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Biotech and the San Antonio Economy

Although the total percentage of biotech employment is currently small, the industry's growth potential and high-wage jobs hold much promise.

Biotechnology is the boat no one wants to miss. Biotech has become the buzzword for new economic development, much the way high tech was in the 1990s. Cities and states are looking to biotech for new jobs and tax revenues. And though the total percentage of biotech employment is currently small, the industry's growth potential and its high-wage jobs hold much promise.

While investors have recently grown cautious, many areas are increasingly seeking to establish themselves as biotech beacons and re-create the success of industry clusters like those in Boston and San Francisco. San Antonio is no exception.

Biotechnology Defined

In the mid-1980s the congressional Office of Technology Assessment defined biotechnology as "any technique that uses living organisms or substances from those organisms, to make or modify a product, to improve plants or animals, or to develop microorganisms for specific uses." Delineating the biotech industry's parameters is less easy, and many different definitions are used. We focus on the two most common.

A study by accounting firm Ernst & Young defines biotech narrowly, limiting the industry to

pharmaceuticals and research. A more recent study by the Texas Healthcare & Bioscience Institute uses a broader definition that also includes medical devices (*Table 1*).

Biotech in San Antonio

San Antonio is home to many successful biotech companies. For example, ILEX Oncology Inc., a pharmaceutical and research laboratory, is a leading developer of cancer drugs. The May 2001 issue of *Technology Review* ranks Bio-Numerick Pharmaceuticals 16th among U.S. biotech firms in terms of the quantity and quality of its patents. Other important biotech players in San Antonio are Brooke Army Medical Center, the University of Texas Health Science Center, Institute for Drug Development, Texas Research Park Foundation, Southwest Research Institute, Southwest Foundation for Biomedical Research, and Cancer Therapy & Research Center.

A 2002 report from the Brookings Institution Center on Urban and Metropolitan Policy divides the 51 largest U.S. metropolitan areas into four general groups: biotechnology centers, research centers, median metropolitan areas, and no significant biotech research or commercialization.¹ The biotech centers are the consolidated metropolitan statistical areas (CMSAs) of Boston,

A Brookings
 Institution study
 classifies the
 San Antonio MSA
 as a median
 biotech area.

Table 1
Two Ways to Look at Biotech

Ernst & Young		Industry
Pharmaceuticals	SIC Code	
	2833	Medicinal Chemicals and Botanical Products
	2834	Pharmaceutical Preparations
	2835	In Vitro and In Vivo Diagnostic Substances
	2936	Biological Products, Except Diagnostic Substances
Laboratories and Research		
	8731	Commercial Physical and Biological Research
Texas Healthcare & Bioscience Institute also includes:		
Medical Devices	SIC Code	
	3841	Surgical and Medical Instruments
	3842	Orthopedic, Prosthetic, and Surgical Appliances and Supplies
	3843	Dental Equipment and Supplies
	3844	X-ray Apparatus and Tubes
	3845	Electromedical Equipment Laboratories and Research
	8071	Medical Laboratories
	8072	Dental Laboratories

SOURCES: Ernst & Young, *The Economic Contributions of the Biotechnology Industry to the U.S. Economy*, report for Biotechnology Industry Organization, May 2000; Texas Healthcare & Bioscience Institute, THBI 2001 Life Science Cluster Index.

San Francisco, San Diego, Seattle, New York, Philadelphia, Los Angeles and Washington and the metropolitan statistical area (MSA) of Raleigh–Durham. These nine areas have above-average shares of total U.S. biotech research activity and commercialization, based on National Institutes of Health funding, patents, research, venture capital in biopharmaceuticals, value of biotech research alliances, new biotech firms, large biotech firms and an index of biotech commercialization.

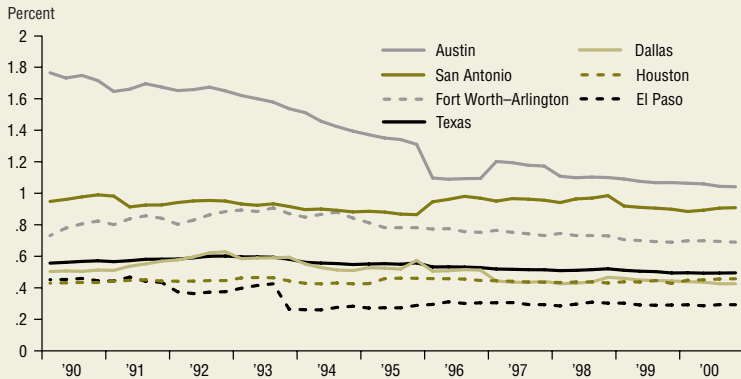
The San Antonio MSA is one of 28 areas categorized as a median metropolitan area because it has a biotechnology presence, but at levels well below the average of the 51 areas in the sample. Dallas–Fort Worth and Austin–San Marcos fall into the same cate-

gory, while Houston is one of four cities classified as a research center, defined as above-average research activity but below-average commercialization.

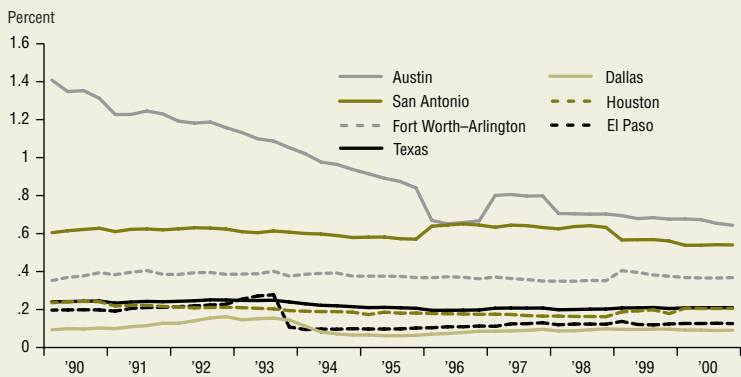
Because the Brookings report looks at how the industry is dispersed across the country, larger metro areas are more likely to be classified as biotech centers simply because of their size. Alternatively, we can look at biotech as a share of the metro area’s industries or jobs. As of fourth quarter 2000, San Antonio’s biotech sector was 0.6 percent of total employment (3,908 biotech jobs) using the narrow definition from Table 1 and 1 percent (6,574 jobs) of total employment using the broader definition.

While biotech represents a small share of jobs in San Antonio

Chart 1
Biotech Broadly Defined



Biotech Narrowly Defined



NOTE: For definitions, see Table 1.

SOURCE: Texas Workforce Commission.

San Antonio's share of biotech jobs is second only to Austin's in the state.

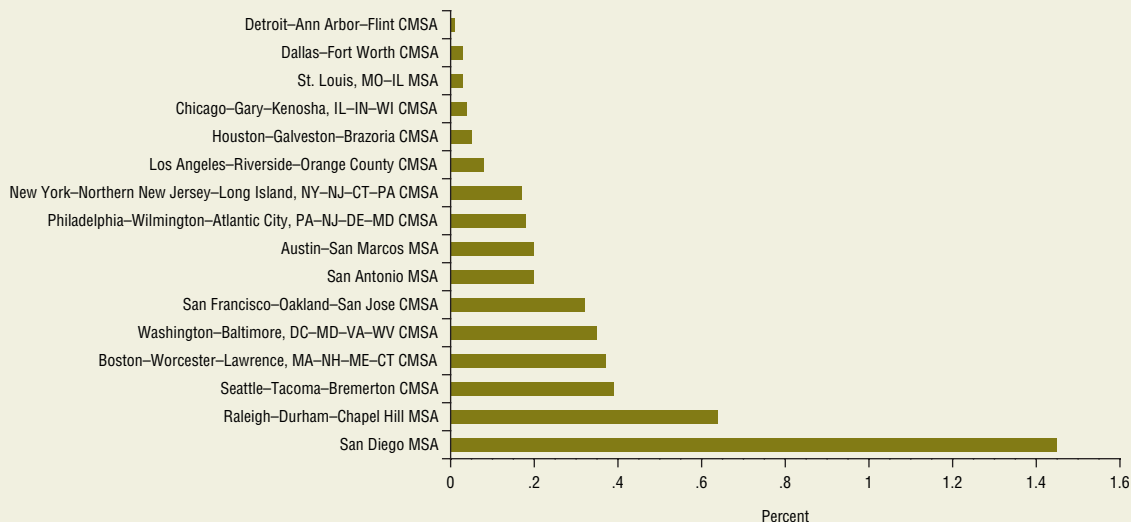
and other Texas cities, it could be a significant source of growth, and it is a high-wage sector. In 2000, average annual biotech wages in San Antonio were \$51,200 (narrow definition) and \$48,702 (broad definition). These wages are well above the 2000 overall local average of \$29,549 and the state average of \$34,943.²

As Chart 1 shows, San Antonio has maintained a steady share of biotech jobs, meaning they have generally grown at the same rate as the average of all other industries. And while this share is small by both definitions, it is second only to Austin's among the state's large metro areas. During the 1990s the gap between Austin and San Antonio declined due to the rapid increase in nonbiotech industries in Austin—mainly high

tech—relatively weak growth in Austin biotech jobs and strong growth in San Antonio biotech jobs. During this period, biotech jobs in Austin declined 15.9 percent using the narrow definition and increased a moderate 4.1 percent using the broad definition. In contrast, in San Antonio the narrowly defined biotech industry grew by 19.5 percent and the broadly defined industry by 26.6 percent.

The data in Chart 1 are based on the Standard Industrial Classification (SIC) system, which the Bureau of Labor Statistics used until the end of 2000. Beginning in 2001, the employment data presented in the charts were reclassified using the North American Industry Classification System (NAICS). NAICS was first

Chart 2
Biotech R&D Jobs as a Share of Total Area Employment



NOTE: Data are for 1997.

SOURCES: Census Bureau; Bureau of Labor Statistics; Brookings Institution Center on Urban and Metropolitan Policy; authors' calculations.

used, however, in the 1997 Economic Census, which is done every five years. The Brookings report uses these census results and defines biotechnology as pharmaceutical and medicine manufacturing (NAICS 3254) and life sciences research and development (NAICS 5417102). Based on the 1997 results, San Antonio had a small pharmaceutical industry with 492 jobs but a significant research and development presence with 1,124 jobs. Of the metro areas the study categorizes as median biotech areas, San Antonio ranks second, behind the Denver CMSA, in number of jobs in life sciences R&D. San Antonio also had more jobs in this category than three of the four metro areas considered biotech research centers.

Of the 51 large metro areas the Brookings study analyzes, San Antonio ranks 12th in the number of biotech R&D jobs. But adjusting for the size of the metro area, San Antonio ranks even higher. Looking at the 16 metro areas considered biotech centers,

biotech research centers or Texas median biotech metro areas, San Antonio ranks seventh in the share of jobs in biotech R&D (Chart 2). And while San Antonio ranks a much lower 11th in the share of pharmaceutical jobs, a disaggregated version of the SIC data in Chart 1 shows that pharmaceutical jobs grew 54 percent from 1997 to 2000. Thus the 1997 Economic Census, which allows a comparison of biotech jobs across metro areas, shows a relatively strong biotech R&D presence in San Antonio but a weakness in pharmaceuticals. More recent data, however, suggest strong pharmaceuticals growth since 1997.

Another important measure of the biotech industry is the number of patents granted. Patent creation marks a biotech company's maturation and is key to raising capital for new research and development. The number of patents generated in San Antonio sheds light on how local biotech companies are using their intellectual capital and on the companies' growth potential.

The U.S. Patent and Trademark Office uses the term *inventor city* to refer to where the inventor lives when a patent is issued. *Assignee city* refers to the location of the party that owns the patent. In terms of inventor city, the patent office granted Texas 2,828 biotech-related patents between 1996 and 2002. Of them, 66 percent went to the four top metro areas: 791 to Houston, 488 to Dallas–Fort Worth, 366 to San Antonio and 218 to Austin.³

San Antonio appears to be competitive in patents issued by inventor city, especially in relation to its size. In patents per capita, San Antonio ranks first (0.0233 percent), Austin second (0.0181 percent), Houston third (0.0172 percent) and Dallas–Fort Worth fourth (0.00953 percent). However, when biotech patents are viewed in terms of assignee city, the rankings change. Austin is the leader with 620 assignee patents, followed by Houston with 373, Dallas with 318 and San Antonio with 184. Adjusting for population size, Austin is far

ahead of the other three metro areas (0.0514 percent), followed by San Antonio (0.0117), Houston (0.0081) and Dallas–Fort Worth (0.0062). Austin is likely the leader in this category because of the presence of several large pharmaceutical companies, including Bristol-Myers Squibb Corp., Abbott Laboratories and Novartis Pharmaceuticals Corp.⁴

While employment and patent data show that San Antonio has generally been successful in attracting biotech jobs, particularly in research and development, future growth will depend on whether the city has the characteristics that are attractive to the industry. One author, writing on the prospects for biotech in Texas, states, “The lifeblood of biotech companies is knowledge, labor and capital capable of enduring the time-consuming, risky process of taking a product to market.”⁵

Growth Potential

Biotech start-ups are very different from pharmaceutical manufacturing companies. Biotechnology firms focus primarily on research and development, while pharmaceuticals concentrate on manufacturing and marketing new

products. Biotech start-ups average 14 employees in laboratory/research services and approximately 68 employees in the medical-device area.⁶ Pharmaceutical firms employ 138 people on average.

It is rare for a biotech start-up to evolve into a large pharmaceutical firm. Instead, biotech firms tend to sell or license their technologies to larger pharmaceutical firms, form joint ventures with them or sell them their entire company. The advantage of being small is that biotech firms are more flexible and can expand much faster than big pharmaceuticals. However, biotech’s characteristics cause more volatility, as the success of a company often rides on the commercialization of only a few drugs. Marketing a new product not only takes time—about 15 years, on average—but also millions of dollars.

Biotech companies are fueled by proximity to academic institutions such as universities, individual scientists and related-science tech schools that conduct basic research. Start-up companies benefit from both agglomeration economies of scale and knowledge spillovers. An em-

pirical study done in 1988 found that the location of “star scientists” was a significant predictor of growth in biotechnology firms in a particular area.⁷ The study found that both star scientists and biotech firms were highly concentrated in a small number of biotech centers and that the reason for this concentration was the overriding importance of scientific research and intellectual capital in the growth of this industry.

Another article reports that firms with established connections to stars had an average increase in employment of 366 workers over 1989–94, versus an 82-employee increase in firms lacking those ties. Furthermore, this relationship accounted for more products in the pipeline (an average of 10.7) and on the market (8.8) compared with firms (1.2 and 3.5, respectively) without proximity to star scientists.⁸ The numbers illustrate the importance of top scientists and academic institutions to the location and growth of biotech firms.

The Brookings report investigates other factors that promote the growth of biotechnology, such as the number of life scientists, Ph.D.’s granted, top-ranked research universities and the area’s

Table 2
Human Capital Measures in Biotech

Metro areas	Life scientists, 1998	Biology Ph.D.’s granted, 1999	Top-ranked research universities, 1982	NIH funding to top 100 cities, 2000 share	Change in NIH medical school funding, 1985–2000
Top three biotech centers					
Boston	4,980	355	3	12.2%	–1.3%
New York	4,790	519	3	11.8%	–3.0%
San Francisco	3,090	215	3	6.0%	–1.2%
Texas biotech					
Houston	750	135	—	3.6%	.5%
Austin	610	58	—	.2%	.10%
Dallas–Fort Worth	560	77	—	1.1%	0
San Antonio	320	20	—	1.1%	–.2%

SOURCE: Brookings Institution Center on Urban and Metropolitan Policy, *Signs of Life: The Growth of Biotechnology Centers in the U.S.*, 2002.

San Antonio's share of biotech venture capital was small, but it was larger than that of other Texas metros and significant given the area's size.

share of NIH funding. Table 2 shows these factors for the biotech areas in Texas and for the top three biotech centers nationally. As of 1998, 320 life scientists resided in San Antonio, below the 426.6 average for the median metro areas. With only one institution granting Ph.D.'s in biological science in 1999 and 20 Ph.D.'s awarded that year, San Antonio is also below the 45 Ph.D. average. None of the nation's top 20 medical schools are located in Texas, while the Boston, San Francisco and New York metro areas each have three.⁹

All nine of the biotech centers have at least one top-ranked medical school, and only four top-ranked schools are located someplace other than one of the nine centers. Nonetheless, San Antonio receives an above-average share of NIH funding. The Brookings report analyzes the total funding distributed to the top 100 recipient metro areas and looks at the share of this funding received by each of the 51 largest metro areas. While the average share of funding was 0.87 percent for the median biotech metropolitan areas, San Antonio received 1.1 percent (\$123.4 million) in 2000, about the same as the much larger Dallas-Fort Worth CMSA, which received \$130.6 million, and more than the Austin MSA, which got \$28 million (0.2 percent). NIH funding is primarily for research at medical schools and flows disproportionately to areas with well-established research facilities.

A highly skilled workforce is also essential to biotech growth. According to Census Bureau estimates on educational attainment, San Antonio performs rather poorly in comparison with Dallas, Austin, Texas and the nation as a whole.¹⁰ Of the population 25 years and older nationally, 80.4 percent have at least a high school diploma and 24.4 percent have at least a bachelor's degree.

In San Antonio, 77.3 percent are high school graduates or higher, and the figure most relevant to the biotechnology sector—the percentage of the population with a bachelor's degree or higher—is 22.4 percent. Looking at the leading biotech centers, the percentage with at least a high school diploma is 85.7 percent in Boston, 83.9 percent in San Francisco and 79.4 percent in New York. The percentage of the adult population with a bachelor's degree or higher is 34.4 percent in Boston, 37.3 percent in San Francisco and 30.5 percent in New York.

While San Antonio faces tough challenges in education, the city is addressing some of these issues. City officials are working with the University of Texas at San Antonio (UTSA) and the University of Texas Health Science Center to strengthen San Antonio's attributes as a biotechnology center. UTSA is offering a Ph.D. program in biology with an emphasis in neurobiology. Starting this fall, UTSA and the Health Science Center will offer a joint Ph.D. program in biomedical engineering. UTSA is scheduled to complete a biotechnology, science and engineering building in 2004. The facility will have 71,000 square feet for research and instructional labs. Also, in August 2002 renovations and construction began on the Center for Excellence in Bioprocessing and Biotechnology at Brooks City-Base, where military personnel and civilians will be taught how to handle vaccines, biosensors and other biological products.

While human capital is important to biotech growth, a firm's early-stage financial capital is also key. Establishing a functional facility and buying equipment constitute a substantial part of a firm's start-up costs. Biotech companies flounder without early access to government funding for basic research, such as NIH grants, "angel" networks (small invest-

ors in R&D firms) and venture capital.

Although capital is critical during start-up, it's important at all stages, especially maturity. The Brookings report notes that although 51 of the largest metropolitan areas have demonstrated an ability to sustain biotech firms, significant growth requires financial and commercial backing. Five of the top nine metro biotech areas—two leaders (Boston and San Francisco) and three other areas where biotech is growing rapidly (San Diego, Seattle and Raleigh–Durham)—account for much of the growth of new biotechnology firms. Together these five areas accounted for 56 percent of the biotech businesses formed during the 1990s and 75 percent of the new venture capital in biopharmaceuticals in the past six years.

The metro areas classified as biotechnology centers received billions of dollars in venture capital over 1995–2001. San Francisco received \$3 billion, 31.1 percent of biotech venture capital nationwide; Boston got \$1.9 billion, 19.7 percent; and San Diego got \$1.5 billion, 15.4 percent. The median metropolitan areas' shares of venture capital were significantly lower, with all but Denver having slightly less than 1 percent. San Antonio's share was small, but it was larger than that of other Texas metros and significant given the area's size. At 0.9 percent, San Antonio's share of U.S. biotech venture capital was larger than Houston's (0.7 percent), Austin–San Marcos' (0.6 percent) and Dallas–Fort Worth's (0 percent). San Antonio received \$90.4 million; Houston, \$72.6 million; and Austin–San Marcos, \$58.4 million.

In a business in which the ability to innovate determines success, young biotech firms find it advantageous to link up with other firms—either horizontally or vertically—to access the fund-

ing necessary to promote innovation and tap the marketing capabilities a research environment often lacks. Big pharmaceuticals and biotech firms forged R&D agreements worth \$17.3 billion over 1980–2001, according to the Brookings report. Typically, the pharmaceutical firm buys the rights to or the use of specific new technologies or purchases marketing privileges for products nearing commercialization stages. Biotech firms, in turn, receive money to continue further R&D. From 1990 to 2002, alliances with pharmaceutical firms were highly concentrated in four large biotech centers that attracted over 80 percent of the value of these contracts: Boston, New York, San Francisco and San Diego. Houston received about \$108 million and Austin \$50 million. The Brookings study did not report any for San Antonio.

Conclusion

The U.S. biotechnology industry is highly concentrated in a handful of large cities that have well-established and world-renowned medical institutions and scientists. A recent Brookings Institution study found that nine metropolitan areas account for three-fourths of the nation's largest biotech firms and three-fourths of the biotech firms formed in the past decade. While San Antonio is not a large biotech center, the industry appears to be prospering there. The Brookings report classifies San Antonio as a median metropolitan area in terms of its share of the nation's biotech industry.

San Antonio's share of biotech employment is second in Texas, slightly behind Austin's. By several measures, San Antonio has a significant amount of biotech research and development, and its pharmaceutical industry, while not as large as other areas, grew strongly from 1997 to 2000. After adjusting for size, San An-

tonio leads the Texas biotech metros in biotech patents classified by inventor residence. Measures of venture capital and NIH funding going to biotech in San Antonio are also relatively strong.

San Antonio faces several challenges. Relatively few Ph.D.'s are awarded in biological sciences, educational attainment is low, and the area lacks a nationally recognized top 20 medical school that would help attract the star scientists critical to industry growth. City officials, however, have recognized the importance of education to biotech and have begun several new initiatives with institutions such as the University of Texas at San Antonio and the University of Texas Health Science Center.

—Keith Phillips
Maria Ritka Dzula

Notes

Dzula, a student at Trinity University in San Antonio, was an intern at the Federal Reserve Bank of Dallas' San Antonio Branch.

- ¹ Cortright, Joseph, and Heike Mayer (2002), *Signs of Life: The Growth of Biotechnology Centers in the U.S.*, Brookings Institution Center on Urban and Metropolitan Policy, www.brook.edu/dybdocroot/es/urban/publications/biotech.pdf.
- ² Bureau of Labor Statistics, Employment, Hours, and Earnings from the Current Employment Statistics Survey (National), <http://data.bls.gov/cgi-bin/dsrv?ee;> and Sept. 24, 2002, press release, Average Annual Pay by State and Industry, 2001, www.bls.gov/cew/aapstind2001.pdf.
- ³ All patent information is from the U.S. Patent and Trademark Office, www.uspto.gov/patft/index.html.
- ⁴ Austin Community College, Biotech Gateway, www.austin.cc.tx.us/biotech/pages/whatis/industry.htm.
- ⁵ Walker, Meredith (1999), "Biotech Bonanza: Prospects for Texas," Federal Reserve Bank of Dallas *Southwest Economy*, July/August, www.dallasfed.org/html/pubs/swe/7_8_99.html.
- ⁶ Walker (1999).

⁷ The number of publications in top journals determines designation as a star scientist. See Zucker, Lynne G., Michael R. Darby and Marilyn B. Brewer (1998), "Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises," *American Economic Review* 88 (March).

⁸ Zucker, Lynne G., Michael R. Darby and Marilyn B. Brewer, (1998), "Geographically Localized Knowledge: Spillovers or Markets?" *Economic Inquiry* 36 (January): 69.

⁹ A word of caution: The list of the top 20 medical schools is based on a 1982 study.

¹⁰ Census Bureau, Decennial Supplementary Surveys, Census 2000 Supplementary Survey Summary Tables, Quick Tables, <http://factfinder.census.gov/servlet/BasicFactsServlet>.

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