Doreen; *Are Biotech Stocks Finally Ready to Soar?* (Medical Economics June 21, 1999), p.101.

[6] Fisher, Larry; *Money Walks* (Forbes May 3, 1999), p.77

pharmaceutical firms. As the public equity markets turned away, private capital evolved into the primary funding source. And to the detriment of early stage biotech firms, venture funds continue to place the majority of their investments in mature biotechnology firms.

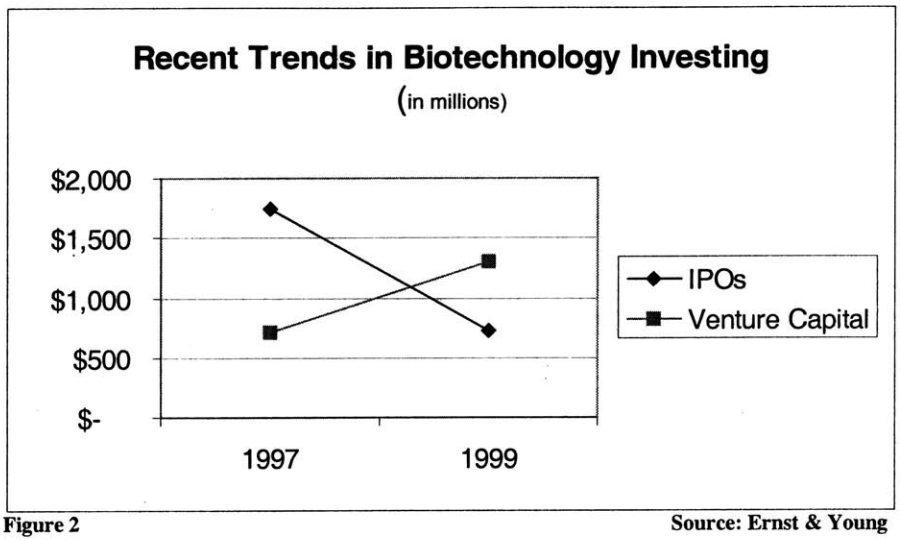

Figure 2 **Source: Ernst & Young**

Further, the majority of all new venture investments are being plowed into internet and software firms. The National Venture Capital Association reported that for 1999, $18 billion had been invested in internet specific firms, an increase of more than 470% over 1998. In contrast to internet investments, VC funds in biotechnology had grown by just 14%, from$1 billion to $1.1 billion from 1998 to 1999.[7] According to the Massachusetts Technology Collaborative, as a percentage of venture capital invested in state firms, biotechnology investments dropped from 25 percent in 1992 to 8 percent in 1998.

[7] Press Release; National Venture Capital Association, February 8, 2000, p.3

The explosion in the size of venture funds has drawn funds and interest away from seed and early stage biotech firms, which normally require $3 – $10 million to start up. According to a 1999 Boston Globe/Pricewaterhouse Coopers survey, the initial biotech seed investments averaged $1.9 million, substantially below the radar of large venture funds.

The public equity market's aversion to biotech, and the venture capital community's stampede to internet and software stocks, has helped to precipitate an unprecedented level of mergers, acquisitions and contracts between cash-strapped, early stage firms and more mature product-starved biotechnology and pharmaceutical firms.

According to a recent Pricewaterhouse study, by the year 2000 large pharmaceutical firms will dedicate more than 30 percent of their R&D to external partnerships.[8] Many large pharmaceutical firms have created internal venture capital entities to invest in promising new firms. In the transaction, large firms access new pipelines of products and small firms receive new sources of scarce funding.

By the third quarter of 1999, some faint signs of renewed interest in the biotech sector were evident in public and private markets. Nonetheless, most of the renewed interest and investment has been concentrated in large mature firms, which have commercially successful therapies and new drugs in late stages of clinical trials.

[8] Press Release; Pricewaterhouse Coopers, October 12, 1999.

Government is a Catalyst and Drag on Biotechnology

Government has been both a catalyst and a source of uncertainty to the biotech industry. Several federal government initiatives have significantly lowered the barriers to the consumer market, and infused the biotech industry with critical research funding, at a time when public markets have been lured away by the higher returns of internet and software stocks. The government's relationship with biotechnology, regulating and simultaneously facilitating its growth, is complex.

Because of the FDA modernization Act of 1997, the FDA has approved more drugs in less time than ever before thus lowering a significant barrier to the market and disincentive to investors. For example, in 1988 the FDA consumed 30 months to approve fewer than 20 drugs. By 1998, the FDA had approved thirty-nine drugs in less than one year.

Biotechnology's federal oversight, partnerships and funding include the FDA, EPA, the Department of Agriculture, the National Science Foundation and NIH. These and other federal agencies impose arguably the highest hurdles across industrial sectors to product testing, development and commercialization. The FDA's stringent product–approval guidelines and its time-consuming research and clinical protocols are the primary reasons for the long time-lines before biotechnology products are brought to market; typically consuming ten years and $250 - $350 million. (See Appendix 4)

The NIH has been the primary benefactor of biotech research across the country. In 1950, the NIH comprised of six research groups was funded at $43 million. By 1999, NIH funding neared $14 billion for its 18 research and grantmaking bodies. Among all the states, Massachusetts is the largest per capita recipient of NIH funding, the majority of which is concentrated in Boston hospitals, MIT and the Whitehead Institute.

According to the biotechnology industry the federal "R&D Tax Credit" is a source of uncertainty. Originally passed in 1981 to foster investments in risky, hi-tech research, the tax credit has yet to be permanently codified into law. Instead the tax credit has been renewed nine times. At an estimated cost of more than $2 billion per year, according to the Congressional Joint Committee on Taxation, it is unlikely to garner the Congressional support necessary to be adopted permanently. Biotechnology firms that are exempt from federal taxes due to operating losses are not financially affected by the uncertainty of the R&D tax credit. Yet, the uncertainty of the tax credit can affect plans for collaboration between large, profitable firms and smaller firms.

Some of the instability in biotech funding, which particularly affects early stage firms, is the national debate over Medicare Coverage of Prescription Drugs. At present, Medicare covers drugs administered in a hospital, but not drugs taken once the patient has been discharged. Several Congressional and Presidential proposals would cover all or part of the cost of drugs outside of the hospital.

Large pharmaceutical companies have strenuously resisted proposals to cover prescription drugs arguing that the government would be tempted to reign in costs by setting drug price ceilings, thus discouraging investments in expensive drug therapies.

The March 2000 announcement by President Clinton and British Prime Minister Blair reaffirming the policy of free and unfettered access to the data generated by the Human Genome Research precipitated a two-day 200-point loss in the Nasdaq, at the time the second highest loss in the index's history. The international Biotechnology conference held in Boston during the Spring of 2000 provoked strong and determined protests, which questioned the premises on which biotechnology is based. As of this writing hundreds of demonstrators protested the manufacture of genetically modified food, outside of the National Academies of Science in Washington, DC.

Section B Framework for the Role of Local Governments

These recent incidents are particularly noteworthy because they are among the latest and most prominent examples of the awkward relationship between biotechnology and government. As regulators and benefactors of the industry, the President and Prime Minister's comments induced a profound adverse reaction in the public markets. As a partner and investor in biotechnology, the NAS is a legitimate target of public concerns about biotechnology's growing role in the food supply. This complex relationship, though less well-publicized, is mirrored at the local level.

The role of local government and its relationship to biotechnology is potentially more intimate than the industry's relationships with the federal level because of the range of issues under the purview of local government including job creation, health and safety. Thus, in order to appreciate fully the evolution of biotechnology at the local level, particularly within Cambridge, it is instructive to develop a framework by which to consider the role of local government in economic development. Three models are considered in brief:

Principles and Roles of Local Economic Development

While the goals of the public and private sectors are not mutually exclusive, they are nonetheless distinct and frequently in conflict. Classical economists affirm that governments should intervene only when free markets explicitly fail. To intervene in the absence of clear market failures, they warn, is to distorts market efficiencies.

Offering a second perspective on government intervention, Pagano and Bowman[9] note that public sector intervention in the private sector can be justified even when markets succeed because governments conclude that markets have maldistributed or failed to provide valuable public goods. Thus, Pagano and Bowman suggest that in spite of, or perhaps due to, a free and efficient market, public intervention is defensible in order to satisfy the public's needs including open space and affordable housing. Consistent with this principle, public intervention could be oriented towards increasing the level of public

[9] Pagano, Michael A., Bowman, Ann O'M. Cityscapes and Capital - the Politics of Urban Development. Johns Hopkins University Press, 1995, p. 69.

services per household, or lowering the percentage of property taxes derived from home-owners.[10]

A third principle informing public sector interventions justifies public economic development programs even when the private sector is efficiently producing goods, *and* contributing to the public welfare. This principle holds that, local governments can defend economic initiatives in the interest of spurring entrepreneurship or diversifying the local economy in order to enhance its regional competitiveness.

However, whether the above-mentioned principles are appropriate to a technology-intensive local economy warrants examination. Biotechnology, in particular, has distinct characteristics that suggest consideration of different principles of risk/reward for local governments:

- Biotechnology is highly entrepreneurial, intrinsically volatile and prone to long lead times.
- Further, erratic investor confidence and industry failures have precipitated industry contraction and mergers.
- The internet, initially sustained by decades of defense department investments, is currently propelled by consumer demand, in contrast to biotechnology R&D.

[10] Two-thirds of Cambridge's property tax revenue is derived from commercial property taxes.

Biotechnology R&D is largely sustained by supply-side forces - government and investors - which have been prone to significant variability.[11]

- Biotechnology has stirred profound questions of health and safety, and like the internet, privacy. These ethical dynamics could retard biotechnology's growth.

Local governments, in light of the above-mentioned characteristics, might consider embracing economic intervention principles that promote dynamism by remedying the inequitable distribution of information, access and predictability that plague young firms in a volatile market. In short, redefining public goods as ensuring that young promising, but vulnerable, firms are not displaced for lack of information or access. Thus, local governments could provide, or induce other institutions to supply, a subsector of the local economy some of the assets that mature firms are more likely to enjoy or hoard, in order to exploit the local economy's dynamism across and within sectors.

Whether organized by the principles of stoking a dynamic local economy, equitable distribution of the results of economic activity, or expanded provision of non-excludable public goods, local governments intervene in spite, and because, of efficient and free markets. These principles, can dictate the roles and process adopted by local governments engaged in economic development programs.

[11] The caps imposed by the 1997 Balanced Budget Agreement (BBA) have led to a real decline, as a percentage of Gross Domestic Product, in Federal support of R&D despite an agreement between the Clinton Administration and Congressional leaders to increase Federal suport for R&D.

Envisioning the Public Sector's Role

The roles that local governments adopt are fluid, reflecting an appraisal of local resources, political momentum and perceived necessity. To be effective the roles have to be appropriate to the local economy or industry being targeted, which is potentially difficult in a highly dynamic and volatile industry. Local governments can play a variety of roles, either exclusively or simultaneously:

- Gatekeeper; using permitting, zoning and the regulatory process to restrict access to the locality, or shape the density, design and quality of new development.
- Nurturer; using the administrative process including permitting and zoning to facilitate entry to the locality, its resources and labor force. And providing the information necessary for firms to efficiently enter, and thrive in, a local market.
- Partner; investing local resources including funds and land, or deferring payments and taxes, in order to attract industry.
- Extractor; utilizing local resources and advantages to leverage concessions from industry such as housing, open space and job training.

The ensuing process is informed by an understanding that, independent of the underlying economic intervention principle, viable economic development programs should proceed methodically and reflectively including:

I. Articulating the necessity of public intervention based on desired goals and self-image.

II. Evaluating the city's powers

III. Appraising the city's resources

IV. Establishing an economic development program

Articulating the Need for Intervention

Before undertaking economic development initiatives, local agencies or leaders should precede their endeavors by articulating the necessity of a particular set of interventions compared to the option of allowing markets to correct, or neglect, the particular target of the intervention. Building public support for intervention includes evaluating the costs and risks weighed against the potential benefits to the locality and its residents. Provided that the local government and residents have validated public intervention and established a clear set of goals, they can begin to envision the public sector's role.

Evaluating the Local Government's Power

Local governments derive their explicit powers from local charters and laws, state constitutions and statutes and federal mandates. Additionally, local governments are comprised of institutions, supplemented by independent entities such as community-based organizations, that provide the means to develop, implement and evaluate their policies. Localities that embark on economic development programs need to measure whether they have the explicit and informal power to carry out their agenda. Further, leadership and momentum whether within the local government or independent of it can enhance or impede its ability to implement an economic development agenda.

Appraising Local Government's Resources

The fourth component should be an appraisal of the local resources, and an evaluation of which resources the locality would be willing to commit to an economic development agenda. Information, perhaps the most valued resource, is rarely distributed equally among industries and cities. Local governments' administrative apparatus is a valuable and limited resource. Additionally, localities often have financial resources and land which, like the bureaucracy, are finite and in demand by competing parties. Local governments should weigh the opportunity costs of devoting the above-mentioned resources to an economic development agenda.

Establishing an economic development program based on goals and self-image

Local governments typically operate parallel economic development programs; providing routine administrative assistance, while trying to attract highly coveted firms or industries. Those dual tracks are generally informed by both the professional assessments of the bureaucracy, as well as the needs and desires of the residents, and other interests. The economic development process should be structured in stages that permit planning, development, implementation and evaluation. Finally, the process should be dedicated to fulfilling the goals and self-image that the locality wants to accomplish.

Summary

Firms choose to locate in regions or cities for a complex mix of reasons. Among the factors that dictate locations choices are the cost of labor and land, public subsidies for

roads, sewers or site acquisitions. Further, firms consider proximity to markets, taxes and the local culture, amenities and economic development policies. The degree to which technology-based companies have changed the mix or relative importance of these factors should be of interest to local governments that host dynamic hi-tech industries.

Cities and regions can overcome significant disadvantages if they provide strategic locations, access to technical innovation and a specialized talent pool, and subsidies generated by other institutions, like the federal government in the case of Cambridge. Labor specialization, human capital accumulation and productivity generate innovations which attract researchers, entrepreneurs and financiers to centers of innovation like Cambridge.

Cambridge, offers no project specific public subsidies.[12] The costs of development and rents are the most expensive in the Commonwealth. The City does not have a history of providing tax abatements, or other inducements. It is a small jurisdiction, approximately six square miles, much of which is built out, making Cambridge among the densest cities in the nation. Further, the City is characterized, whether fairly or unfairly, as anti-business and anti-development. As a result of its abundant resources, Cambridge enjoys the advantage of being home to new (or among the first) innovators of technology-based companies and research institutions, which offset the scarcity and cost of land, and the relative lack of public subsidies.

[12] One could argue that zoning changes, and variances amount to subsidies. However, as used in this context I mean direct investments such as roads, sewers or land acquisition for the direct benefit of a particular project or corporate citizen. In recent history, the City has provided a significant public subsidy on just one occasion; In the depths of the last recession, and in the wake of Genzyme's sudden decision to build a new research facility in Boston, Cambridge granted Biogen a "121-A" deal allowing the firm to make payments in lieu of taxes.

The evolution and challenges faced by biotechnology firms in Cambridge reflect the City's priorities, constraints and self-image. As discussed in greater detail in the following chapter, the momentum at present seems to be shifting towards increasing the stock of affordable housing and reducing development and traffic congestion, while remaining an attractive location for high-growth industries. The success or failure of the City's balancing act will have an impact on fast growing and unprofitable biotechnology firms such as the twelve firms on which this thesis is focused.

CHAPTER 2 THE EVOLUTION OF BIOTECHNOLOGY IN CAMBRIDGE AND ITS IMPLICATIONS FOR THE CITY'S ROLE

Section A The Evolution of Biotechnology in Cambridge

Cambridge's Assets Attract and Nurture Biotechnology

All of the firms, including those that are considering leaving the City, cite essentially the same reasons for initially choosing Cambridge; access to a talented labor pool, scientific innovations and research institutions, as well as opportunities for collaboration with mature and profitable biotech and pharmaceutical firms.

Access to public infrastructure like the subway and proximity to Logan airport were consistently mentioned as important advantages to Cambridge. Additionally, biotech firms cite an abundance of property owners, developers and public officials who are familiar with biotechnology as important benefits to locating in Cambridge. Internationally renowned universities, research centers and Boston-area hospitals are the primary impetus for the concentration of biotechnology in Cambridge. Area universities, in particular MIT and Harvard, proliferate new biotechnology companies, patents and researchers.[13]

Of the twelve randomly chosen biotech firms, eleven were affiliated with either Harvard or MIT. Harvard and MIT are sources of research, funding, and employees for new and established biotechnology firms. For example, in November 1999, MIT announced a

[13] MIT has been especially prolific. According to the MIT TLO, each year 5 – 10 percent of licenses go t startup firms. At present, 125 startup companies have been founded using MIT technology.

new $1.5 billion fund-raising campaign, which will include a new $20 million biomedical imaging center.

MIT's Whitehead Institute is at the center of the multinational Human Genome Project (HGP), the effort to map out the entire genetic code. The effort, already five years ahead of schedule, received $18 million in NIH funding in 1998, up from $ 5 million five years earlier. Whitehead's growing Federal funding stream and accelerated progress has helped to attract several multinational pharmaceutical firms such as Bristol Meyers Squibb, Bayer AG, and Pfizer as well as small biotech entrepreneurs to Cambridge.

The Growth of Biotechnology jobs, salaries and firms in Cambridge

One indicator of biotechnology's growth in Cambridge, within firms and in the number of firms, is suggested by the growth in real estate assessment. For fiscal year 1996, the City of Cambridge assessed biotech firms more than $7.1 million in real estate property taxes. By fiscal year 2000, the assessment had climbed to $106 million.

At present the Commonwealth numbers more than 23,000 biotechnology jobs compared to more than 15,000 in 1996, and 7,682 in 1991, According to the Massachusetts Biotechnology Council. The majority of jobs is hi-skilled and hi-wage. According to the MBC, a Vice-President of Research and Development can earn $140,000 per year, compared to $100,000 in 1994. A Research Associate, requiring a BS in a scientific field and 2-5 years experience can earn between $32,000 and $45,000. At present, Cambridge biotech wages are, on average, 28 percent higher than wages for comparable jobs in the

rest of the Commonwealth, according to the Massachusetts Department of Employment and Training.

The number of biotech firms in the Commonwealth has risen consistently for the past twenty years. Seventy-nine biotechnology firms were founded in the Commonwealth during the 1980s. By 2000, the Commonwealth was home to 240 firms, of which 62 are located in Cambridge.

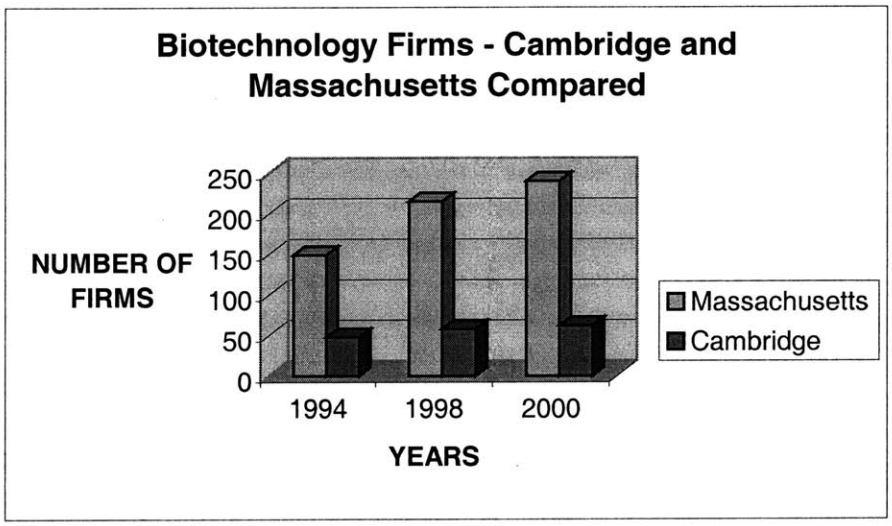

Figure 3 **Source: Massachusetts Biotechnology Council**

By comparison, Boston has 16 firms and Woburn, Waltham and Lexington each have 11 firms for the year 2000. As the industry has grown and matured firms have increasingly established operations in cities and towns throughout the Commonwealth. Cambridge continues to host the overwhelming number of the state's biotech firms. Yet, its share has dropped from 32 percent to 26 percent from 1994-2000, even as the percentage of firms in the Commonwealth has risen by more than 60 percent.

Many factors may be contributing to Cambridge's declining share of the state's biotech firms, including lower rents and higher vacancies outside of the City. Along Route 128, rents for office and R&D space for the third quarter of 1997 ranged from the low $20s – low $30s. Further vacancy rates stood at approximately 11%. By the end of 1999, according to Spaulding & Slye vacancies for lab/office space stood at 8%, and rented for just under $30. Like Cambridge, rents along Route 128 have grown and vacancies have shrunk. However, Rt. 128 rents and vacancies have consistently lagged behind those of Cambridge. While complaining that rents were a significant concern, the overall scarcity of space in which to grow was a more pressing concern.

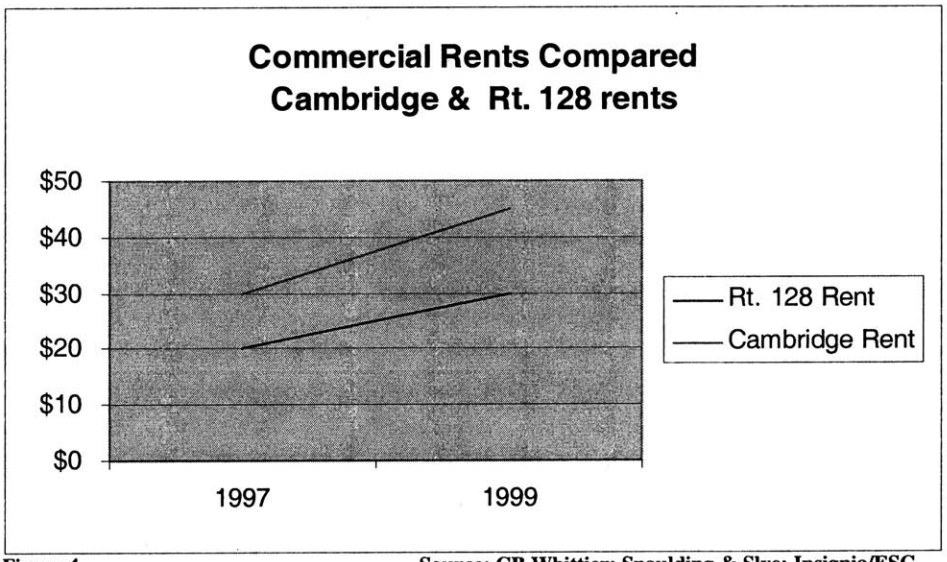

Figure 4 **Source: CB Whittier; Spaulding & Slye; Insignia/ESG**

Another factor likely to contribute to the decline in Cambridge's share of biotech firms is the efforts of neighboring cities like Worcester, Woburn and Waltham to attract biotechnology firms. Worcester, in particular has succeeded in attracting startups and early stage firms, including Cambridge-based companies, to its 370,000 square foot

research park with "cheap space and the promise of office and technical support."[14] In addition, mature well-endowed firms are locating in Worcester. At present, BASF Bioresearch Corp. is building a $37 million, 8,200 square foot research and manufacturing facility. In Boston, two new facilities, Biosquare next to the Boston Medical Center, and Merck and Co., on the grounds of Emmanuel College are likely to attract firms that might otherwise locate in Cambridge.

Cambridge's Regulatory Response Helped to Nurture Biotechnology

Cambridge's early regulatory response to rDNA research may have encouraged biotechnology in the City. Harvard's 1976 proposal to build a laboratory at which it planned to conduct rDNA research instigated an outpouring of concern, disputes and televised City Council hearings. The ensuing controversies divided the scientific community in Cambridge and across the nation on the relative safety of biotechnology, and provoked rumors of "bio-monsters" in the City's sewers.

Eventually, MIT and Harvard agreed to a six-month moratorium on rDNA research, and to the creation of a review committee comprised primarily of lay people. Subsequently, the City codified the NIH guidelines, and created a Cambridge Biohazard Committee (CBC). The CBC continues to review proposals by universities and firms planning to conduct rDNA research. By being one of the first cities in the nation to codify and institutionalize procedures for rDNA research, the City established the predictability and stability on which biotechnology firms and their neighbors depend.

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[14] Rosenberg, Ronald, *BASF Starts Cconstruction on Worcester Facility*, Boston Globe, April 26, 2000 p. D-1.

Section B Implications for the City's Role

Despite Challenges, Cambridge Biotechnology Firms Grow

Despite the numerous challenges faced by Cambridge-based biotechnology firms and the industry at large, most of the firms interviewed have grown robustly, requiring more staff and space. For example:

- Microbia, originally founded by four scientists just over one year ago, has grown to 28 staff members, and projects doubling its staff by the end of 2000. Microbia is currently in its second lab/office space.
- Neurometrix, founded in 1997, has grown from one founder to forty staff persons. By the end of 2000, the firm projects adding sixteen staff.
- Sontra Medical, currently numbering fourteen staff persons, plans to grow to twenty by year's end.
- Acusphere, founded in 1994 by two persons, is currently at forty, and anticipates doubling its staff within the year.

Another, perhaps more tangible measure of the firms' growth potential and space pressure is the number of drugs being developed and in advanced stages of clinical trials. Further, their rates of fundraising, royalty and collaboration agreements are a rough barometer of potential growth, and thus, future lab/office space needs:

- Cubist entered into four major agreements with pharmaceutical firms during 1999, and has one drug in Phase II, and three drugs in Phase III, clinical trials. Further, cubist raised $18.8 million in late 1999.
- Ontogeny, which recently announced a merger with Creative BioMolecules and Reprogenesis to form a new biotechnology firm named Curis, will have in its combined portfolio dozens of products in all stages of research and development, and a staggering 255 pending patent applications. With a combined staff of 155, up from 70, the new firm is building a third facility in Alewife.

According to a majority of the firms that were interviewed, the scarcity of suitable lab and office space is the biggest challenges to growth in the City of Cambridge. Consequently, the firms, including Ontogeny, have searched outside of Cambridge for flexible and affordable laboratory space. Of the twelve Cambridge-based firms, nine have considered lab/office space outside of Cambridge. The fundamental dilemma faced by the small- and mid-sized fast growing firms is how the City can accommodate their growth. And their competitiveness for space may depend on whether the City embraces a role which enhances their access to the information, public support and networks that the larger firms enjoy,

The Cambridge Political Environment and Policies Pose Challenges to Biotechnology

Rapidly growing Cambridge-based biotechnology firms are operating in a property market that is not only scarce and expensive, but one in which the political and public policy landscape has changed significantly. Over the course of the last several years,

coinciding with the end of rent control and the rapid rise of commercial and residential rents, development projects in Cambridge have been confronted with considerable opposition and changes in public policy.

In January 2000, the Cambridge City Council adopted a controversial resolution imposing an eighteen month moratorium on all construction over 20,000 square feet in most of East Cambridge, the City's prime biotechnology districts.[15] (see illustration 2) Adopted in response to a petition from residents of East Cambridge who cited concerns about the pace of development, rising rents and traffic congestion, the law's supporters pledged to conduct a comprehensive planning study of the area. Opponents complain that the moratorium is unnecessarily delaying new development and imposing unfair rent pressures on other parts of the City.

East Cambridge residents in particular have been aggressive about pursuing both administrative and judicial avenues to delay or block development projects. In its selection of Boston over Cambridge, Merck cited Cambridge's political and regulatory unpredictability, as well as the scarcity of space in which to expand as provocations to operate across the Charles. The combination of political upheaval and policy changes, high rents and low vacancies has bred uncertainty for Cambridge's fast growing biotechnology firms.

[15] Located within the zone are the Whitehead Institute, Amgen, Biogen and Genzyme, as well as numerous small and mid-size firms.

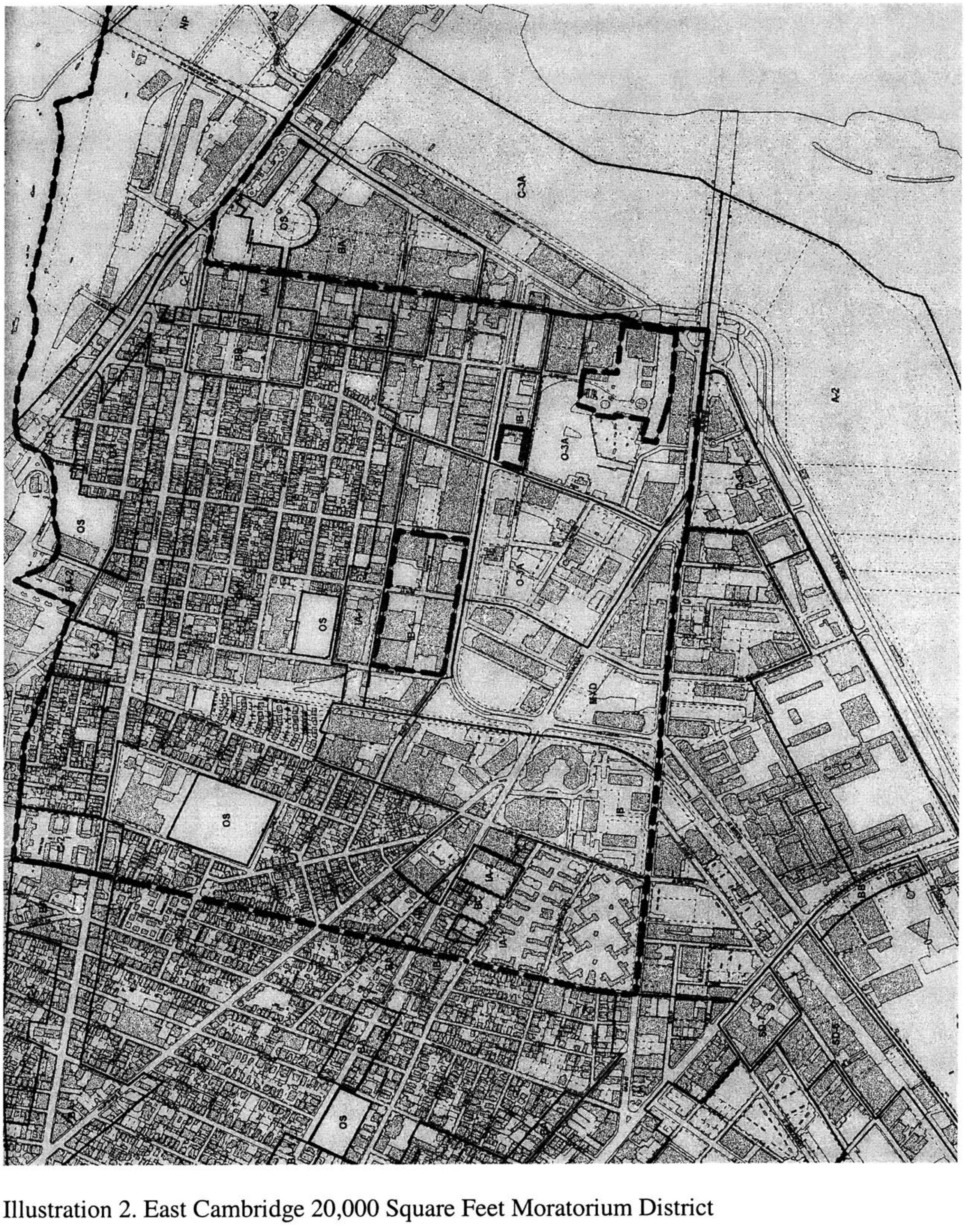

Illustration 2. East Cambridge 20,000 Square Feet Moratorium District

Over ruling the recommendations of the City's Planning Board, in 1998, the City Council adopted the Interim Planning Overlay Petition ordinance (IPOP) which required an additional level of public scrutiny for development projects above fifty thousand square feet. Scheduled to expire in 1999, since its adoption the IPOP has been extended twice to permit the Citywide Growth Management Advisory Committee (CGMAC) more time to research and recommend zoning changes to the City Council, expected in July 2000. As of this writing, the City Council is expected to approve a third six-month extension, to October 2000.

The IPOP has increased the amount of time necessary for project approval by six months, according to the Deputy City Manager. Since January 1999 twelve IPOPs have been granted according to Cambridge's planning staff. Further, in its first year of implementation, fifteen downzoning petitions have been granted nearly double the number for 1998.

Cambridge's Policies Within the Framework of Potential Roles

Throughout its recent history, as the City's economy has changed, the Cambridge has assumed the roles of gatekeeper, nurturer, partner and extractor. Motivated by the competing principles of distributing public goods and facilitating a more dynamic and diverse economy, Cambridge has actively intervened in the local economy. The delicate balance, of maintaining neighborhood character while continuing to attract new industries and enlarge the tax base, is captured in the City's 1998 *Growth Policy Document* (GPD). The GPD articulates the dual goal of preserving the "existing scale of neighborhoods, minimizing traffic impacts and ensuring a smooth transition between commercial and

residential uses . . ."[16] The document's vision was shaped by extensive public hearings and resident participation.

Developers and segments of the business community regard the IPOP and development moratorium in East Cambridge, as anti-development. At minimum, and largely at the behest of Cambridge residents, the City has recently augmented its role of Gatekeeper. At present, the City is on the cusp of adopting a permanent version of IPOP. Whether the City's renewed role as gatekeeper is appropriate to a volatile, technology-intensive local economy merits further consideration from the City and the affected firms.

[16] City of Cambridge *Growth Policy Document*, 1998, p. 36.

CHAPTER 3 CHALLENGES TO FAST GROWING, UNPROFITABLE,SMALL- AND MID-SIZE CAMBRIDGE BIOTECHNOLOGY FIRMS

Introduction

Each of the twelve firms cited concerns about the cost of lab/office space. However, according to the nine firms that have actively looked for space outside of the City, the primary impetus is the scarcity, not the cost, of lab/office space in Cambridge. As a proportion of operating costs, rents ranged from 4 percent to 7 percent, significantly less than the 50-75 percent devoted to staff and research.

Although some new lab space is being produced in Cambridge, developers are largely catering to mature and profitable tenants, according to the firms that were interviewed. Additionally, the twelve firms believe that the scarcity of lab space is compounded by their lack of competitiveness relative to more mature and profitable biotech firms able to build their own space and compete effectively for rental properties. Additionally, some rental properties may be out of reach of the fast growing, unprofitable firms because landlords prefer long term leases that are inimical to hi-growth firms.

Although most Cambridge biotechnology firms across all market sectors are confronted by scarcity and high rent and land costs, their relative ability to thrive in the Cambridge market may depend as much on their own strengths and resources as on their relationships with developers, brokers and the City.

Section A What are Biotechnology Firms' Space Needs, and Demand for Space in Cambridge?

Flexible Space in Which the Firms Can Grow

According to the twelve firms, they need space in which they can grow, or a flexible real estate market that allows them to move into larger spaces in relatively short periods of time. Further, they identified short and flexible lease terms as an important goal. Though concerned about the cost, the overriding dilemma for these fast growing firms is scarcity of lab space.

Several firms identified the progression of space requirements as 5000 – 10,000 square feet initially, moving up to between 15,000 to 25,000, and 25,000 to 50,000 square feet. One half of the respondents to a recent survey[17] (of which R&D/Startup firms comprised 73 percent of respondents) anticipated needing "additional space in the future in the range of 25,000 – 50,0000."

Firms that are unable to find their own lab space may find that subleasing is a poor substitute. Sheila Magil of Bion noted that the firm is subleasing which imposes contractual restrictions on the types of research that Bion can conduct. Further, Bion cannot meet its need for additional lab space within its current location.

Buildings that Can Accommodate Biotech Infrastructure and Equipment

Space requirements for biotechnology are unique and expensive. Biotechnology labs generally require high ceilings to accommodate hoods and other ventilation equipment

[17] Survey; Massachusetts Biotechnology Council and Forest City Enterprises, April 27. 1999. P.3

necessary to the safe disposal of waste, and the circulation and maintenance of a sterile environment. Further, the plumbing and water disposal must be able to withstand and treat the hazardous chemicals and waste discharged in biotechnology research. Thus, biotech space costs as much as $245 more per square foot to develop than conventional office space.

Further, due to the weight of some of the equipment including autoclaves and heavy duty cabinetry, the lab floor must be able to sustain high loads. In addition, radiation experiments that use lead lined equipment can place substantial stress on a floor's maximum load-bearing capacity.

Section B What are the Biotech Firms Experiences Meeting their Space Needs?

The record number of consolidations, mergers and collaborations within the biotechnology industry in general, and in Cambridge in particular, would suggest that lab space might frequently become available. However, whether the collaborations and new development is supplying fast-growing seed, early- and development-stage firms with suitable space or whether mature firms are primarily benefiting from the industry's dynamism is a central question. According to the twelve firms the financing, leasing and security components of the biotechnology lab market favor larger, mature and profitable firms. The scarcity of lab space that small- and mid-size fast growing, unprofitable firms are confronting seems to be compounded by a lack of information, networks and capital relative to the larger firms.

Scarcity & Cost

In 1996, the rate of vacancies in East Cambridge, which includes Kendall and Technology Squares, the epicenters of global biotech, was 5 percent. Rents in this sector of the City ranged from $14.50 - $29 per square foot. Similarly for 1996, vacancies in Mid-Cambridge stood at 5 percent, and rents hovered between $18 and $26 per square foot. By the end of 1999, rents in Kendall Square were as high as $45 per square foot, and the vacancy rate for office space had dropped to below 1 percent according to Spaulding & Slye. Ontogeny, due to high rents and lab scarcity, moved from Kendall to Alewife during this period.

Larger biotechnology and pharmaceutical firms are in a stronger position than small- and mid-size unprofitable hi-growth firms to lease larger spaces for higher rents, and longer periods of time. The profitable firms, such as Amgen, Genzyme and Biogen, are in a position to build their own sites, unlike eleven out of the twelve firms.[18] (see illustration 3) Further sustaining their advantages relative to smaller and unprofitable firms, the larger biotechnology and pharmaceutical firms are presently located in some of Cambridge's prime locations, and have ongoing relationships with property owners, brokers and developers.

[18] Ontogeny is building a new facility to join its two existing facilities, but does not own the land.

Illustration 3. Biogen's new research facility under construction

David Clem, whose development project will include 700,000 square feet of lab space, had considered leasing to smaller less established firms. Conceding that demand is coming from large firms he currently plans to lease lab space for firms that need 100,000 square feet or more. Still several years from completion, fully half of the lab space has been leased or optioned by a large firm.

The twelve firms criticized the shortcomings of the Cambridge real estate market for not providing an adequate inventory of space in which they could grow. Cubist's experience seems to bear out the predominance of space availability as the primary concern for growing firms. Cubist, which recently expanded into a second site of eleven thousand square feet, considered a site in Waltham, and the Schrafft Center in Charlestown prior to

finding its second Cambridge site by word of mouth. What is noteworthy is that Cubist has the lowest rent of any of the firms that were interviewed, $9 per square foot. Despite the fact that the Waltham site rented for more than twice Cubist's current rent, the location provided space in which the firm could expand.

Suitability

The range of available spaces offers some insight into the challenges fast growing biotechnology firms face in finding suitable lab/office space. Seven out of the twelve Cambridge-based firms (58%) were able to find locations previously used as laboratories. Sheila Magil of Bion noted, firms would prefer "not to renovate lab space." Yet, all of the firms that found laboratory space found it necessary to invest in expensive leasehold improvements.

Cambridge Biotechnology Site Renovations

Name	Previous Use	Current Use
Bion	Lab	Lab/Office
Cubist	Industrial	Lab Office
TKT	Industrial	Lab/Office
Ontogeny	Industrial	Lab/Office
Metabolix	Industrial	Lab/Office
EP Ltd.	Industrial/Lab	Lab
Natural Pharmaceuticals	Lab	Lab/Office
Microbia	Lab	Lab/Office
Bench Mark Science	Industrial/Lab	Lab
Sontra	Industrial/Lab	Lab/Office
Acusphere	Lab	Lab/Office
Neurometrix	Office	Lab/Office

Table 1

Those firms that needed lab space but instead found industrial or office space, unavoidably also incurred the cost of expensive leasehold improvements. In marked contrast to the large and profitable firms that have been able to rent or build new lab/office space, seven out of the twelve small firms (58%) are in former industrial sites, such as the Metabolix and Cubist sites pictured below (Illustrations 4 & 5)

Illustration 4. Metabolix Lab/Office in former Commonwealth Gas Building

Illustration 5. Cubist Pharmaceutical's second site (11,000 square feet)

According to David Clem, lab space can cost a developer $215-$245 per square foot to build. By comparison, premium office space in Cambridge typically costs between $100-$125 per square foot to develop. Consequently, in order to recoup the investment, the developer must charge premium rents "which are out of range for small firms."

Clem noted that firms will "often supplement the existing lab infrastructure provided by the developer", thus incurring additional costs. A 1999 survey conducted jointly by the Massachusetts Biotechnology Council and Forest City Enterprises, found that the 52 percent of the time, buildout is provided exclusively by biotechnology tenants, and 35 percent of the time the cost is shared by the tenant and property owners. Typically,

leasehold improvements include HVAC, and plumbing that can properly dispose of biotech waste.

For example, after a five month search Microbia moved to a second and larger space previously used by Shriner's Hospital. Despite the site's previous use as a lab, Microbia invested $200,000 in leasehold improvements. Nonetheless, Peter Hecht of Microbia emphasized that when considering the percentage of operating costs that are devoted to rent, particularly when compared to labor costs, the rent and leasehold costs are less significant than the availability of "flexible, ready to go space." TKT's Alewife site cost the firm $14 million to renovate and install the necessary infrastructure. Ontogeny reported that it spent "several million" dollars remediating a former industrial site and installing leasehold improvements to develop its current lab space.

Finding the Right Space Took Too Long

Finding a suitable space in Cambridge can be a complex and expensive endeavor, particularly for biotechs which have significant restrictions on where they can locate, the types of research they can conduct, and the cost of research infrastructure and equipment. The process of finding lab/office space is a product of myriad factors including local and regional prevailing rents, vacancy rates and the suitability of the available space. Nine out of the twelve Cambridge-based firms reported how long it took to find their current locations.[19] Three firms did not respond or know how long it took to find their current space.

[19] TKT has more than one site. The length of time reported by TKT, 2 years, is specific to its Alewife location. The length of time necessary to find its other sites was not reported. Several of the firms have

Length of Time Required to Find Space

Firm	Length of Time
Benchmark Science	1 year
EP Ltd.	Immediately
Metabolix	6 months
Microbia	5 months
Natural Pharmaceuticals	6 months
Neurometrix	2 months
Ontogeny	2-3 years
Sontra	6 months
TKT	2 years

Table 2

Microbia, which moved to its second, larger, space during its first year, devoted five months to its search. The firm reported that due to a scarcity of suitable lab space in Cambridge it looked at locations in Worcester, Beverly, Woburn and Waltham. At one point during its search, Microbia entered negotiations with another biotech firm to share a space on Vassar Street. However, when one of the existing tenants was unprepared to vacate the site, the agreement collapsed. Eventually, After five months the firm found the above-mentioned former Shriner's lab site in Kendall Square.

Natural Pharmaceuticals, which devoted six months to its search, "contracted the first available site it found", a sublet from Cambridge Neuroscience at Kendall Square.[20] The only exception, EP Limited, found the space it needed virtually as soon as it became necessary through the firm's relationship with the owner of the site in which it is presently located.

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expanded and moved during the course of their existence, and thus the question is specific to their current site.

[20] Cambridge Neuroscience is leaving Cambridge. However, despite repeated attempts no interview was scheduled.

The duress caused by the length of time required to find a space is relative. Large, profitable firms such as Biogen and Amgen have been capable of buying and holding on to Cambridge properties for several years. Smaller firms with no profits and unpredictable growth projections may not have that flexibility.

Long Term Leases Are Impractical

In light of the rate at which the twelve firms are growing long term leases are unlikely to be to their benefit. The firms complained that landlords frequently asked for long-term leases. For example, during Microbia's initial search, David Clem offered the firm a ten-year lease on a raw space on Vassar Street. Yet, Microbia has moved to its second and larger site in Kendall Square within its first year of existence, and grown from several staff to 28. The firm projects that staff will double within the next year, and is already searching for a third and larger space.

Within the last year, Acusphere occupied 10,000 square feet sublet from another biotechnology firm. Subsequently, it moved to a second site of 16,000 square feet. Within the next year, Acusphere expects to double its staff from 40 to 80 during which time the firm will renew its search for a new site.

Proximity Breeds Competition for Skilled Labor

As noted above, all of the interviewed biotechnology firms stressed their need or desire to locate near MIT and Whitehead as well as other biotechnology firms. The proximity facilitates collaboration, informal meetings and information about staffing opportunities.

However, proximity may be a double edged-sword for fast growing small- and mid-sized biotechnology firms.

Several firms complained that despite, or more likely because of, their proximity to MIT, Harvard and profitable firms, finding skilled staff at all levels is more competitive, expensive and time consuming than in the recent past. For instance, Tom Shea of Cubist noted that competition from large profitable firms such as Millennium makes the recruitment of "talent expensive and difficult." David Clem, speculated that more established firms would welcome the exodus of small biotech firms because it would relieve some of the competition for skilled labor

According to DET data during the period 1987 - 1997, in Cambridge average real wages in the drug and pharmaceutical industry grew by 102 percent from more than $26,000 to $54,000. The growth is noteworthy because in 1987 Cambridge's drug and pharmaceutical industry wages were 11 percent lower than the Commonwealth's average wages. However, by 1997, Cambridge biotech wages surpassed the state's $39,000 average salary, by 28 percent

Section C How are the Development, Biotechnology and Institutional Sectors Responding to this Demand?

How are Developers Responding?

David Clem noted that lenders are unwilling to loan for development projects whose tenants are small, relatively obscure biotech firms that have yet to turn a profit. Consequently developers are unwilling to build for, and rent to, small firms.

Mike Cantalupa of Boston Properties observed that developers are not building on "spec." Biotech Firms "need to have strong credit and be willing to rent large sites for long-term leases in order to motivate" developers to build lab/office space, according to Cantalupa. Small- and mid-size, fast growing and unprofitable biotech firms seldom meet this criteria.

A particular example of the dilemma faced by small and mid-sized biotechnology firms is Technology Square, purchased for $123 million by the Beacon Capital Partners, a Real Estate Investment Trust, in June 1998. Beacon explicitly notes in a press release that at present the properties lease for "below market rents" and its intent to "substantially increase net income" on the redevelopment. Beacon plans to renovate four buildings, of which one buildings, totaling nearly 475,000 square feet, will be devoted to laboratory space. Tom Ragno, of Beacon conceded that "larger, better established firms are taking the space." As of December 1999, one year before becoming available for occupancy, the building is fully rented.

Tom Lucey of Forrest City Enterprises (FCE) noted that especially in the wake of the last construction crash, developers and lenders are "not willing to build on spec." Small firms are not the primary market for which FCE builds, and only when there is some "filler" space available will Forrest City or its large tenants sublet to small firms. Lucey's comments are noteworthy because Forrest City is currently in the midst of a multi-year development project to build millions of square feet of office/R&D space at University Park.

Brokerage firms seem to perpetuate the information and access gap between the large and profitable firms and the small unprofitable firms. Fallon, Hines & O'Connor, for example, handles the largest and most mature biotech firms such as Amgen, Biogen and Millennium, but has virtually no relationships with smaller unprofitable firms. This may clarify why 75 percent of the interviewed firms found their sites through word of mouth, rather than word of mouth.

The development log issued by the City of Cambridge supports the observations of the developers and brokers. New and renovated R&D spaces are being built by large real estate trusts, or development companies, as well as pharmaceutical and biotechnology firms. The large square footage of the developments favors large, profitable tenants rather than small and mid-sized firms with rapidly evolving space needs, and weak bottom lines.

How are Mature Biotechnology and Pharmaceutical Firms Responding?

In addition to developers, large biotechnology and pharmaceutical firms are potentially in a position to supply the space needed by the fast growing and unprofitable firms. At present there is an influx of large biotechnology and pharmaceutical firms prepared to build their own space in Cambridge. Further, there is development, and redevelopment of existing, lab space.

Bayer and Amgen (Illustration 6), among other new arrivals to Cambridge, are building their own facilities. In addition to Tech Square's 475,000 foot lab space, Biogen, based

in Cambridge, is adding a new 210,000 square foot research facility at Kendall Square, and is holding on to two additional sites for future development.

Illustration 6. Amgen's new 285,000 square foot research facility under construction

However, there is some question as to whether the new development will free up space for smaller fast-growing firms either because of property owners' reluctance to lease to smaller firms for short-term periods, or due to the anticipated expansion needs of the larger firms. David Clem observed that "big companies are swallowing up new space" adding that small companies do not have the capital to secure development loans.

Steve Delaney of Acusphere complained that it is competing with larger more established firms which are "holding onto" smaller spaces that early stage firms would normally inherit, due to the Cambridge's scarcity of adequate lab space and uncertain political climate. Mike Cantalupa, of Boston Properties, observed that in the past, large firms

would not typically consider hoarding small spaces, but at present large firms "will take it."

Concern over security breaches and unauthorized access to technology and information, according to Cantalupa and Lucey, is one of the reasons that large biotechnology firms are reluctant to sublet to smaller firms. Lucey noted that Millennium provides its own van pool rather than utilize the University Park Service because of the concern over inadvertent information leaks. According to local developers and City officials, Biogen plans to sublet to non-biotechnology firms. Amgen plans to sublet to Genzyme, a large, stable and profitable peer-firm. Scott Simpson, an architect who designs biotech buildings including the new Amgen building, noted that concerns over central services like loading zones, storage and waste disposal as well as liability make some large firms unwilling to sublease to smaller biotech firms.

Finally, partnerships and collaborations between the larger profitable firms and the smaller unprofitable firms offer a potential remedy to the space needs of the interviewed firms. However, just four out of the twelve firms had active collaborations, and in no case did the collaborations lead to shared lab space.

How are Cambridge's Largest Institutional Property Owners – Harvard and MIT - Responding to the Needs of Small, Fast Growing Biotechnology Firms?

MIT and Harvard are responsible for dozens of spin-off firms. Their licensing and patent output is a powerful lure to entrepreneurs and investors. Both institutions own millions of square feet of property in Cambridge.

Nonetheless, neither school implements a formal process by which new firms are assisted in obtaining the information and access necessary to find suitable locations. According to Harvard's Office of Planning and Real Estate, that office focuses on helping "departments anticipate and meet demand for expansion space, not helping startups."

The MIT Treasurer's Office states that "the majority of MIT's (1.5 million square feet) holdings are for investment purposes." The Office refers inquiries to commercial brokers. The MIT Technology and Licensing Office explicitly states that MIT does not incubate firms or provide location assistance for new firms.

Section D How has the City of Cambridge Responded to the Specific Needs of the Twelve Firms?

Cambridge Has Adopted an Affirmative Economic Development Goal

The City of Cambridge recognizes that "markets fail and the distribution of information is highly variable."[21] Consequently, the City has adopted several simultaneous goals including:

- Maintain a Positive Business Climate
- Facilitating Information Flow
- Overcoming Market Imperfections
- Advocacy

[21] City of Cambridge *Economic Development Policy*. 1997, p.3.

Further, the City has committed itself to provide a climate for the private sector "in which it can conduct business", and to "address imperfections in the real estate market."[22] Accordingly, the City's Economic Development Division (EDD) provides a range of services, and resources for entrepreneurs including a revolving loan fund and streamlining and clarifying the permitting process, a site-finder service, and facade improvement projects. Specific projects and population are also targeted for assistance by the EDD including women- and minority-owned businesses.

The University Park project exemplifies the City's ability to merge roles, in effect becoming a facilitator and extractor of affordable housing for the City's low-income residents. For example, Forest City initially proposed 100 units of affordable housing, which at the City's insistence was increased to more than 240. Moreover, the City acted as arbiter in negotiations among the private parties, and neighboring community over issues of traffic impacts and land swaps.

The City has also been a partner to startups and early stage firms for which "it is harder to obtain funds"[23] by contributing $5 million from its pension fund to invest in two private venture funds which placed equity in Cambridge high tech firms.

Motivated by an explicit desire to diversify the industrial base and provide employment opportunities across the labor force, the City has actively recruited, supported and invested in industries and firms. Nonetheless, the City's policy makers consistently

[22] Ibid.
[23] Ibid.

articulate a need for balance between community/residential interests and business needs, reflecting the City's "civic values."[24] In addition, a Cambridge official noted that the "collective understanding is that some firms will have to move out of the City" due to the cost and scarcity of space, citing the examples of Lotus and Polaroid.[25]

The need to balance the interests of Cambridge's residential and business sectors is the City's fundamental responsibility. And to some degree, the cyclical and structural exodus of business and industry is inevitable. At other times, private landowners' decisions profoundly affect the mix and viability of industries. For example, as the City concedes in its 1997 economic development policy, landowners are sometimes reluctant to develop their land for manufacturing, "preferring instead to instead wait until a high density office use becomes feasible."

The question at the center of the biotech firms' experiences is whether firms and industries vacate the City because the economic possibilities unique to Cambridge are relatively exhausted, or due to market and information failures in which the City could successfully intervene.

The interviews with the firms suggest that there are opportunities for the firms and City to bridge information and access gaps that otherwise may compel some to relocate outside of Cambridge. For example, eleven out twelve firms had no association with the City of Cambridge, other than a minimal regulatory relationship.[26] The most compelling

[24] Ibid.
[25] City of Cambridge Budget Office Representative
[26] Ontogeny, the only exception, has donated computers to the City's public schools.

rationale for a closer relationship between the firms and the City is that firm displacement, whether due to remediable market failures or policy obstacles, is not in the public's interest, when the City's treasury, prestige and labor force may continue to benefit from biotech.

Location Assistance

The City's economic development policy document notes that "Municipal government can design programs to address specific imperfections in the capital, employment, and real estate markets." In an effort to fulfill this principle, the City subscribes to a commercial site finder, and publishes a *Development Log*, which tracks development projects in excess of 20,000 square feet.

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However, in an effort to avoid competing with commercial brokers, and due to finite staff resources, the site finder is not widely advertised to firms that might benefit from access to its data. Further, most of the twelve firms' space needs fell below the 20,000 square feet which the *Development Log* monitors, and thus could not analyze its data to evaluate site trends. The interviews revealed a number of information and service gaps:

- None of the firms interviewed was aware of the City's site finder service.
- None of the firms interviewed solicited location assistance from the City.
- None of the firms was aware of Economic Development Division staff member who has extensive experience working with several large biotechnology firms.
- Despite the cost of leasehold improvements and biotech equipment, none of the firms was aware of the City's *Revolving Loan Fund.*

Is a Biotechnology Incubator a Viable Location Remedy?

The viability of an incubator with shared lab space was explored with the biotechnology firms and developers. Of the twelve firms, eight firms supported the concept of locating in an incubator. Whether, the City would provide assistance in developing an incubator is doubtful. In the recent past, the City had invested in an incubator, which lost income and became politically unpopular. Additionally, the incentives that developers such as David Clem suggested including "tax deferments and an expedited permitting process", would be difficult to secure from the Cambridge City Council. When asked about an the merits of an incubator, a highly-placed City official responded "I'm not sure we should."

Zoning Issues

The momentum in favor of downzoning and reevaluating the City's growth policies is at odds with the twelve firms' growth projections and pressures. As noted in Chapter 2, eight downzoning petitions were adopted in 1998 compared to fifteen in 1999, IPOP's first full year of implementation.

Dan Gefken, of TKT, notes that IPOP "has made it difficult for TKT to interest developers and lenders in the firm's plans to consolidate" its four sites, due to the uncertainty and time lags induced by IPOP. Most of the firms that were interviewed (75%) were aware of IPOP, and expressed general concern about its impact on their future expansion plans. Benchmark Science, which has to vacate its current location by Summer, characterized the current climate as "scary", and felt resigned to moving out of the City.

Acusphere, stated that the larger firms would weather the downzoing storm, but that the City needs "a mix of firms – large and small." Interestingly, none of the twelve firms was aware of the recently adopted moratorium on development in excess of 20,000 square feet in East Cambridge. In several cases (Metabolix, Sontra, Microbia & Natural Pharmaceutical), the firms were located in the affected district.

Section E What are the Obstacles & Market Failures Faced by the Firms?

Obstacles

As I define the term, the following obstacles are comprised of practices and policies that impede the growth of fast growing, small- and mid-sized, unprofitable biotechnology firms, and inhibit the benefits that could accrue to Cambridge.

- City's Role as Gatekeeper

  The City's adoption of IPOP and the East Cambridge moratorium are likely to lead to a permanent downzoning of Cambridge's prime biotechnology districts, according to City officials. Further, Cambridge's renewed emphasis on affordable housing is likely to include housing in some portions of industrial districts currently zoned exclusively for industry, further reducing the available space for biotech.

- Firms Fail to Use Some of the City's Services

  As noted above, none of the firms was aware of the City's *Revolving Loan Fund*, or *Site Finder* service. Consequently, the firms may find that without the City's

help relying primarily on word of mouth is no match for the resources and networks available to the larger, profitable firms. Other than regulatory matters, eleven of the twelve firms lack an ongoing relationship with Cambridge

- Security and Liability Concerns Impede Subleasing

  At present two out twelve firms, Bion and Natural Pharmaceutical, sublet from larger firms. Some of the larger firms that could accommodate smaller firms seem reluctant to do so for security and liability reasons.

- Harvard and MIT Play No Comprehensive Role in Finding Space

  Despite their prolific rate of startups and licensing, neither institution offers location nor incubation services. With their extensive property holdings they could play a potentially stabilizing role in helping young firms find adequate space.

Market Failures

Market failures represent the local market's inability to efficiently and rationally meet the demands of local entrepreneurs and workers. The reasons for the failure include a concentration of information and access among firms with networks and resources that inhibit the competitiveness of other firms.

- The Cambridge market is not meeting the overall demand for lab space, inducing smaller unprofitable firms to look outside of the City.

- Profitable, larger firms are more likely than the smaller firms to own property or build to suit. Consequently, the profitable, larger firms and their representatives have more consistent interactions with the City. Relationships among large firms and developers, brokers and City officials may benefit the larger firms, and put the smaller firms at a competitive disadvantage.
- Firms that need short-term leases may find it difficult to compete for lab space against firms that are profitable and capable of signing on to long-term leases.
- Developers and lenders will not build on "spec" thus artificially limiting the potential supply of new lab space.
- Small amounts of lab space are not made available to small firms even if they can pay market rents due to information asymmetries and the lack of financial support from lenders.

CHAPTER 4 FINDINGS, CONCLUSIONS & RECOMMENDATIONS

Section A Findings

The interviews with the twelve Cambridge biotech firms, as well as the non-Cambridge firm Syntonix, yielded a wealth of information. The degree to which I could confirm or challenge their views was enhanced through interviews with brokers, public officials and developers. While much of the information was suggestive, and even compelling, the findings are restricted to those items in which I had a reasonable measure of confidence. A lack of public sector data and the fact that ten out twelve firms were private and thus effectively guarded about what information they revealed, were the biggest impediments to establishing findings.

Biotechnology Firms

- My hypothesis is that given their current choices, fast growing, unprofitable firms would look to cities and regions outside of Cambridge for available lab/office space. Although rent was cited as a substantial concern among all of the firms, the primary reason they cited was the scarcity of lab/office space which made planning research and staff expansion difficult. Nine of the twelve firms that were interviewed conceded that, in some cases very reluctantly, they had begun to look outside of Cambridge for lab/office space. One of the nine firms, *Natural Pharmaceuticals*, had secured space in another city at the time of our interview.
- Eight firms were open to the idea of sharing lab space either in an incubator setting, or subletting from a larger firm.
- Collaborations with more mature firms didn't lead to shared lab space.

- Seventy-five percent of the firms found their space through word of mouth rather than through a broker.
- Brokers and developers confirmed the small firms' complaint that the developers are not committed to building for small, unprofitable firms.
- The concentration of firms, hospitals and research institutions in Cambridge is correlated to higher wages compared to the rest of the state. This is a source of concern for the small firms competing for skilled workers.
- The firms had a very superficial understanding of how recent zoning changes in Cambridge could affect them. With the exception of Ontogeny, the firms had no relationships or involvement in local affairs except for the minimum regulatory association.

City of Cambridge

- The City of Cambridge's relationship to the small, unprofitable firms is restricted to regulatory and fiscal affairs. None of the twelve firms used the City's *Site Finder*, or was aware of the *Revolving Loan Fund.*
- Data from the Assessor's Office is a potentially useful proxy by which to measure the growth of biotechnology in the City. While the Real Estate Tax Assessment is relatively simple to measure, the same is not the case for the personal property tax assessment. The personal property tax assessment is hampered by the failure of other City agencies, including the City Clerk, inspectional services, public health and the state office of incorporation, to supply information to that office. Subsequently, the growth of the industry as measured by equipment and infrastructure is impeded.

- The assessor was unfamiliar with several of the firms that comprised the focus of this research.
- Data from the City Clerk in which businesses located in Cambridge are required to register is inadequate to the task of evaluating the growth trends of the City's industries. Thus, conducting an analysis independent of the biotechnology trade association, or the state's DET, is hampered.
    - Business registration is required once every four years, during which time a wealth of business activity may go unmonitored.
    - Firms that fail or leave City do not notify the City Clerk or other agency.
    - Firms that are registered in another state or with the Commonwealth are not required to register in Cambridge.
    - The information on the forms is not organized by Standard Industrial Codes for analysis with state and federal data.
    - The database is not designed to sort and respond to queries about particular industries.
- The City's Office of Inspectional Services, which issues construction permits makes evaluating the current and projected stock of lab/office space unfeasible because the agency requires so little detailed data on its forms.
- The Health Inspector's Office effectively monitors firms conducting rDNA research. However, only a fraction of all of the City's biotech firms conduct rDNA research, impeding analysis of the broader industry.
- Several new policies are likely to make the scarcity of lab space more pronounced:
    - The Interim Planning Overlay Petition ordinance (IPOP) was originally adopted by the City Council to allow a review of current growth and zoning

policies. According to City officials, a permanent ordinance is likely to be adopted making the traffic and design policies more stringent.

- Downzoning petitions adopted by the City Council increased from eight in 1998 to fifteen in 1999, the first year of IPOP.
- The City is considering increasing the stock of affordable housing by rezoning areas that are currently zoned for industry including biotechnology, into mixed-use industrial/residential districts. The policy being considered would not increase the density of the affected districts.

MIT and Harvard

➢ Despite owning millions of square feet in property, and turning out prolific numbers of firms, licensed technology and patents, MIT and Harvard do not provide a formal mechanism by which firms can find lab space or incubation facilities.

Section B Conclusions

The twelve firms that were interviewed are growing robustly. Consequently, they face pressure to find lab space. However, the Cambridge market is effectively full, and the Cambridge government seems intent on slowing the rate and scope of development. Compounding the space dilemma for the twelve firms, larger, profitable firms capable of signing long term leases, hoard space and build to suit are locating in Cambridge, simultaneous to the City's new policies.

That these dynamics may affect the smaller firms disproportionately more than mature, profitable firms is unsurprising. The mature firms are profitable and associated with effective networks. In some cases the mature firms are landowners and thus able to press their claims to the City in ways not available to renters.

With the exception of Natural Pharmaceuticals, which found a site outside of Cambridge, the remaining firms are actively looking in Cambridge while simultaneously searching for space in other cities. At present, some of the remedies that could alleviate their space shortage including incubation and subleasing are largely unavailable. Nonetheless, despite the temptation of moving to other cities, several factors may serve to keep the remaining eleven firms in Cambridge.

Millions of square feet of lab space are due to come on line in the next several years. However, the industry's volatility may precipitate a decline in the demand from mature firms that smaller unprofitable firms could fill. Further, all of the firms interviewed planned to develop partnerships with mature and profitable firms, which could lead to shared lab and research arrangements. Moreover, all of the firms withstood labor competition, higher rents and lab scarcity because the access and prestige of locating in Cambridge was deemed to be particularly valuable to the firms. Thus, they have demonstrated that at least at this stage of their development they are willing to tolerate difficult and expensive challenges to their viability in return for the advantages of operating in Cambridge. Finally, as the firms mature they may find that, as in the case of Ontogeny, they can expand their facilities within the City.

Nonetheless, there are several issues that the City should consider. The City's fastest-growing industries – biotechnology, E-commerce and software design – are volatile and dynamic. Thus, the City should consider whether its current menu of policies, especially its role as gatekeeper, is suitable to the hi-tech industries which it hosts. For example, the development and contributions of small and unprofitable biotechnology firms could be retarded by policies that artificially skew access to information, technical assistance and suitable lab sites. Firm displacement due to obstacles to information and market failures are not in the long-term interest of the City's treasury, prestige or labor force.

The City's ability to determine whether it should intervene to promote the growth, or stability, of small, unprofitable firms is hampered by two factors. First, the dearth of City-generated data impedes its ability to evaluate industry trends. Second, the momentum in favor of downzoning may substantially create a barrier which some firms are unable to overcome, and pre-empt the City's efforts. Should this come to pass, the City may find that increasingly the firms operating in Cambridge are large, profitable firms whose primary headquarters are in cities, states or countries other than Cambridge, Massachusetts or the US, as in the case of Amgen (California) and Bayer AG (Germany).

Moreover, Cambridge is subject to competition from rival cities and states increasingly capable and willing to provide the soft and hard infrastructure necessary to young, dynamic biotechnology firms. Worcester, Boston and Woburn, among others may not ultimately rival Cambridge, but could be in a position to deplete some of the City's most dynamic and promising firms. Increasingly effective competition from rivals may be

inevitable as Cambridge becomes built out, and local firms mature and consume more space.

Further, California, has significantly more firms than Massachusetts, and Silicon Valley continues to rival Cambridge as the primary center of biotech innovation. In the Spring of 1999, the Wisconsin State Investment Board approved a $50 million venture fund to invest in biotechnology. Provoked by a lack of investor interest from both coasts, the Board resolved to invest in promising local biotech firms in the hope of eventually attracting outside equity. The Wisconsin investment provides a noteworthy counterpoint to Cambridge. Faced with a shortage of investor interest, rather than lab space, the State Investment Board decided to intervene as a partner, utilizing the pension fund under its control.

As the industry matures and grows, cities and states newly interested in hosting biotechnology firms will find it necessary to confront investor volatility, long lead times to market and high rates of failure. Developing a clear rationale for intervention – market failure, public goods, or firm displacement – will be essential to successfully hosting biotech firms. Crafting the appropriate roles - partner, extractor, nurturer or gatekeeper – will determine whether efforts such as Wisconsin's succeed.

Despite the City's years of experience, the interviews suggest that Cambridge should consider whether its policies and its role as Gatekeeper are appropriate to the industry's needs and potential benefits to the City. Small and dynamic firms caught between the twin phenomena of downzoning and the influx of mature and profitable firms, may find it

increasingly difficult to stay in Cambridge and eventually flee the City. If this comes to pass, the diversity and competitiveness of Cambridge's biotech sector may be severely undermined. The City could redefine its gatekeeper role to include an affirmative effort to keep particular types of firms in the City, rather than the narrower sense of restricting development and traffic.

As suggested by most of the firms, an effort to promote an incubation facility or district specifically zoned for small and innovative firms is one role the City could adopt consistent with its powers and resources. Alternatively, the City could redefine the gatekeeper role by addressing the information and network deficits suffered by small firms, thus promoting their viability in Cambridge.

Section C Recommendations

Biotechnology Firms

- Actively Solicit Information and Assistance from Cambridge; The twelve firms that were interviewed might have benefited from location assistance. Access to the City's *Revolving Loan Fund*, which lends up to $150,000, for leasehold improvements might have facilitated decisions about potential sites and the required infrastructure investments.
- Actively Pursue Relationship-Building with Developers and Mature Pharmaceuticals; The majority of new lab/office properties being developed in the City is being produced by developers and mature firms whose resources and networks are superior to the twelve firms. The twelve firms should consider how to develop mutually beneficial relationships that help them find shared lab space.

- Participate in Public Affairs; Most of the firms were aware of IPOP. However, none of the firms was aware of the new moratorium on development in excess of 20,000 square feet to which East Cambridge is currently subject. The twelve firms should consider attending zoning hearings, or requesting that the Massachusetts Biotechnology Council, of which all of the firms are members, keep them abreast of zoning issues that affect them.
- Partner with the City to Train Workforce; The City's Community Development Division and Office of Workforce Development are focused on industries and programs that expand job opportunities for Cambridge residents. Given the twelve firms' concerns about competition for labor, partnering with the City and a local community college or transitional assistance program might alleviate some of the shortage. Further, such a partnership could create goodwill and relationships that could benefit the firms in the future.
- Commission an Independent Report; Given the industry's dynamism, and impressive growth the industry should consider commissioning an independent report that articulates its contributions to the City, its needs and opportunities for partnerships with the public sector.
- Make Common Cause with supporters of affordable housing; The City's Community Development Division will recommend a renewed emphasis on affordable housing in districts in which biotechnology is currently operating. Working with local residents, and workers may help biotech firms stave off potential losses in available square footage.

City of Cambridge

- Require Agencies to Record and Analyze Data in Greater Depth; As noted in the findings, the dearth of information at several City agencies makes it very difficult for the City or an independent analyst to evaluate trends in the City's industrial mix.
- Conduct a Study of the Biotech Industry; Notwithstanding the above-mentioned recommendation, the City should consider a study of the industry in order to determine needs, contributions to the City's tax and employment base and means by which the City can minimize externalities produced by the industry. Further, the City should consider whether there has been a shift in the market sectors, development stages and states of incorporation for firms operating in Cambridge.
- Investigate Whether there is a Correlation Between Downzoning Petitions and Construction Permits; Several brokers suspect that the intensity of development is landowners' response to an increasingly restrictive environment, and the ensuing fear of property value losses. The City should review whether its policies have contributed to the intensity of development.
- Use the Revolving Loan Fund to Credit Enhance Firms; Brokers and firms stated that landlords are often reluctant to lease to biotech firms due to the industry's volatility. The City might consider using an existing program such as its *Revolving Loan Fund*, to credit enhance firms trying to lease space in the City.
- Consider Design and Security Factors that Promote Subleasing; Several developers noted that large pharmaceutical firms are reluctant to sublease due to security and liability concerns. The Community Development Division should consider whether there are design protocols that promote corporate integrity for larger firms and their subtenants.

- Consider Using Site Finder to Address Information Gaps of Small Firms; As noted in the findings, none of the firms used, or was aware of, the City's site finder service.

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Appendix 1

QUESTIONS FOR CAMBRIDGE EARLY-STAGE BIO FIRMS

SECTION 1.

1. Name of firm
2. Public or private
3. Location(s)
4. Staff size - at outset; at present & projected in the next 1-2 years
5. Revenue & Cap size
6. Cash on hand
7. Age
8. Product(s) on market
9. Pipeline
10. Financing trends & sources
11. Mergers/contracts/royalties

SECTION 2. **LOCATION ISSUES**

12. Why did the firm select Cambridge?
13. How did the firm find its space?
    - Word of mouth, broker, City of Cambridge, other?
14. Was the firm interested in renting, buying or building?
15. How long did it take to find its space?
16. What type of space did the firm look for?
    - Class A,B or C?

17. Was the space newly constructed, renovated, or previously occupied by another biotech?
18. Does the firm feel as though it is in competition for space with larger/more mature firms?
19. Are large biotechs and pharmaceuticals vacating space that is being filled by early stage biotechs, or are the large pharmaceuticals "filtering down" – effectively taking space that would otherwise go to early stage firms?
20. Are developers still eager to build for biotechs, and if so, are they primarily building for mature firms or early stage firms?
21. Did the firm look outside of Cambridge?
22. If so, how did the other locales compare to Cambridge?
23. Did the firm look at other states, CA, TX., NC?
24. How many square feet did the firm look for, and did it find what it needed?
25. Does the firm have plans to expand, and if so, does the firm plan/hope to expand in Cambridge?
    - Rent, buy or build
26. Does the firm currently manufacture in Cambridge?
27. How would you characterize your relationships with MIT & Harvard?
28. Have the firm's partners, or investors had an influence on location – city, space, cost?
29. Are there amenities that attracted the firm to Cambridge?
30. Are there amenities or quality of life factors that the firm would like to see Cambridge develop?
31. What role does transportation, traffic or public transportation play in the firm's location?

32. Does Cambridge foster a social, economic or intellectual interaction or interpendence with other firms and researchers that the firm values?

33. Does being in Cambridge provide access to suppliers, peers and support such as consultants, other firms, lawyers, and VCs?

34. Is the culture of Cambridge different than that of competitor cities or Rt. 128?

SECTION 3. **COST ISSUES**

35. Were there special infrastructure or remediation needs that the firm had to install and/or invest in prior to moving into its present space?

- Lab, disposal or waste/emissions equipment?
- Contamination?
- What was the square foot cost?

36. How much is the firm currently paying per square foot?

37. What percentage of the firm's revenues is paid in annual rent?

38. Is there a rule of thumb that early stage firms try to observe in terms of the percentage of revenue devoted to rent?

39. What are the terms of the lease?

40. What is the length of the lease?

41. Is the firm leasing or subleasing?

42. Would the firm consider incubating another firm, or being incubated in the space of larger bio-pharms?

43. Are their special arrangements with the landlord or investors/partners?

SECTION 4. **CITY OF CAMBRIDGE/PUBLIC POLICY & INCENTIVES**

44. How would you characterize your relationship with the City of Cambridge?

45. Did the firm solicit assistance from the City in finding its current space?

46. Is the firm aware of the City's programs?

- RLF
- IDB
- Site finder

47. Does the firm believe that the permit and zoning statutes are transparent and efficient?

48. Is the firm aware of IPOP and the 18-month moratorium?

49. Have they been impediments or had no impact?

50. What type of public policies or incentives would the firm prefer to see implemented in the City?

Appendix 2
LIST OF TWELVE CAMBRIDGE BIOTECHNOLOGY FIRMS

Cambridge Biotechnology Firms				
Name	**Years in Cambridge**	**Stage of Development**	**Employees**	**Partners**
Acusphere, Inc.	6	R&D	40	No
Bench Mark Science	1	Early Stage	1	No
Bion, Inc.	4	R&D	10	Yes
Cubist, Inc.	7	R&D	70	Yes
EP Limited	5	Pre-Seed	3	No
Metabolix, Inc.	7	Research	25	No
Microbia, Inc.	1	R&D	28	No
Natural Pharmaceuticals, Inc.	2	R&D	10	No
Neuro Metrix, Inc.	3	R&D	40	No
Ontogeny, Inc.	6	R&D	75	Yes
Sontra, Inc.	2	R&D	14	No
Transkaryotic Therapies (TKT), Inc.	6	R&D	260	Yes

Appendix 3
LIST OF ALL INTERVIEWS

NAME	FIRM/AGENCY
BIOTECH INDUSTRY	
Andrea Jeffrey	TKT
Doros Platika	Ontogeny
Sheila Magil	Bion, Inc.
Tom Shea	Cubist
Janice Bourque	Massachusetts Biotechnology Council
Fernando Quesada	Biotechnology Center of Excellence Corp.
David Bradley	Benchmark Science
Peter Hecht	Microbia
Shawn Stovall	Sontra
Wendy Graham-Coco	Biostrean
Shai Gozani	Neurometrix
Dan Gefken	TKT
Tony Sinskey	Metabolix
Garen Bohlin	Syntonix
Mike Curley	EP Ltd, biotech
Steve Delaney	Acusphere
Anonymous	Natural Pharmaceutical
Eric Meyers	3rd Millennium
INCUBATORS	
Brenda Morris	Office at Kendall
John Savelenski	Greenworks
Ed O'Lear	100 Inman Street
Geoffrey Smythe	342 Columbia Street
Diane Franklin	Cambridge BDC
Eileen Mahoney	HQ Cambridge
Bill Hughes	Cambridge Incubator
ENTEPRENEURS	
Michael Werthime	Smarter Living
Keith G. Ciampa	World Energy
John Debarios	Debarios & Co., P.C.
BROKERS/REAL ESTATE	
Brendan Noonan	Meredith & Grew
Anonymous	Harvard Planning & RE
Greg Larson	Fallon, Hines & O'Connor
Joe Maguire	MIT Treasurer's Ofc. (RE)

DEVELOPERS

Mike Cantalapa	Boston Properties
Tom Ragno	Beacon Capital Properties
David Clem	Lyme Properties
Scott Simpson	Stubbins Assoc.
Darryl Morse	Insignia/ESG
Tom Lucey	Forest City Development

PUBLIC OFFICIALS

Jim Maloney	Cambridge Budget Director
Joe Donovan	Massachusetts Office of Business Development
Sally Powers	Cambridge Assessors Office
Kevin Mcdevitt	Cambridge Assessors Office
Sam Lipson	Cambridge bio licensing Office
Liza Paden	Cambridge Community Development
John Hodgman	Massachusetts Technology Corporation
Anonymous	Cambridge Inspectional Services; City Clerk

FINANCIERS

Scott Heeson	National Venture Capital Association

OTHERS

Leta Nelson	MIT Technology and Licensing Office

Appendix 4
FDA PRODUCT APPROVAL PROCESS

FDA Drug Development Cycle			
Stage	**Requirements**	**Years**	**Probability of Advancing to Next Stage**
Pre-Clinical	in vitro and animal studies	3-5 years	10%
Phase I	Test on healthy humans to gauge efficacy and side effects.	1 year	70%
Phae II	Larger testing group of humans afflicted with target disease	2 years	33%
Phase III	Larger testing group of humans afflicted with target disease, as well as healthy control group	3 years	25%-30%
New Drug Application (NDA)	Submit 1 year marketing application to FDA, which contains all testing data.	1 year	75%