

DECLINING BUSINESS DYNAMISM IN THE  
U.S. HIGH-TECHNOLOGY SECTOR

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## **ABSTRACT**

The U.S. economy is very dynamic—with firms entering, exiting, expanding, or contracting at all times. More competitive firms grow and replace less-competitive ones. This dynamic process is an important source of productivity growth and sustained economic prosperity in modern economies. New and young firms play an outsized role in this productivity-enhancing dynamic process, and in net job creation.

But, recent trends point to sustained declines in business dynamism and in entrepreneurship across a broad range of sectors in the U.S. economy. While the causes and implications of this development are still being uncovered, it may suggest a lower growth economy and standards of living than otherwise would have been.

We examine how these trends apply to the U.S. high-tech sector—defined here as the group of industries with very high shares of workers in the STEM occupations of science, technology, engineering, and math. Our findings show that the recently documented secular declines in business dynamism that occurred broadly across the U.S. economy during the last couple of decades also occurred in the high-tech sector in the post-2000 period. As part of this decline in dynamism, we find indicators of a slowdown in entrepreneurship in the high-tech sector in the post-2000 period.

This slowdown in the high-tech sector may be especially problematic for all the reasons stated above. High-tech firms also play an outsized role in income, employment, and productivity growth overall and are generally focused on the types of cutting-edge technologies that can drive sustained economic growth. This sector typically is viewed as very entrepreneurial, but we document a pronounced slowdown in such activity in the post-2000 period.

## INTRODUCTION

Business churning is an important part of economic activity. Some firms are born while others fail, and some companies expand while others contract. New and superior ideas, processes, and goods replace obsolete ones in a dynamic process of “creative destruction.”<sup>1</sup> Labor markets reflect that churning as some jobs are created while others are destroyed, and some workers move into new roles as others seek to replace them.<sup>2</sup>

Though costly for some individual workers or firms in the short-term, this process contributes substantially to productivity growth overall as labor and capital are more efficiently allocated across the economy.<sup>3</sup> This makes the process of business- and labor-market churning indispensable because the resulting productivity gains help drive sustained economic growth.

A number of signs point to a secular decline in U.S. business dynamism, which goes far beyond the more recent effects of the Great Recession.<sup>4</sup> For example, the rate of new firm formation—a key element of business dynamism and new job creation—has been declining steadily for at least the last three decades. Job reallocation—the process that moves workers away from contracting or closing businesses and toward expanding or new firms—also has been declining over the same period.

We contribute to the understanding of the secular decline in business dynamism in the United States by examining how these trends apply to the innovative high-tech sector—defined as the group of industries with very high shares of workers in the STEM fields of science, technology, engineering, and math (see Appendix A).

Despite its relatively small size—representing just 4.1 percent of total private-sector firms in 2011—the high-tech sector packs a lot of economic punch. Aside from the obvious productivity gains across the U.S. economy that are directly attributable to the adoption of high-tech goods and services, the high-tech sector itself is a key contributor to income generation, job creation, and productivity growth.<sup>5</sup> Because of this, a slowdown in high-tech entrepreneurial activity might have disproportionate effects on long-term economic growth overall.

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<sup>1</sup> Schumpeter (1942), *Capitalism, Socialism & Democracy* (London and New York: Routledge, 1943), pages 81–86.

<sup>2</sup> See Davis and Haltiwanger, “Gross Job Flows,” *Handbook of Labor Economics*, O. Ashenfelter and D. Card (ed.), 1999, for a review of the literature.

<sup>3</sup> For a recent review of the empirical literature, see Syverson (2011), “What Determines Productivity?,” *Journal of Economic Literature*, 49(2): 326–65; Haltiwanger (2011), “Job Creation and Firm Dynamics in the U.S.,” *Innovation Policy and the Economy*, Volume 12, *NBER*.

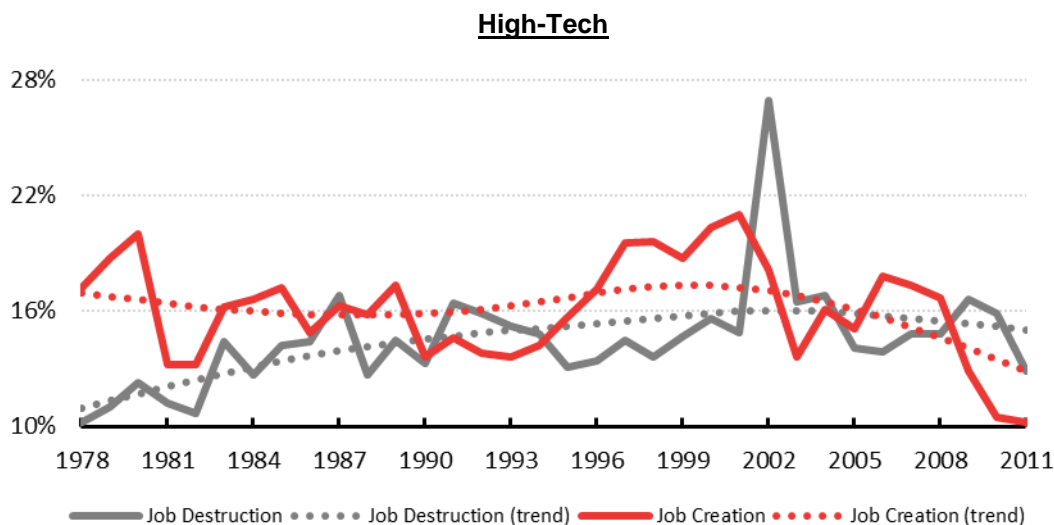
<sup>4</sup> Hathaway, Bell-Masterson, and Stangler (2013), “The Return of Business Creation,” Kauffman Foundation; Haltiwanger, Jarmin, and Miranda (2012), “Where Have All the Young Firms Gone?” Kauffman Foundation; Reedy and Litan (2011), “Starting Smaller; Staying Smaller: America’s Slow Leak in Job Creation,” Kauffman Foundation.

<sup>5</sup> Hathaway (2012), “Technology Works: High-Tech Employment and Wages in the United States,” Bay Area Council Economic Institute; Spence and Hlatshwayo (2011), “The Evolving Structure of the American Economy and the Employment Challenge,” *Comparative Economic Studies*.

## JOB CREATION AND DESTRUCTION

A standard approach to understanding business dynamism is to examine the job flows associated with this process during a given period of time. **Figure 1** shows annual job creation and destruction rates for the high-tech sector between 1978 and 2011 using the Business Dynamics Statistics (BDS) of the U.S. Census Bureau.<sup>6</sup> Because these data are based on annual snapshots of U.S. businesses over time, annual job creation

**Fig. 1: Gross Job Creation and Destruction Rates in High-Tech Sector (1978–2011)**



Source: U.S. Census Bureau, BDS and Special Tabulation; authors' calculations

Note: Trends are calculated by applying a Hodrick-Prescott filter with a multiplier of 400

reflects a net addition of employment at a particular business through one of two channels—the expansion of employment at an existing business establishment or the birth of a new one in a particular year. Job destruction reflects a net loss of employment—when an existing business either contracts employment or closes its doors.

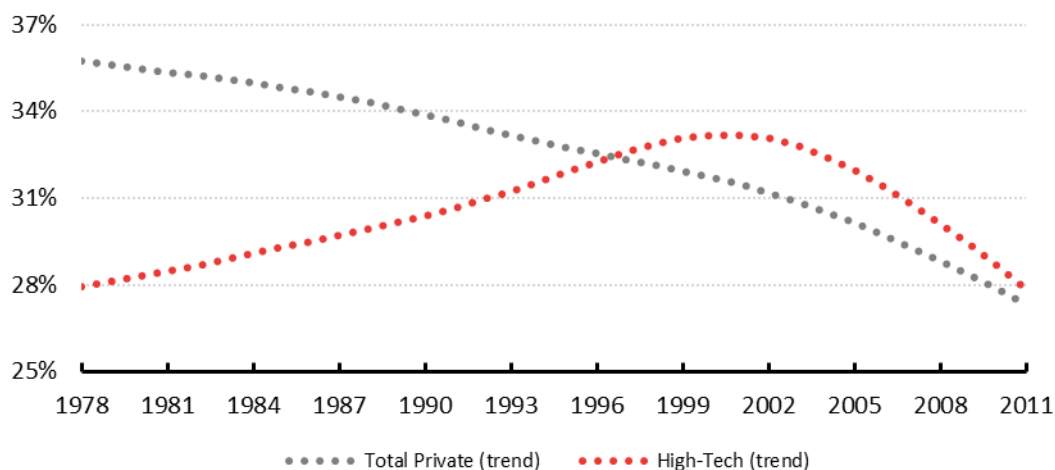
As Figure 1 shows, the rate of both job creation and destruction in the high-tech sector were elevated in each year. The high-tech boom in the second half of the 1990s is evident, with a high pace of job creation and a slightly increasing rate of job destruction during this period. The spike in job destruction in the March 2001 to March 2002 period is associated with the well-known dot-com bust. Of particular interest for the current analysis is the slowdown in the overall pace of job creation and destruction in the post-2002 period. This slowdown is evident in the declining trends of both job creation and

<sup>6</sup> The BDS is a publicly available dataset available at <http://www.census.gov/ces/dataproducts/bds/>. For a description of the methodology used in its creation, see <http://www.census.gov/ces/dataproducts/bds/overview.html>. The data for high-tech are not publicly available, but were prepared by the U.S. Census Bureau's Center for Economic Studies as a Special Tabulation.

job destruction from about 2004 onward. The drop in both gross job creation and net job creation has been especially pronounced in the wake of the Great Recession.

To compare the patterns for the high-tech sector to the private sector as a whole, a summary measure of economic dynamism is used: the job reallocation rate. The latter measures the sum of job creation and destruction rates in a given year, providing an integrated view of business dynamism. Here, we focus on trend rates rather than the actual rates themselves.

**Fig. 2: Trends in Job Reallocation Rates: High-Tech vs. Private Sector (1978–2011)**



Source: U.S. Census Bureau, BDS and Special Tabulation; authors' calculations  
 Note: Trends are calculated by applying a Hodrick-Prescott filter with a multiplier of 400

As Figure 2 shows, job reallocation in the entire private sector has been on a sharp and steady trend decline for the last few decades, while the high-tech sector exhibited a trend increase in the pace of reallocation until about 2002. However, since 2002 there has been a sharp trend decline in high-tech sector job reallocation that has even exceeded the pace of the decline in the overall economy. So, interestingly, the high-tech sector bucked the national trend by exhibiting rising dynamism until 2002—but even it has exhibited a trend decline since 2002.

## ENTREPRENEURSHIP RATES

A key player in the process of creative destruction and business dynamism is the entrepreneurial firm, which is measured here by firm age—in particular, new and young firms (those aged five years or younger). Previous research has firmly established that these businesses play a central role in productivity gains and employment growth.<sup>7</sup>

<sup>7</sup> Dunne, Roberts, and Samuelson (1989), “Plant Turnover and Gross Employment Flows in the U.S. Manufacturing Sector,” *Journal of Labor Economics*; Davis and Haltiwanger (1999), “Gross Job Flows,” *Handbook of Labor Economics*; Foster, Haltiwanger, and Krizan (2001), “Aggregate Productivity Growth: Lessons from Microeconomic Evidence,” *Studies in Income and Wealth*; Foster, Haltiwanger, and Kirzan (2006), “Market Selection, Reallocation and Restructuring in the U.S. Retail Trade Sector in the 1990s,” *The Review of Economics and Statistics*; Haltiwanger, Jarmin, and Miranda (2013), “Who Creates Jobs? Small vs. Large vs. Young,” *Review of Economics and Statistics*.

While mature firms are responsible for the majority of employment *levels* (static), it is new and young firms that make disproportionately large contributions to net *new* jobs (dynamic) overall.<sup>8</sup>

A recent Engine-Kauffman Foundation report analyzed firm formation and job creation in the high-tech sector, extending the existing research to this innovation-driven segment of the economy.<sup>9</sup> It found that the high-tech sector has produced an outsized share of entrepreneurship and job creation during the last few decades, and has been spreading throughout the country.<sup>10</sup>

Even among job-creating young firms, surviving young high-tech businesses add jobs at a rate twice that of all surviving young firms, and the rate of job creation is so robust that it offsets losses from early-stage failures—something that is not true for young firms as a whole.<sup>11</sup> In short, firms aged five or younger are key drivers of new job creation, a fact that is especially true in high-tech. Sustaining a robust rate of net new job creation requires a constant supply of firm births each year.

Figure 3 shows the number of new and young firms (aged five years or younger) annually between 1982 and 2011, comparing the high-tech sector against all private-sector firms.

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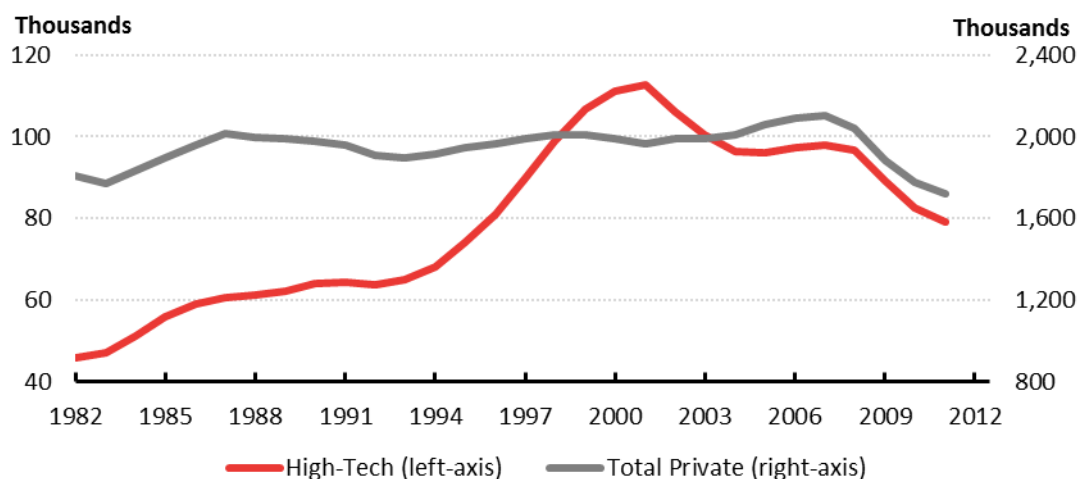
<sup>8</sup> Haltiwanger, Jarmin, and Miranda (2013), “Who Creates Jobs? Small vs. Large vs. Young,” *Review of Economics and Statistics*; Horrell and Litan (2010), “After Inception: How Enduring is Job Creation by Startups?,” Kauffman Foundation; Kane (2010), “The Importance of Startups in Job Creation and Job Destruction,” Kauffman Foundation; and Haltiwanger, Jarmin, and Miranda (2009), “Jobs Created from Business Startups in the United States,” Kauffman Foundation.

<sup>9</sup> Hathaway (2013), “Tech Starts: High-Technology Business Formation and Job Creation in the United States,” Kauffman Foundation. Even among young, job-creating firms, young high-tech businesses add jobs at a rate twice that of all firms, and the rate of job creation is so robust that it offsets losses from early-stage failures—something that is not true for young firms as a whole.

<sup>10</sup> For a more detailed discussion of the geographic dimensions of high-tech startups, see Stangler (2013), “Path-Dependent Startup Hubs, Comparing Metropolitan Performance: High-Tech and ICT Startup Density,” Kauffman Foundation.

<sup>11</sup> Hathaway (2013), “Tech Starts: High-Technology Business Formation and Job Creation in the United States,” Kauffman Foundation.

**Fig. 3: Young Firms (aged five years or younger) by Sector (1982–2011)**



Source: U.S. Census Bureau, BDS and Special Tabulation; authors' calculations

Several patterns stand out that remind us of the particular nature of the high-tech sector and some of its idiosyncrasies vis-à-vis the rest of the economy. First, the number of young high-tech firms increased considerably during this period—more than doubling between 1982 and 2007, to 97,836 from 45,959. For the private sector as a whole, young firms held steady throughout much of this period, even though the overall number of firms was growing substantially at the same time.

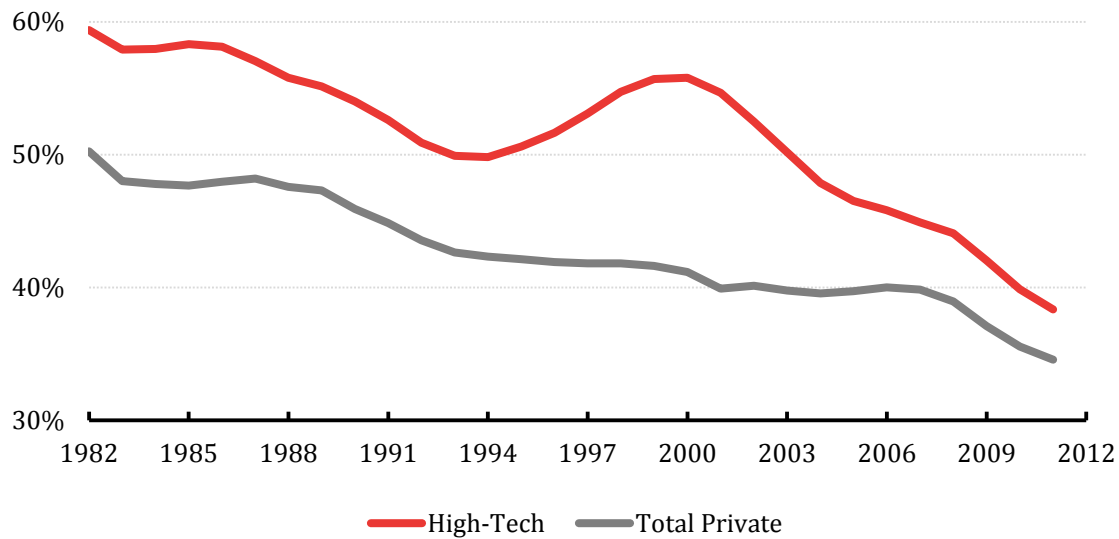
The 1990s saw a particularly sharp rise in high-tech entrepreneurship coinciding with wide adoption of the Web and speculation around Internet-based companies (the dot-coms). This period of growth ends with the collapse of the dot-com bubble and instigates a steep decline in high-tech entrepreneurship in the late 1990s and early 2000s.

From about 2002, the number of high-tech young firms continues to decline, while there is a modest increase in the number of young firms overall. The impact of the Great Recession on entrepreneurship is evident after 2007, with sharp declines in the number of young businesses both in the high-tech sector and in the economy as a whole. The number of young high-tech firms fell to 79,034 in 2011, marking a 19.2 percent drop from 2007. By contrast, the number of young firms for the entire private sector fell by 18.3 percent during the same period.

Looking at the absolute number of new and young firms can help us identify relevant trends and inflection points affecting entrepreneurship. However, it does little to help us understand the context in which these patterns take place. A more relevant statistic in this regard is the entrepreneurship rate, which tells us the *relative* importance young firms have in a sector.



**Fig. 4: Young Firms (aged five years or younger) as a Share of Total Firms by Sector (1982–2011)**



Source: U.S. Census Bureau, BDS and Special Tabulation; authors' calculations

Figure 4 shows entrepreneurship rates in the high-tech and the private sector as a whole. The entrepreneurship rate is defined as the number of startups and young firms (up to five years old) over the total number of firms. The entrepreneurship rate in the high-tech sector has declined significantly despite the actual increase in absolute numbers during the same period. The high-tech entrepreneurship rate fell from a high of nearly 60 percent in 1982 to a low of 38 percent by 2011.

However, the decline has not been monotonic, with a rise in the entrepreneurship rate in the second half of the 1990s, which was followed by the dot-com bust. Perhaps even more relevant is the continued decline in the entrepreneurship rate in the post-2002 period. The latter occurs at a pace that even exceeds the decline in entrepreneurship for the private sector as a whole during the same period.<sup>12</sup>

Why entrepreneurial activity has been so anemic in the high-tech sector post-2002 is an open question.<sup>13</sup> The overall economy has been exhibiting a declining trend in entrepreneurial activity over a much longer period, but now, even the highly dynamic and entrepreneurial high-tech sector is becoming less so.

<sup>12</sup> The patterns for the overall economy are consistent with recent findings for the whole economy by Decker, Haltiwanger, Jarmin, and Miranda (2014), "Entrepreneurship and Job Creation in the U.S.," in process. We also have found the patterns of Figure 4 by examining the share of employment accounted for by young firms.

<sup>13</sup> Anecdotal and empirical evidence suggests that high-tech entrepreneurship may have experienced a rebound in the years since our data were collected in March 2011. See for example: PricewaterhouseCoopers (2013), MoneyTree Report, Historical Trend Data; CB Insights (2013), Venture Capital Activity Report; Silicon Valley Bank, Angel Resource Institute, and CB Insights (2013), 2012 Halo Report: Angel Group Activity Year in Review; Silicon Valley Bank, Angel Resource Institute, and CB Insights (2013), Halo Report: Angel Group Update: Q3 2013; Silicon Valley Bank (2012, 2013), Startup Outlook.

## CONCLUSION

In the post-2000 period, the high-tech sector is experiencing a process of economic activity consolidation, away from young firms and into more mature firms. The high-tech sector looked different than the rest of the private economy did during the 1990s, when the share of young firms was declining in the overall economy but rising in high-tech. In the early 2000s, entrepreneurial activity in the high-tech sector began declining sharply during what is well-known as the dot-com bust.

Less well known is that the share of young firms in the high-tech sector has exhibited a more pronounced secular decline in the post-2002 period than in the rest of the economy. Consistent with that pattern, we have found that the pace of business dynamism, as measured by the pace of job reallocation, has declined in the high-tech sector in the post-2002 period at a pace that exceeds that of the overall economy.

Empirical evidence suggests a link between business dynamism, innovation, and productivity growth. In this regard, the findings here point to the possibility of a slowdown in productivity and economic growth in the high-tech sector in the last decade. The slowdown we find for the high-tech sector might be an even larger source of concern than that for the overall economy, since young high-tech firms may be more important for innovation and new job creation than their non-high-tech counterparts are.

## APPENDIX A: DEFINING HIGH-TECH

According to a Bureau of Labor Statistics study published in 2005 that followed an interagency seminar aimed at classifying high-tech industries, a high-tech industry is defined by the presence of four factors: a high proportion of scientists, engineers, and technicians; a high proportion of R&D employment; production of high-tech products, as specified on a Census Bureau list of advanced-technology products; and the use of high-tech production methods, including intense use of high-tech capital goods and services in the production process.<sup>14</sup>

The study also concluded that because of “data and conceptual problems,” the intensity of “science, engineering, and technician” employment would be the basis for identifying high-tech industries. Seventy-six “technology-oriented occupations” were used to conduct the employment intensity analysis. A condensed list is outlined in Table 1, but broadly speaking, these occupations coalesce around three groups—computer and math scientists; engineers, drafters and surveyors; and physical and life scientists.<sup>15</sup>

**Table 1: Technology-Oriented Occupations**

SOC Code	Occupation
<i>Computer and Math Sciences</i>	
11-3020	Computer and information systems managers
15-0000	Computer and mathematical scientists
<i>Engineering and Related</i>	
11-9040	Engineering managers
17-2000	Engineers
17-3000	Drafters, engineering, and mapping technicians
<i>Physical and Life Sciences</i>	
11-9120	Natural sciences managers
19-1000	Life scientists
19-2000	Physical scientists
19-4000	Life, physical, and social science technicians

Source: Bureau of Labor Statistics

After this group of occupations was identified, an intensity analysis was conducted to determine which industries contained large shares of these technology-oriented workers. Of the more than 300 industries at the level of granularity used, the fourteen shown in Table 2 had the highest concentrations of technology-oriented workers. Each

<sup>14</sup> Daniel E. Hecker, “High-technology employment: a NAICS-based update,” *Monthly Labor Review* (U.S. Dept. of Labor and U.S. Bureau of Labor Statistics), Volume 128, Number 7, July 2005: 58.

<sup>15</sup> For the detailed list, see Table 3 in Hecker, “High-technology employment: a NAICS-based update,” 63.

of these fourteen “Level-1” industries had concentrations of high-tech employment at least five times the average across industries.<sup>16</sup>

**Table 2: High-Technology Industries**

NAICS Code	Industry
<i>Information and Communications Technology (ICT) High-Tech</i>	
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational, measuring, electromedical, and control instruments manufacturing
5112	Software publishers
5161	Internet publishing and broadcasting
5179	Other telecommunications
5181	Internet service providers and Web search portals
5182	Data processing, hosting, and related services
5415	Computer systems design and related services
<i>Miscellaneous High-Tech</i>	
3254	Pharmaceutical and medicine manufacturing
3364	Aerospace product and parts manufacturing
5413	Architectural, engineering, and related services
5417	Scientific research-and-development services

Source: Bureau of Labor Statistics

This report uses the method described above to define the high-tech sector of the U.S. economy. Checks were made to ensure that the identifying conditions held in the latest available data, and crosswalks were performed to account for changes in industry and occupation classifications over time. Though the Bureau of Labor Statistics report ultimately concluded that a wider group of industries could be considered high-tech, this report uses a more conservative approach by analyzing just the fourteen Level-1 industries with very high concentrations of technology-oriented workers in the STEM fields of science, technology, engineering, and math.

<sup>16</sup> See the Level-I Industries section of Table 1 in Hecker, “High-technology employment: a NAICS-based update,” 60.