focus on high-tech

What's in a name? Gauging high-tech activity

FOR THE PAST TWO DECADES, high-tech fever has been contagious. Regional economic researchers have been struck by the dynamism of these new industries, dubbed "high-tech," and their apparent roles in driving differences in regional growth rates. Places like Silicon Valley, and Routes 128 and 495 outside Boston, have achieved fame as prototypes for new industrial regions. And state and local officials have created strategies to grow, attract, and retain high-tech industries and firms.

But what exactly is a high-tech industry? And how can we determine how high-tech a city or metro area is? In the late 1970s, researchers often used the share of scientists or engineers to classify an industry as high-tech, but recent studies have tended to focus on factors such as whether the industry produces high-tech products (like electronics and computers) or uses high-tech inputs (for example, spends a lot of money on research and development).

A growing body of research suggests that human capital—skilled labor— may be a better gauge and a more important driver of economic development. Growth theorists have stressed the importance of human capital to productivity and income growth for the economy as a whole. Other researchers have tried to assess the role of skilled labor in regional employment growth. In "The Rise of the Skilled City," for example, Edward Glaeser and Albert Saiz suggest that metro areas with educated workers grow more quickly than comparable cities with less human capital, for the most part because they are more economically productive and better able to adapt to economic change.

This rising emphasis on human capital has prompted some researchers to refocus on measures of high-tech that capture the scientific and technical

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Illustrations by Christian Northeast

composition of the workforce. In a recent study, researchers from the University of Minnesota selected a group of science and technology occupations, including scientists, engineers, managers with scientific and engineering backgrounds, and certain computer professionals, and ranked industries by the shares of their national workforce engaged in these occupations. If the share equaled or exceeded three times the national average (of 3 percent), the industry is classified as high-tech. Unlike some studies, services are not excluded, reflecting the belief that high-tech services are as important to a modern economy as high-tech manufacturing.

Computer services and electronics are identified as high-tech industries in this man-

Even with the decline of the minicomputer, Boston continues to generate high-tech jobs

ner, as might be expected. But so are a number of industries not always so classified—including pharmaceuticals, engineering and architectural services, management and public relations, research, testing and evaluation services, and even Federal Reserve Banks (called "Central Reserve Depository Institutions" in the table on page 8). Some of these are among the fastest-growing high-tech industries in the nation. In the 1990s, for instance, employment in all the above-mentioned industries (except Federal Reserve Banks) grew faster than jobs in electronics.

Using this method to calculate a metro area's high-tech jobs sheds new light on the location of jobs in high-tech industries (see

sidebar). It also suggests that Boston may be holding its own with Silicon Valley in a number of important ways.

BOSTON AND SILICON VALLEY

Economic development researchers and policymakers have long been fascinated by comparing Silicon Valley and the Boston metro area, two of the nation's oldest and largest high-tech clusters. In her 1994 book, *Regional Advantage,* for example, AnnaLee Saxenian characterized Silicon Valley as an innovative region led by small, tight-knit firms, while Boston's Route 128 was dominated by large bureaucratic companies that were slow to respond to market changes. On the other hand, John Campbell looked at Massachusetts firms in the software and networking industries for the *Regional Review* in 1995 and found management and market orientation to be surprisingly similar to that of firms in Silicon Valley.

High-tech metropolis

Which metro areas have a large number of high-tech jobs? Using a definition based on the share of scientific and technical workers, Chicago and Washington, D.C. top the list, each with more than 300,000 workers in high-tech industries. New York and Philadelphia both contain a significant number of jobs in high-tech industries—as do Dallas, Seattle, Minneapolis-St. Paul, and Houston—suggesting that the American Sunbelt is not the only high-tech winner. Nor are jobs in high-tech industries concentrated only on the coasts, as Detroit, Chicago, Minneapolis-St. Paul, Austin, Phoenix, and Denver all show substantial high-tech employment.

Some metro areas tend to have their high-tech jobs concentrated in a relatively small number of industries. Washington, D.C.'s high-tech jobs are concentrated in research, development and testing services, and computer services; New York specializes in financial services and management/public relations; and Silicon Valley and Seattle specialize in high-tech manufacturing. By contrast, jobs in high-tech industries in Chicago, Boston, and Philadelphia are spread more evenly across a range of industries.

CORBIS

Boston's strength in high-tech services may offer an edge, as high-tech employment in services rose faster than in manufacturing over the decade.

Where are high-tech jobs?

Selected metro areas	Jobs in high-tech industries (000)	High-tech share of all jobs (percent)	High-tech diversification index
Chicago	318	12	0.80
Washington, D.C.	305	20	0.46
San Jose (Silicon Valley)	282	41	0.64
Boston	266	21	0.77
New York	217	10	0.54
Philadelphia	208	13	0.79
Dallas	187	16	0.65
Seattle	171	21	0.45
Minneapolis-St. Paul	144	15	0.82
Houston	144	12	0.67
Orange County	144	18	0.83
Atlanta	142	10	0.61
Detroit	117	9	0.60
Phoenix	110	13	0.68
San Diego	109	16	0.84
Denver	87	15	0.62
Austin	74	20	0.51
Portland, OR	73	13	0.73
Tampa-St. Petersburg	68	9	0.71
Raleigh-Durham	65	17	0.69

NOTES: Metro areas are defined by the MSA/PMSA Census boundaries. High-tech diversification index measures concentration among high-tech industries, with higher values indicating greater diversification (less concentration) across high-tech industries.

Employment in key high-tech industries, Boston and San Jose, 1997

	Boston	San Jose
Total high-tech industry employment	**260,500**	**281,200**
MANUFACTURING	100,400	196,900
Electronic components & accessories	19,900	65,400
Laboratory apparatus & scientific equipment	16,500	19,800
Search, detection, navigation, & guidance equip.	14,500	3,400
Communications equipment	11,600	36,000
Surgical, medical, & dental instruments	9,100	10,900
Special industry machinery, except metalworking	7,200	7,000
Computer & office equipment	7,000	36,700
Aircraft & parts	5,700	0
Drugs	3,400	1,500
Photographic equipment & supplies	2,700	0
Ordnance & accessories	1,500	0
Industrial inorganic chemicals	1,300	0
Guided missiles, space vehicles, & parts	0	16,200
SERVICES	160,100	84,300
Software, data processing, & computer services	64,300	47,000
Engineering, architectural services, & surveying	28,900	14,900
Management & public relations services	27,900	7,400
Research, development, & testing services	22,300	14,400
Life insurance	15,600	600
Central reserve depository institutions	1,100	0
Ratio of high-tech manufacturing to services	**0.6**	**2.3**

NOTES: A "0" for employment in a given industry does not necessarily indicate no worker presence in that industry, as the Economic Census assigns employment in plants based on the predominant product/service rendered, and not any secondary output that is produced. Figures are rounded to the nearest hundred.
SOURCE: 1997 Economic Census and Bureau of Labor Statistics

Using a human-capital-based measure of high-tech industries, our study finds that Boston and Silicon Valley both live up to their reputations as high-tech centers, each with more than 250,000 jobs in high-tech industries. Despite the decline of the minicomputer industry centered around Route 128, the Boston metro area continues to generate a large enough stream of high-tech jobs to remain on par with its West Coast counterpart.

In Boston, however, these jobs account for a much smaller share of all jobs (21 percent) as compared to Silicon Valley (41 percent). This difference may contribute to the perception that Silicon Valley leads Boston as a high-tech center, despite their roughly similar overall high-tech job totals. On the other hand, Boston retains significant employment in traditional industries such as transportation and warehousing (32,000 jobs) and printing (14,000 jobs), which contributes to its more diversified economy.

Even within high-tech, Boston has a more diversified job base. Silicon Valley hosts jobs in only 18 of 30 high-tech industries, with a large proportion of its workforce employed in electronics, computer and office equipment, communications equipment, and missiles and space vehicles. In contrast, Boston's high-tech employment is spread much more evenly across almost the entire list.

Boston also has much higher concentrations in high-tech services, such as computer programming and data processing, engineering, architecture and surveying, research, development and testing, and management and public relations. (By contrast, Silicon Valley is more concentrated in high-tech manufacturing.) This representation in high-tech services may well offer Boston an important edge: U.S. high-tech employment in services increased more than in manufacturing over the past decade; and employment in science and technology occupations rose much faster in services than in manufacturing. Since high-tech services firms tend to cater to other businesses (as opposed to households), they may fuel future economic growth by introducing new technologies across industries and building

Regions may want to rethink their definition of high-tech when setting development policies

channels for cross-fertilization.

Boston's diversification may also confer some advantage in weathering economic downturns. In the recent recession, for example, Silicon Valley's unemployment rate reached 9.5 percent, higher than Boston's rate of 5.4 percent (both seasonally adjusted). Nonetheless, Massachusetts suffered larger job losses in percentage terms than almost every other state, including California. High-tech diversification is not a panacea for job loss during a recession, and other factors may be more important during any particular downturn.

It is also interesting to note that although previous research attributed much of Silicon Valley's success to its network of small high-tech firms, today the number of employees per establishment in the high-tech industries of Silicon Valley (42 employees) is much larger than that in Boston (29 employees). Although large high-tech companies are Boston's legacy, this suggests that numerous entrepreneurial activities are under way. And the emergence of new high-tech establishments along Route 495 outside Boston, and the new

wave of innovation around biotech, are contributing to Boston's high-tech vitality.

Thus, cities and regions may want to rethink their working definitions of high technology and the economic development initiatives that promote it. By abandoning narrow notions of high-tech restricted to maturing technologies in computers, electronics, and telecommunications and by focusing on science and technology occupations as a marker, it may be possible to identify emerging sectors. Strategies that seek to diversify a region away from only a few high-tech sectors may help to insulate the region from severe recessions and long-term structural change. With this in mind, regions may be able to improve their chances of maintaining a vibrant economy and securing a dynamic future. ✳