

Appendix

Definitions of the Biotechnology Industry

Biotechnology is a new and rapidly changing industry that has yet to find a neat, separate categorization in either the old Standard Industrial Classification (SIC) code or the new North American Industry Classification System (NAICS). Even so, a general consensus about the contours of the biotechnology industry has emerged from industry participants, investors, and a range of comprehensive studies of the industry. Rather than rely on secondary statistics compiled by government agencies in broad industry classifications, industry analysts and researchers have relied heavily on primary microdata—firm level statistics on employment, investment, and activity. The present study follows this generally accepted biotechnology definition that has emerged, and it employs microdata from a variety of sources.

How the Industry Defines Itself

Those involved in the biotechnology industry—running companies, making investments, recommending stocks, and performing other tasks—seem to have a pretty clear idea of what their industry is and who is and is not part of it. The industry has come of age during the past two decades and has formed an industry association that defines and represents its interests. In addition,

major accounting firms have worked with the industry to compile widely recognized and commonly used data on industry sales, profitability, and investment levels. The definitions and databases used by these organizations may not coincide perfectly with each other, but they are broadly congruent, listing between about 1,000 and 2,000 firms nationwide that constitute the industry.

Two of the leading industry directories have been maintained for more than a decade by the Institute for Biotechnology Information and by the accounting firm Ernst and Young. These sources are well known and widely used by individuals in the biotechnology industry, and biotech firms have a strong interest in being listed in such directories to make themselves visible to potential investors and customers and to the pharmaceutical industry.

TABLE A1. INDUSTRY DEFINITIONS OF BIOTECHNOLOGY

Source of Definition	Description of Source	Definition of Biotechnology Industry
Biotechnology Industry Organization	Founded in 1993 by the merger of two predecessor associations from the 1980s. Now has more than 1,000 members, including about 800 in the United States.	“the application of biological knowledge and techniques to develop products and services”
Ernst and Young (Morrison and Giovanetti 1998)	Has produced surveys of the biotech industry since 1986. States that in 1999 there were 1,283 U.S. biotech companies, 327 of them publicly traded.	not defined (Some E&Y publications use BIO definition.)
IBI (Institute for Biotechnology Information 2001)	Has for 15 years produced the most widely used industry directory of the biotechnology industry. Latest database (2001) lists approximately 1,238 U.S. “biotechnology” firms. (IBI now known as Bioability.)	“firms founded to use new technologies as the basis of their R&D or manufacturing efforts” (Differentiates between pharmaceutical and biotechnology firms.)
PriceWaterhouse Coopers Moneytree (PriceWaterhouseCoopers 2001)	Produces Moneytree database and lists investments in “biopharmaceuticals.” Database lists more than 1,100 investments in 450 companies between 1995 and 2001.	“developers of technology promoting drug development, disease treatment, and a deeper understanding of living organisms, including biochemicals, cell therapy, genetic engineering systems, drug delivery, and pharmaceuticals” (Treats medical devices, health care services, and medical information systems as separate industries.)
Standard and Poor’s 2000	Reviews industry for investors. Estimates that biotech industry has more than 1,300 public and private enterprises with 151,000 employees and that human therapeutics account for 75 percent of industry sales and human diagnostics 20 percent (1999).	no specific definition (Treats pharmaceutical firms separately.)

How the Industry Is Defined by Those Who Study It

Among the researchers in a variety of fields who have studied the biotechnology industry, fairly widespread

agreement exists concerning the definition of that industry. Most of the researchers who have undertaken comprehensive nationwide studies of the industry have embraced the industry definitions given in the first

table. A sampling of nationwide comparative studies published in a range of academic journals is presented in the second table.

TABLE A2. ACADEMIC DEFINITIONS OF BIOTECHNOLOGY INDUSTRY

Source of Definition	Description of Source	Definition of Biotechnology Industry
Goetz and Morgan 1995	Studied 734 firms in 1990 reported by Bureau of National Affairs (BNA) State-by-State biotechnology directory. Statistical analysis of locational factors including venture capital and fiscal policies affecting biotechnology firms.	“any technique that uses living organisms or parts of organisms to make/modify products, improve plants or animals, or develop microorganisms for specific use”
Hall and Bagchi-Sen 2001	Sampled 597 firms from combined base of 1,185 firms drawn from the 1997 IBI directory and the 1996 North American Biotechnology Directory. Analysis of factors influencing the location and performance of biotechnology firms.	“products and processes for the diagnosis, treatment, and cure of human disease, as well as the development of genetically customized animals, plants, and food”
Prevezer 1997	Studied 849 firms in 1991 as reported by Dibner. Examination of industry clustering of biotechnology firms and analysis of interrelationships and locational factors in different industry segments.	no definition
Paugh and LaFrance 1997	Relied on Ernst and Young data estimating 1,308 firms founded primarily to commercialize biotechnology. Overview of competitiveness policy issues facing the U.S. biotechnology industry.	a set of “techniques that use organisms or their cellular, subcellular, or molecular components to make products or modify plants, animals, and micro-organisms to carry desired traits”
Zucker, Darby, et al. 1998	Studied 751 distinct U.S. firms based on data on 1075 firms drawn from NCBC (IBI) for April 1990 and additional information drawn from Bioscan for 1989 through 1993. Analysis of role of localized presence of star scientists in determining geography of the biotechnology industry.	no definition
Gray and Parker 1998	Studied 1,308 firms identified by Lee & Burrill (E&Y) in 1994. Examination of location and organization of biotechnology firms based on product life cycle theory.	no definition (Distinguishes between biotechnology and pharmaceuticals.)

How the Industry Is Defined Locally

In addition to comprehensive nationwide studies of the industry, many states and regions have prepared analyses examining the local concentration of biotechnology-related economic activity. In almost all cases the definition of biotechnology is tailored to local perceptions. Every community, it seems, defines its local biotech industry in its own fashion, including and excluding sectors based on differing judgments. Almost all of these definitions include biotechnology as defined earlier, but they also reach out to draw in other activities under a wide array of terms including “biosciences,” “life sciences,” “biomedical sciences,” and “health care technology.” Many of these state and regional studies are used for marketing and promotional purposes; comparisons among local studies tend to be difficult or impossible. A study about Virginia reviewed a dozen studies in other states and concluded that there was “relatively wide divergence in the production sectors that are included in these classifications” and that the conservative approach would be to adopt the current BIO definition (Center for Public Policy 1999).

An expansive, customized local definition of a bioscience industry may be useful in promoting that industry locally or in highlighting unique local linkages between biotechnology firms and other sectors and institutions (like medical device manufacturers, agricultural chemical producers, or medical laboratories). But such definitions are not a reasonable basis for national comparisons, because most of the firms and activity in these other industries, nationally, are unrelated to the core of biotechnology. Moreover, focusing tightly on the biotechnology industry helps reveal the dynamics of industry growth and location in the fastest-growing, most technology-intensive part of the “life sciences.” Trends observed here are likely to be indicative

of the processes that will drive growth in other fields of life sciences if those fields also turn out to be significant future growth industries.

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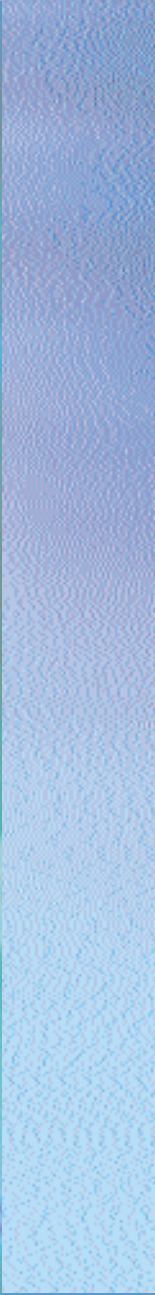
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FOR IN-DEPTH PROFILES

More in-depth profiles of the research and commercialization trends in each of the top nine biotech centers—New York, Philadelphia, Boston, San Francisco, San Diego, Raleigh-Durham, Seattle, Washington-Baltimore, and Los Angeles—can be found on the Brookings Institution Center on Urban and Metropolitan Policy website at www.brookings.edu/urban.





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